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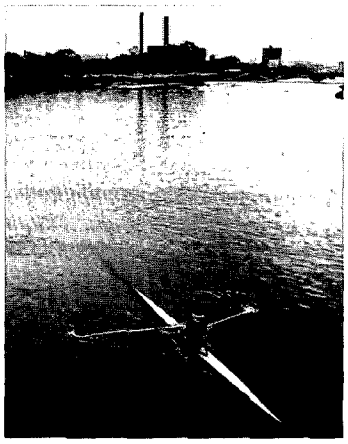
Report of the Southeastern New England Study



a Strategy for Balanced Development and Protection of Water and Related Land Resources in Eastern Massachusetts and Rhode Island

REGIONAL REPORT

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New England River Basins Commission

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The Southeastern New England Study (SENE) is a "level B water and related land resources study." It was conducted under the provisions of the federal Water Resources Planning Act of 1965. The resources management program the Study produced was developed by a team of federal, state, and regional officials, local citizens, and the scientific community, under the overall coordination of the New England River Basins Commission. It is a part of the Commission's comprehensive, coordinated joint plan for the water and related land resources of New England.

The recommended program for managing the resources of Southeastern New England is described, in increasing level of detail, in the following Final Reports:

A SUMMARY highlighting the principal findings and recommendations of the Study, and their implications for the future of the region.

A REGIONAL REPORT and Environmental Impact Statement describing *in detail* the natural resources, issues and problems facing the region, the alternative solutions examined during the Study, the recommendations made, and their implications. It includes policies and programs for dealing with water supply, land use, water quality, outdoor recreation, marine resources, flood and erosion protection, and key facilities siting, and the changes in state and local government required to implement the program.

Ten PLANNING AREA REPORTS dealing with the same subjects as the Regional Report, but aimed at the local level. Eastern Massachusetts and Rhode Island were divided into ten "planning areas" based either on traditional sub-state divisions or principal river basins. Reports were prepared for the following areas:

1. **Ipswich-North Shore,**
2. **Boston Metropolitan,**
3. **South Shore,**
4. **Cape Cod and the Islands,**
5. **Buzzards Bay,**
6. **Taunton,**
7. **Blackstone and Vicinity,**
8. **Pawtuxet,**
9. **Narragansett Bay and Block Island,**
10. **Pawcatuck**

Other reports prepared during the course of the Study include the following:

Inventory Reports

For each of the ten planning areas, inventory reports were prepared covering the following subjects: climate, meteorology, hydrology, geology; land use, patterns, allocations, and management; special environmental factors; water supply; ground water management; water quality control; outdoor recreation; fish and wildlife; navigation; flood plain zoning and streamflow management; inland wetlands management; coastal resources; irrigation and drainage; sediment and erosion; power; minerals.

Special Reports

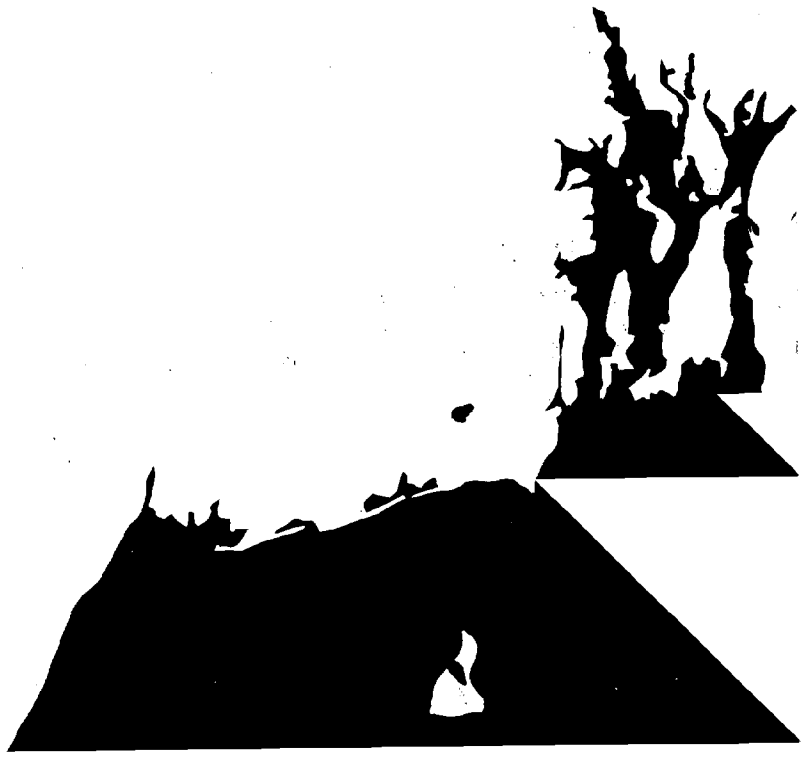
In addition to inventory reports, over a dozen special reports were prepared, including: Socio-Economic and Environmental Base Study, Volumes I and II; Economic analyses of water supply and demand issues, power plant siting, coastal resources allocation, and sand and gravel mining; Legal and institutional analyses of the state wetlands laws, arrangements for water supply service, fiscal policy and land control, access to natural resources areas, and management structure for water and land use issues; Urban Waters Special Study; Summaries of public workshops

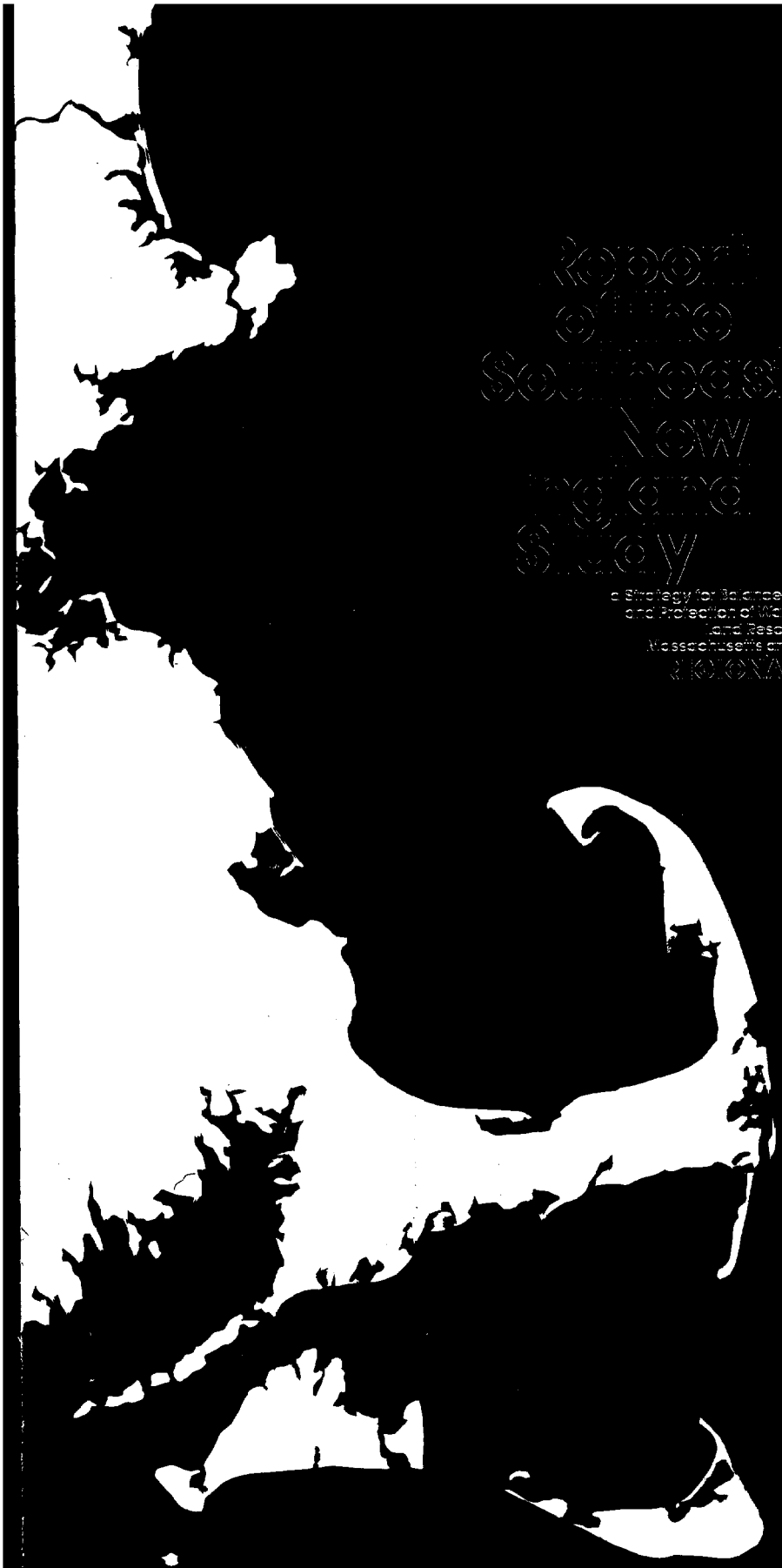
Copies of reports are available from:

New England River Basins Commission
55 Court Street
Boston, Massachusetts 02108

National Technical Information Service
Springfield, Virginia 22151

and also in each of the 208 libraries and 210 town halls throughout the SENE region.





Report of the Southeastern New England Study

a Strategy for Balanced Development and Protection of Water and Related Land Resources in Eastern Massachusetts and Rhode Island

REGIONAL REPORT

December 1975

To Their Excellencies, the Governors of Massachusetts and Rhode Island; to the Water Resources Council for transmittal to the Congress through the President of the United States; and to the people of Southeastern New England:

The water and related land resources of Southeastern New England serve over five million people in eastern Massachusetts and Rhode Island with one of the most attractive landscapes for living of any urban region in the world.

These resources are under intense pressure. The future will bring additional stress as population grows and the region seeks the expanded economic base it needs to provide a decent standard of living for all its citizens.

Fortunately, the needs of the foreseeable future *can* be met without degrading the special quality of this environment—if patterns of growth respect the capabilities of land and water resources, and if resource systems of special value and vulnerability are vigorously protected.

This report outlines a strategy for accommodating and helping guide growth in ways consistent with wise use of natural resources, and recommends policies, programs and specific actions to develop, protect and enhance these resources to meet a wide range of human needs.

The report represents the diligent labor of over 250 individuals, both private citizens and public officials working at local, state and federal levels for the management of our resources. Many of the solutions they have proposed can be carried out immediately; still others will require changes in laws or custom or funding levels. The participants did not always agree, but to an unprecedented degree this document represents a consensus. We are deeply grateful to all.

Southeastern New England is, to put it simply, a good place to live and work. The resources management strategy offered in this report is designed to help keep it that way.

Respectfully submitted,

R. Frank Gregg, Chairman
New England River Basins Commission

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A detailed guide to each Chapter appears on the back of the divider pages.

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY

READER'S GUIDE: HOW TO REVIEW THIS REPORT

- In five minutes

  FOR A "THUMBNAIL SKETCH"

  Read the **OVERVIEW** which folds out as one large sheet. There is an extra copy in the pocket in the rear for those who would like to mount it on the wall.

- In a half hour or less

  TO LEARN THE MAIN POINTS

  Read the **SUMMARY**. It is published separately. You can read it in either of two ways:

  - **SELECTIVELY.** Read the Chapters on Goals and Approach and Guiding Growth, plus any others that interest you. Chapters are boldly labeled to facilitate selective reading; or

  - **ENTIRELY.** Read the full summary for a fuller understanding of the highlights of the SENE Study.

- In one day or less

  TO UNDERSTAND THE DETAILS

  Read the **REGIONAL REPORT**.

  - **SELECTIVELY.** It is organized exactly like the summary. Wherever your interests lie, you can turn to those sections for additional background, amplifications, analysis of rejected alternatives, and especially for the full text of each recommendation, including who should do what and when. Also, remove the Development Capabilities Maps in the rear pocket and examine the legend to appreciate the type of information the maps portray; or

  - **ENTIRELY.** Read the full report for full appreciation of all recommendations, and how they interrelate.

- In an additional 10 minutes to 2 hours

  FOR APPLICATION TO YOUR AREA

  Get the **PLANNING AREA REPORT** for your locale. Scan it or read it to see how the broader recommendations presented in the Regional Report may apply to the area where you live or work.

OVERVIEW

A Brief Look at the Findings and Recommendations of the Southeastern New England Water and Related Land Resources Study

A central question facing eastern Massachusetts and Rhode Island today is: *Can we accommodate growth and provide adequate economic opportunities for the people of the region and at the same time protect the amenity values of the region's natural resources – those amenities which make this such an attractive place in which to live?*

The conclusion of the Southeastern New England (SENE) Study is that *we can.* Three key findings support this important conclusion:

- **ENHANCING THE ENVIRONMENT ENHANCES THE REGION's ECONOMY.** The export of services - education, medicine, research, and others – is rapidly becoming the dominant economic activity of the region. It is expected to outstrip manufacturing before 1990. The region's pleasant living environment is the force which attracts and holds such businesses and the personnel they require. The region's amenities are its competitive economic advantage today, as water power and ports were in the past.

- **ANTICIPATED GROWTH CAN BE ACCOMMODATED AND SHOULD BE GUIDED TO PROTECT FRAGILE RESOURCES AND MAKE DEVELOPMENT MORE EFFICIENT.** We can protect those fragile resources so critical to the region's environment and economy and still have enough developable land to accommodate growth through 2020, even if we continue to consume land at the exorbitant rate of the last decade. But in many cases we can no longer afford, either fiscally or environmentally, to consume land as we have in the past. We need to guide growth to those areas already served by sewer, water, and transportation services and channel growth through the expansion of these services.

- **EXISTING KNOWLEDGE, PROGRAMS, AND INSTITUTIONS PROVIDE THE TOOLS FOR ACHIEVING RESULTS, BUT SOME CHANGES ARE NEEDED.** Not only can the region's natural system accommodate future growth, its political system is capable of guiding that growth. Broad state responsibility, tempered by the tradition of local control, can still achieve results, but some changes in how they relate to each other will be needed. The Study chose achievability over novelty, proven institutions over grand schemes.

A "thumbnail sketch" of the major chapters in the Regional Report is presented below. For reference, a complete listing of every recommendation and the relative priority of each is presented on the reverse side.

GUIDING GROWTH (Chapter 3). Between 1960 and 1970, land was consumed in the SENE region at a rate four times higher than the historical average. While the population grew by only eight percent, urbanization increased by 45 percent. Low density urban "sprawl" increased by almost 70 percent. Today, one-third of the region is urbanized (though even in urban areas there is room for growth), one-third is too fragile to be developed, and one-third is legitimately developable. It appears that the developable third is sufficient to meet future growth needs through 2020 even if we continue to consume land as rapidly as we did in the last decade. Despite this finding, the Study concludes that to continue to consume land as we have in the 1960's would be grossly inefficient, both environmentally and economically. State development policies and comprehensive land use programs are badly needed. In the interim the Study recommends (on the reverse) *increased protection of the third of the region termed "Critical Environmental Areas" and calls for improved management of the developable third* (see multi-colored plates in pockets at the back of the Regional Report for definition and location of these areas). The *use of existing and proposed expansions of infrastructure – water, sewers, and roads – to guide growth in a way which reinforces land use policy* is strongly recommended.

WATER SUPPLY (Chapter 4). To meet the 38 percent increase in water use expected by 1990, the Study presents 14 recommendations (listed on the reverse) which emphasize *protecting and fully developing local ground water and regional surface water supplies and instituting modest conservation measures.* For the Boston area, which uses nearly half the water used in all of SENE, the *proposed diversion of Connecticut River water at Northfield Mountain is needed immediately, as well as conservation measures. The Millers River facility should be planned, but by the time additional resources must be developed, other alternatives may be more feasible in place of it.* In Rhode Island, *supplies from the proposed Big River Reservoir should be sufficient to meet the additional demands of many municipalities beyond 1990.*

WATER QUALITY (Chapter 5). About two-thirds of the total length of the region's streams are below established water quality standards. Along the coast, water quality is generally high, except in certain major harbors. The worst sources of pollution, in descending order of importance, are (a) urban stormwater runoff and combined sewers, (b) municipal discharges, (c) industrial discharges, (d) non-point sources, (e) oil spills, and (f) watercraft wastes. A massive local, state, and federal cleanup effort is underway to meet the national goal of achieving "swimmable-fishable" waters wherever possible by 1983. The Study presents 15 recommendations (listed on the reverse) designed to support these efforts. Those with the *highest priority* are *(1) protection of waters already clean enough for swimming and fishing, (2) treatment of combined sewer effluents, (3) accelerating federal grants for municipal wastewater treatment,* and *(4) continuing the successful industrial permit system.*

OUTDOOR RECREATION (Chapter 6). Southeastern New England is a recreational and tourism center of national significance, each year drawing millions of visitors. It is a region of exceptional beauty. And yet hundreds of thousands of the region's urban residents are either unable to reach, or are denied access to, its recreational opportunities. To meet 1990 recreational demands from the region's residents alone, about 2,000 more acres of developed public beach will be needed, 14,000 more picnic tables, 500 more boat launching lanes, 20,000 more slips and moorings, 20,000 more campsites, and about 130,000 more acres of natural areas for such less intensive activities as hunting and hiking. To meet as much of this demand as is feasible, the Study presents 21 recommendations (listed on the reverse). *Highest priority* is given to expanding the grossly inadequate recreational opportunities available to urban dwellers by *(1) urging states to execute their plans to acquire and develop the Boston Harbor Islands and the Narragansett Bay Islands Park, and (2) expanding and increasing access to existing facilities at state beaches and parks.* Much of the acreage needed for less intensive activities can be provided by protecting and managing Critical Environmental Areas as described in Chapter 3, Guiding Growth.

MARINE MANAGEMENT (Chapter 7). The history of the region's ties to the sea is a long and colorful one. Yet for the last several decades SENE's ports, fisheries, and urban waterfronts have been declining. Severe overfishing by highly efficient foreign fleets has drastically, in some cases irreversibly, reduced the yield of the traditional fishing grounds. SENE's own fleets are antiquated, inefficient, unable to compete. Only in the Port of Boston is any planning being done to expand and revitalize port facilities, and dredging to maintain existing channels is complicated by the problem of disposing of dredged material. The potential for offshore sand and gravel mining exists but such operations may conflict with more traditional uses of the marine environment. Aquaculture, although operating at a very small scale, could increase the domestic production of some fish and shellfish. To help the region cope with these problems and opportunities, the Study presents 24 recommendations (listed on the reverse). *Highest priority* is given to *(1) establishing a 200-mile offshore "economic zone"* and *(2) developing a port planning and development program for the New England region.*

FLOODING AND EROSION (Chapter 8). The region is characterized by extremely high tidal, but relatively low riverine flood damages. With few opportunities for flood storage dams, protection of the region's remaining flood storing wetlands and flood plains is critically important. It has been 20 years since the last disastrous hurricane and much of the region's damage prone coastline has been heavily developed. To prevent further increases in potential flood damages the Study presents 18 recommendations (listed on the reverse). While some flood control projects are recommended, the *emphasis* is on *non-structural solutions, such as flood plain zoning, to minimize increases in present flood damages.*

LOCATING KEY FACILITIES (Chapter 9). Power plants, petroleum facilities, sand and gravel extraction operations, and solid waste disposal facilities are critical to the economy and the public health and safety. Indeed, the availability and cost of energy have become New England's most serious economic problems. The Study concludes that while the demand for these facilities can be significantly reduced, the protection of sites suitable for their development is as important as the protection of Critical Environmental Areas. The Study presents 33 recommendations designed to meet the region's needs for the services these facilities provide. *Highest priority* is given to *(1) setting state goals for reducing energy (electrical and petroleum) consumption, (2) studying ways to simplify power plant licensing procedures,* and *(3) establishing or strengthening state authorities for facilities siting.*

HOW TO PROTECT OUR NATURAL RESOURCES (Chapter 10). Existing institutions and programs can generally provide the necessary tools for implementing the Study recommendations. *Several options for integrating water and related land resources policy making and program management* into other state economic and social programs are examined for both Rhode Island and Massachusetts. They range from comprehensive and centralized statewide natural resources management and regulation, through several mechanisms emphasizing shared state, regional, and local authority, to completely local control under state guidelines.

TYING THE RECOMMENDATIONS TOGETHER (Chapter 11). Through text and charts, the integration of recommendations with the Study's goal and planning objectives is displayed, with special focus on the contributions the Study makes to national economic efficiency, environmental quality, regional economic development, and social well-being. The picture which emerges is that the Study strongly recommends better resource management programs and emphasizes regional planning to accomplish better resource management. In addition, a modest and balanced mix of research and development, private investment and public projects are recommended along with a minimum of new acquisition and legislation.

OVERVIEW

RECOMMENDATIONS

GUIDING GROWTH (Chapter 3)

Planning Objective: *To suggest strategies for protecting the critical water and related lands resources of SENE while accommodating economic activities and guiding growth.*

- • 1. Increase protection of Critical Environmental Areas: priority protection and other protection areas.
- • 2. Improve management of Developable Areas by resource capability, judicious use and expansion of infrastructure, and regulation of large-scale development.

WATER SUPPLY (Chapter 4)

Planning Objective: *To meet municipal needs for adequate supplies of fresh water in the most economically feasible and environmentally sound manner.*

Everywhere

- • 1. Maintain and protect existing water resources.
- • 2. Prefer local ground water to intermunicipal surface water to interbasin transfer.
- o 3. Limit water consumption through education and water-saving technology.
- * 4. Acquire key watersheds and potential well sites.
- 5. Establish regional water management agencies.
- 6. Study advanced technologies leading to new sources of water.

Ground water dependent areas

- o 7. Survey ground water location, quantity and availability.
- * 8. Restrict activities shown to be hazardous to ground water quality.
- * 9. Limit ground water withdrawal to maintain stream levels.
- 10. Monitor saltwater encroachment in coastal aquifers.
- 11. Provide recharge basins to capture storm runoff.
- 12. Establish state ground water boards.

Surface water dependent areas

- • 13. Expand MDC sources by completing the Northfield Mountain Facility. Carry out conservation measures. Plan the Millers River Facility.
- * 14. Encourage regionalization of water supply systems.

WATER QUALITY (Chapter 5)

Planning Objective: *To achieve swimmable-fishable waters by 1983 wherever realistically attainable economically, socially, and technically.*

Preservation

- • 1. Stress anti-degradation in areas now swimmable-fishable.
- o 2. Carry out current state non-degradation policies.
- * 3. Attenuate runoff from new urban developments.
- * 4. Negotiate acceptable low-flow regimes with upstream communities.
- 5. Provide streambank buffer strips.

Restoration

- • 6. Emphasize treatment of urban stormwater overflows.
- • 7. Accelerate federal grants for municipal wastewater treatment.
- • 8. Continue current industrial permits program.
- o 9. Begin regionwide stormwater and wet-weather stream sampling.
- o 10. Make towns responsible for scavenger waste disposal.
- * 11. Determine municipal sludge disposal policy on plant-by-plant basis.
- * 12. Place burden on industry for disposing hazardous wastes.
- 13. Study and define the landfill leachate problem.
- 14. Provide pumpout facilities and treatment for watercraft wastes.

Area priorities

- o 15. Give priority to Cape Cod, New Bedford, Providence, and Boston.

The priority of the recommendation is indicated by the symbol preceding it:

- • Highest priority recommendations (18)
- o High priority recommendations (28)
- * Other priority recommendations (39)
- (Blank) Remaining recommendations (43)

Priority was assigned to the recommendations according to their significance in meeting the objective of each chapter. Consideration was given to those policies and actions which are expected to meet the greatest needs the fastest and which support, most directly, the three themes of the Study.

OUTDOOR RECREATION (Chapter 6)

Planning Objective: *To meet 1990 recreation needs in economically, environmentally, and socially acceptable ways.*

Swimming

- • 1. Expand facilities at existing state beaches and parks.
- 2. Study beach erosion control.
- 3. Study beach expansion.
- o 4. Secure public access to shoreline.

Boating

- o 5. Form state boating advisory committees.
- 6. Undertake authorized channel and anchorage improvements.
- 7. Investigate new regional marina basins.

Salt water fishing

- o 8. Construct public boat ramps and fishing piers.
- 9. Encourage private construction of boat ramps and fish piers.

Camping and picnicking

- * 10. Form state recreational advisory committees.
- o 11. Expand state forests and parks near tourist centers.

Wildlife and fresh water fisheries

- * 12. Acquire SENE's most important upland and wetland wildlife habitat.
- 13. Acquire SENE's most important streambanks.
- 14. Acquire public access to ponds.
- 15. Enforce wetlands legislation and local zoning regulations.

Extensive outdoor recreation

- • 16. Develop Boston Harbor Islands and Narragansett Bay Islands Park.
- o 17. Develop guidelines for limited recreation on selected storage reservoir lands.
- o 18. Make multiple use of urban lands.
- o 19. Implement or develop scenic rivers legislation.
- * 20. Expand existing forests and parks near urban centers.
- 21. Develop a regional trail system.

MARINE MANAGEMENT (Chapter 7)

Planning Objective: *To maintain the region's renewable marine resources at a level sufficient for a sustained future use and to develop the region's nonrenewable marine resources in an environmentally sensitive manner.*

Offshore fisheries

- • 1. Declare interim offshore 200-mile economic zone.
- * 2. Adopt national fisheries management policy and program.
- 3. Increase tariffs on imported fish products.
- 4. Allow privately financed purchase of foreign-built fishing boats.
- 5. Improve market for underutilized fish species.
- 6. Accommodate coastal fishing facilities through improved planning.

Shellfish and aquaculture

- 7. Increase Mass. technical assistance for local shellfish management.
- 8. Increase shellfish license fees in Massachusetts and require recreational licenses in Rhode Island.
- 9. Develop underutilized shellfish market.
- * 10. Research removal of virus and bacteria to enhance shellfish habitats.
- * 11. Site new wastewater discharges away from estuaries.
- 12. Enact aquaculture legislation in Rhode Island.
- 13. Investigate potential aquaculture sites.
- 14. Increase technical assistance to towns for aquaculture.
- 15. Increase research on use of wastewater for aquaculture.

Port development

- • 16. Plan regionwide port development.
- 17. Continue interim dredged materials disposal procedure.

Offshore sand and gravel

- * 18. Develop state policy and program regulating mineral extraction activities in coastal waters.
- 19. Coordinate future federal far-shore leasing with adjacent states.
- * 20. Develop predictive modeling techniques.

Urban waterfronts

- 21. Coordinate local waterfront planning and development.
- o 22. Provide guidance and set criteria for priority waterfront uses.
- 23. Review and coordinate waterfront use at state and substate regional level.
- * 24. Support state and local waterfront development plans.

FLOODING AND EROSION (Chapter 8)

Planning Objective: *To reduce flood damages in the region, both riverine and coastal; and to reduce critical coastal erosion.*

Flooding

- o 1. Prepare flood plain programs with non-structural emphasis.
- * 2. Adopt zoning to regulate new flood plain construction.
- * 3. Establish local regulations to control runoff and erosion.
- 4. Provide technical assistance to local officials.
- 5. Acquire key flood plains and wetlands.
- 6. Locate in existing safe buildings in the flood plain.
- 7. Require relocation out of flood plains where appropriate.
- * 8. Discourage reconstruction or redevelopment after storm damage.
- 9. Update and establish flood warning and evacuation programs.
- 10. Increase funding for storm forecasting.
- * 11. Amend and strengthen administration of wetland laws.
- * 12. Construct flood protection projects selectively.

Erosion

- 13. Establish local sediment and erosion control ordinances.
- o 14. Manage critical erosion areas through state coastal zone programs.
- * 15. Protect critical coastal erosion areas under local regulations.
- * 16. Encourage natural stabilization of coastal erosion area.
- 17. Construct erosion control projects selectively.
- 18. Build or restore salt marshes.

LOCATING KEY FACILITIES (Chapter 9)

Planning Objective: *To provide certain vital services to society – power, fuel, construction materials, solid waste disposal – in a manner which supports continued economic growth and minimizes the negative environmental impacts such facilities have traditionally had.*

Onshore sand and gravel extraction

- o 1. Centralize minerals management authority.
- * 2. Conduct state minerals resources survey in Massachusetts.
- 3. Create public education program for minerals management.
- * 4. Promulgate minimum state extraction operation and rehabilitation standards.
- * 5. Provide state guidance to municipalities on extraction permits.
- * 6. Reclaim selected abandoned extraction sites for recreation.

Electrical power

- o 7. Create state energy conservation education program.
- • 8. Provide state technical assistance on state energy consumption rate reduction goals.
- o 9. Implement program of mandatory and voluntary energy-saving measures.
- * 10. Study electric rate schedules; encourage off-peak power use.
- o 11. Identify and secure power plant sites for future use.
- • 12. Avoid Critical Environmental Areas for future sites.
- o 13. Maximize development capabilities at existing power plant sites.
- * 14. Upgrade or phase out inefficient fossil units near cities.
- * 15. Put transmission and distribution lines underground in urban redevelopment programs.
- * 16. Provide interim recreational use of undeveloped power plant sites.
- • 17. Simplify procedures for power plant licensing.

Petroleum facilities

- o 18. Revise new building standards to improve heating-cooling efficiency.
- * 19. Provide tax incentives for voluntary energy-conservation measures.
- • 20. Provide state energy-consumption rate reduction technical assistance.
- * 21. Fund mass transit systems.
- o 22. Establish petroleum facilities siting authority in Rhode Island.
- o 23. Strengthen petroleum facilities siting authority in Massachusetts.
- * 24. Consider New England-wide implications of siting decisions.
- o 25. Establish standards and criteria for refinery siting and operation.
- * 26. Use SENE Study development capability analysis in siting decisions.
- o 27. Establish deepwater ports; evaluate sites individually.
- o 28. Locate refineries and related development inland near infrastructure.
- * 29. Distribute refined products by pipeline wherever feasible.
- * 30. Use most advanced technologies in facilities operation.

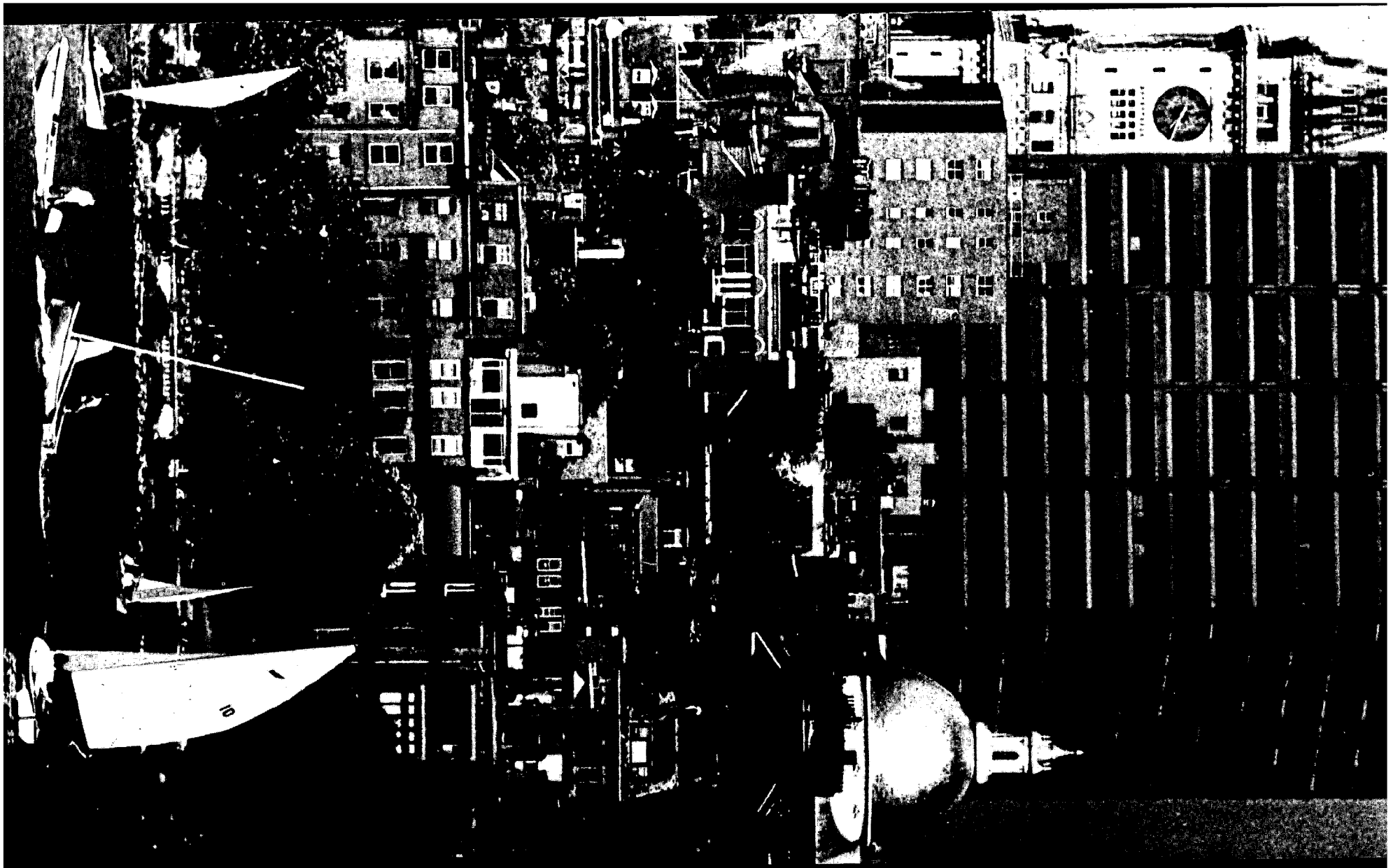
Solid waste management

- * 31. Enforce existing sanitary landfill regulations.
- o 32. Fund the Rhode Island solid waste management program.
- 33. Accelerate local participation in state recovery programs.

HOW TO PROTECT OUR NATURAL RESOURCES (Chapter 10)

Planning Objective: *To ensure appropriate action taken with regard to planning recommendations.*

- • 1. Maximize use of existing resource policy institutions.



Goals and Approach

CHAPTER 1 GOALS AND APPROACH 1-1

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CHAPTER 1 GOALS AND APPROACH

This chapter is intended to outline, briefly, how the recommendations for Southeastern New England were developed and to highlight the major conclusions of the Study.

The principal goals of the Study are presented first, followed by a brief description of the major planning objectives which influenced the direction of the Study. A brief characterization of the SENE Study recommendations and the process used to develop them is explained next, followed by a summary of the major themes or conclusions which emerged from the Study effort.

Study Goals

The Southeastern New England (SENE) Water and Related Land Resources Study was authorized by Congress and funded in 1971 in response to the increasingly troublesome pressures the region's rapid urbanization was exerting on its rich and varied natural resources. The SENE Study had two principal goals:

- "To identify and recommend actions to be taken by all levels of government and by private interests to secure for the people of the region the full range of uses and benefits which may be provided by balanced conservation and development of the region's water and related land resources" (From the Plan of Study), and

- To provide a compilation of base data on the region's water and related land resources for the benefit of future planners and researchers.

The attainment of these goals is documented in the twelve final reports produced by the SENE Study: the Summary, Regional Report (including Environmental Statement and Methodology) and ten planning area reports. The recommendations and the resource capability analysis which form the foundation of the Study are supported by literally dozens of technical reports and maps available in the library of the New England River Basins Commission.

Major Regional Planning Objectives

The initial step toward the stated Study goals was to identify the major regional planning concerns within SENE. These ranged from such purely technical objectives as the provision of a safe water supply, to such political and social objectives as the maintenance wherever possible of local autonomy in resource decision making. Objectives such as these served to focus the Study effort and are the foundation upon which the recommendations are built.

Analysis of these concerns and objectives led to the emergence of the understanding that the development of a publicly acceptable regional growth policy is basic to making intelligent water and related land resource planning and management decisions.

The Regional Report does not attempt to define a single growth policy for the SENE region. It does, however, in *Chapters 2 and 3*, clearly identify the major elements which must be considered in such a policy. Moreover, in *Chapter 10*, the Study identifies several alternative approaches for implementing such a policy within the political and social realities of Southeastern New England.

The Study's special emphasis is to detail a comprehensive program which establishes the vital role that water resources and certain water related land resources play in such a regional growth policy. Thus SENE Study recommendations have consciously and deliberately been formulated in a manner which contributes to the development of a regional growth policy and to potentially have an important influence on its articulation and implementation by the region's decision makers.

The SENE Study Recommendations

The SENE Study presents in this Regional Report (and in the ten Planning Area Reports) a program of recommended actions and policies which includes development projects, management programs, land acquisition activities, institutional modifications, and legislative changes. These are detailed in each of the functional chapters and summarized and evaluated in *Chapter 11, Tying the Recommendations Together.*

The Major Characteristics of the SENE Study Recommendations

Before the recommendations can be presented, it is important to understand their major characteristics and how they determined the scope of the Study.

The SENE recommendations are *broad, comprehensive, long-range, multi-agency, water and related land resource oriented, and coordinated.*

The SENE recommendations are *broad* because principal emphasis was placed upon major regional policies and programs. They are *comprehensive* in that all principal water-related resource uses are addressed for all parts of the region, for all levels of government, and for the private sector as well. Since they are *long-range,* they not only consider current conditions, but also attempt to anticipate condi-

tions, problems, and solutions for the year 1990 and to gauge the compatibility of these solutions with conditions which might be present in the year 2020. The recommendations are *multi-agency* in that the states of Massachusetts and Rhode Island, eight federal agencies, two other regional agencies, a Citizen Advisory Committee, a Regional Scientific Task Force, and ten Basin Advisory Committees helped prepare and review them under the direction of the New England River Basins Commission, a regional federal-state planning organization.

The Study focuses on *water and related land resources.* To make the study manageable, the tendency to expand into ever-widening circles had to be resisted. It is important to recognize, for example, that the treatment of land use in Chapter 3 was developed primarily from a water resources point of view. Other major growth concerns – such as economic development, housing, transportation, and education – were considered only to the extent necessary to determine how water resources programs could contribute to objectives associated with these concerns.

The Study is *coordinated:* One of the principal benefits of the Study was the bringing together of major federal and state agencies as a team during the organization, preparation and review of this report. Everyone could see what everyone else was doing. All of the recommendations have been exposed to all participants, who have been given an extended opportunity to voice objection or support. Most, but not all, of the recommendations thus have the support of the participating federal and state agencies and the other members of state government with whom they judged it desirable to coordinate. In instances where agreement was less than complete, prominent divergent views were included in the analysis. Thus, it is correct to say that the SENE recommendations represent a generally agreed-upon, consistent set of proposed actions, coordinated with the federal and state governments. The recommendations should therefore be particularly useful for coordinated planning, for programming, for assigning priorities and, to a lesser extent, for budgeting.

Using the Study

The SENE recommendations are a guide for meeting the needs of people, developed in a manner consistent with their desire to manage future growth. The recommendations are intended for continuous use by those having responsibilities for, or interests in, the management of the water and related land resources of the region. To use them, agreement with every recommendation is not necessary. Associated with each recommendation are the alternative solutions with which it competed. Others may weigh the pro's and con's differently; but, at least if they use this guide, their solutions will have been formulated with an awareness of what they have chosen to gain and what they have thereby chosen to forfeit. The recommendations and their supporting rationale – and the SENE Study files – can also be used as a starting point for more detailed work.

Compilation of Base Data

As indicated earlier, one goal of the Study is "to provide a compilation of base data on the region's water and related land resources for the benefit of future planners and researchers." This goal is satisfied by the creation and filing of a massive amount of unpublished material on the region's resource base. It is available for inspection and abstracting at the offices of the New England River Basins Commission (NERBC) at 55 Court Street, Boston, Massachusetts 02108. This wealth of material could not be adequately reflected in the SENE Study report itself. Draft documents have been prepared for each of the functions covered in Chapters 3 through 9 for each of the ten planning areas. A mass of raw and analyzed data and information has been assembled. Much has been graphically depicted on a common map scale and integrated into a multi-purpose map. For many portions of SENE, this is the only information available at uniformly comparable scales. For other portions of SENE, much more detailed information is available at the local level. It is now, however, possible in these areas, using the SENE Study data, to compare the local situation with the regional perspective. This multi-purpose framework for decision making has never before been available for Southeastern New England. The Study has codified and condensed the results of a myriad of previous work in order to take a broad comprehensive geographic viewpoint and relate individual functions to broad regionwide policies.

Table 1.1 lists the type of material contained in the SENE files. The material and the processes followed are available to assist other planners in increasing the store of knowledge about SENE's natural resources.

Formulating the SENE Study Recommendations

To serve as a guide for meeting expressed needs and to contribute to orderly future growth, the Study recommendations were formulated by systematically appraising alternative programs aimed at both meeting needs within individual functional areas (water supply, recreation) and synthesizing the functional programs to determine how they contributed to the future regional growth objectives.

Thus, three basic steps were followed:

- analysis of problems and issues and alternative solutions within individual functional areas;
- development of alternative plans within functional areas; and,
- analysis of implications for future regional growth.

Functional Analysis. Each area of functional concern begins with an assessment of the resource situation which provides background, describes problems and opportunities and explains the effects if the problems are not resolved. Alternative solutions are then described and evaluated in terms of their major environmental, economic, and social impacts. Choices are made in the form of recommendations indicating who is to do what, and often how it might best be done.

Alternative Plan Development. After the alternative solutions were described and evaluated, they were grouped to form three distinct alternative plans emphasizing different objectives. One emphasized environmental quality, selecting only those measures which favored, or at least did not detract from, environmental enhancement. Another emphasized economic development. The third plan, more often than not the recommended plan, sought a middle road providing opportunities for economic development consistent with the region's environmental aspirations.

Analysis of Implications. Finally, the recommended functional plan was discussed in terms of its broad economic, social, and environmental implications on regional growth policy.

In applying this approach, a separate report was developed for each of seven broad functions corresponding to Chapters 3 through 9 of the Regional Report, for each of ten planning areas – a total of 70 reports. These reports were then condensed and combined into ten planning area reports. The ten reports were then synthesized into this Regional Report with added coverage given to the alternatives, rationale, and policy aspects. Finally, new insights gained in preparation of the Regional Report were fed back into the individual planning area reports.

The process by which the recommendations were formulated is in many ways similar to the requirements for an environmental statement – it identified critical environmental areas, and analyzed alternative measures (the environmental and economic impacts). Despite this similarity, a separate environmental statement was prepared and is included as part of the Regional Report.

Major Conclusions

At the end of the Study three major conclusions, or themes, emerged around which all of the recommendations appear to revolve. These themes or conclusions are that:

TABLE 1.1 TYPICAL INFORMATION CONTAINED IN THE SENE STUDY FILES

1. **General Information Publications.** Plan of Study, pamphlets, newsletters, a map overlay packet, and an annotated bibliography.

2. **Base Reports.** A socio-economic and environmental framework, an environmental base study, data books, and population projections.

3. **Inventory Reports.** For each of 10 basins, a separate report on 18 individual subjects including flood plain zoning and streamflow management; water quality control; ground water management; water supply; land use patterns, allocations, and management; special environmental factors; fish and wildlife; outdoor recreation; inland wetlands management; navigation; coastal resources; power; minerals; irrigation and drainage; sediment and erosion; health aspects; climate, meteorology, hydrology, water quality, geology and ground water availability; and related land -- a total of 216 reports.

4. **Maps.** Mainly at a scale of 1 inch = about 1 mile (1:62, 500), occasionally at 1 inch = 2000 feet and 1 inch = 4 miles (1:24,000 and 1:250,000, respectively): (1) maps showing physical characteristics such as surficial geology, soils classifications, slopes, depth to bedrock, depth to seasonal high water table, flood plains, water quality, ground water recharge areas, coastal resources, physical characteristics, and tidal flooding; (2) maps showing land use, ownership, and services such as land use patterns, land use capability groups, transportation systems, zoning, town functional environments, unique natural areas, unique cultural areas, recreation areas, navigation, sewer service areas, existing and potential water supply sources and service areas, power generation stations, and ownership and use of coastal resources; and (3) suitability analyses on basic resource configurations, limitations for septic tank wastewater disposal, special environmental factors, fish and wildlife habitats and corridors, freshwater fisheries, salt water sport fishing, quality of wildlife wetlands, existing and potential navigation developments, suitability for base load power plant siting, potential sand and gravel resource areas, and many others.

5. **Special Economic Reports.** Economic considerations, economic criteria, economic implications, economics of power plant siting, economic analysis of coastal resource allocation.

6. **Special Legal and Institutional (L & I) Reports.** Design of L & I arrangements, changes in wetlands law, fiscal policy and related land use control, ensuring access, proposed legislation and implementation of the SENE study.

7. **Citizen Participation Publications.** Tabulations of major watershed problems by workshop participants and citizen-preferred solutions, summaries of news releases about public workshops and Regional Citizen Advisory Committee meetings.

- Enhancing the environment also enhances the economy.
- Anticipated growth can be accommodated, but it needs guidance.
- Existing knowledge, programs, and institutions provide the most realistic tools for achieving results.

Enhancing the environment also enhances the economy. It is the major conclusion of this Study that environmental enhancement and economic development will tend to reinforce each other in Southeastern New England. Environmental and economic goals are often considered polar opposites. The Study has found, however, that while society may have to be prepared to pay some "opportunity cost" for preserving a given resource or environmental value in the short run, it will gain significant economic values in the long run. Both environmental and economic objectives seek to improve the overall quality of life, but in different ways.

A future favoring environmental values would enhance the quality of life by giving first preference to clean air and water, to natural beauty, to open space, to opportunities for outdoor recreation or solitude.

A future favoring economic values would enhance the quality of life by giving first preference to employment, to a high economic standard of living, to upgrading the labor force through education, to increasing the use which people can make of their natural resources for material and recreational benefits, to improving the region's infrastructure* and generally upgrading the efficiency with which the region produces or acquires goods and services.

In the SENE region it has been found that these generally polar cases tend to merge for several reasons:

(1) Population growth is slowly leveling off;

(2) Per capita income will remain high; and

(3) The region's economy is getting "cleaner", i.e. less resource-consuming, more services-oriented.

Almost all of these socio-economic trends will tend to lessen tension between environmental and economic aspirations. Indeed, achievement of environmental goals should actually reinforce economic goals. In recognition of its regional disadvantages of remoteness from bulk raw materials, of poor transportation links, of high power rates, and of high labor costs, the region's basic economy in the future will probably increasingly rest on its ability to export essential services and pioneer in high unit value, state-of-the-art, and prototype manufacturing. To attract and hold the necessary skills – which could really be located almost anywhere in the nation – the region's principal drawing power will be a clean, attractive environment – a good place to live, work, and raise a family. There are many other environmentally attractive places in the nation. Therefore, SENE's success cannot be taken for granted. *If SENE does not maintain and improve the quality of its natural landscape, not only will its environmental future be degraded, but its long-range economic future will probably also falter.*

Notwithstanding the above general strategic harmony of long-range environmental and economic aspirations in this region, several major current conflicts need to be resolved. They are considered principally in *Chapter 9 on Locating Key Facilities.* They provide the services everyone needs but no one wants nearby. In general, the recommendations emphasize the importance to public welfare of providing for these facilities and then gives priority equal to that given to preservation of critical environmental areas.

Anticipated growth can be accommodated, but it needs guidance. *The Study has found that, overall, sufficient legitimately developable land exists in the region to meet development requirements not only in the near future but through the year 2020.* This finding is true even if the region continues to consume land at the current rate of one-half acre per person – a rate *four times* higher than the historical average in Southeastern New England. Should current population trends and the tendency among developers to cluster development continue, the development picture could even be brighter. The implication for resource management is that we can encourage and support the economic development the region needs so badly without sacrificing critical or fragile natural resources or risking public safety.

To assure that development is guided to those lands most capable of supporting it, the Study concludes that a regional growth policy or regional land use plan is essential. Such a plan would seek to influence the location of our future development investments in order to emphasize economic efficiency, and reflect the region's social preferences and environmental values. In addition to water and related land resources input, that plan needs input from other diverse spheres of human interest such as employment opportunities, transportation, utilities, housing, and urban renewal.

The SENE Study presents what it considers to be a powerful beginning. As will be seen in more detail in *Chapter 3,*

* Infrastructure means the facilities required to support development. It includes interrelated basic services such as energy sources, utilities systems, and communication and transportation links.

Guiding Growth, and on the Development Capability Maps in the rear pocket, the SENE Study has categorized every parcel of land and water in the SENE region; suggested whether it ought to be protected, managed, developed with controls, or developed fully; and given the reasons for this choice. In general, the suggested protection areas are those Critical Environmental Areas which are essential to the environmental quality of life described earlier, especially the preservation of open space to give visual variety to growth. Use of the more developable areas, if properly managed, can generally improve the economic quality of life, which was also discussed earlier.

In addition to offering a specific framework for strategic land use planning for endorsement or modification by other decision makers, the Study's water and related land use management recommendations can influence land use decisions. Setting priorities for the provision of water supply and sewer systems, the rational intensification or relaxation of environmental standards, and the enhancement or carefully considered sacrifice of amenities, can all play a very important part in implementing any consensus as to how growth can best be distributed. *Once a general land use consensus is achieved, water resources management can become one of the major tools for implementing growth policy, rather than simply responding to development, as has been the case up to now.*

Existing knowledge, programs, and institutions, with some changes, provide the most realistic tools for achieving results. The SENE Study's recommendations were developed with special attention to "implementability." There was a deliberate effort to avoid "grand schemes." Instead, the recommendations emphasize better use of existing knowledge, programs, and institutions as the most realistic way of achieving its first major goal. Effort was concentrated on collecting and analyzing existing information. Expensive additional field surveys and research were avoided. The inclination to postpone recommendations until, somehow, more research could be accomplished was generally resisted. The Study accepted the conclusion that "no decision" is indeed a decision. In cases of doubt, the general tendency was to recommend reversible action coupled with research to permit adjustments to be made if new knowledge should suggest them. Full use of ongoing programs, notwithstanding some inadequacies, was viewed as a pragmatic way of "piggy-backing" on programs that had already weathered most of the realities of the political process. For example, at every reasonable opportunity the SENE Study sought to mesh with the federal Coastal Zone Management Act of 1972 and the Federal Water Pollution Control Act Amendments of 1972. The Study also sought ways to use the existing institutions to get things done rather than search for new arrangements that might have been slightly better if judged from a parochial water resources point of view. In choosing these strategies *the Study traded off novelty to increase achievability.*

Therefore, the SENE Study recommendations strongly bring out the need for a comprehensive management system with the following major elements:

- State leadership and control;
- Federal agency support;
- Implementation frequently at local level; and,
- A modest continuing planning process, capable of linking all three levels of government.

Within this system, the emphasis throughout the SENE Study recommendations has been on delegation of authority – placing decision making at the lowest level commensurate with the anticipated scope of the decision, but prescribing the policy framework and the types of external considerations that should be referred to a higher level. Here the recommendations ran into an administrative management problem. To recommend that "every community should (do what)" would have unquestionably produced an unevenness of awareness, interpretation, and performance that could have destroyed the overall intent of the recommendation. A consistent leadership, a catalyst, was needed, and for this the SENE Study focused responsibility primarily on the states of Massachusetts and Rhode Island. The typical wording chosen was "the Department of (what) in the state of (what) should encourage municipalities to (do what) by providing leadership, information, technical advice and (sometimes) seed money." This approach casts the state in a leadership role but leaves the details to be elaborated and implemented to those closest to the decision, including federal and local governments and substate regional agencies.

The Setting

2

CHAPTER 2 THE SETTING 2-1

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CHAPTER 2 THE SETTING

Southeastern New England (SENE) is the northern terminus of the Northeast Megalopolis, a belt of dense urban growth reaching from Norfolk, Virginia, to Boston. SENE is the commercial, industrial, financial, and cultural center of New England. Fifty percent of the total population of New England lives and works in SENE, though it contains only seven percent of New England's land area.

The dense press of people, commerce, and industry which characterizes most of the Megalopolis has not yet blanketed SENE. A coastally-oriented region, SENE has its major urban centers; but it also has vast expanses of open space – extensive forests, broad wetland networks, productive farmland. Indeed, the diversity of its natural and human landscape makes SENE difficult to describe as a "region". While people in SENE perceive a sense of "place" in the South Shore, Cape Cod, or Narragansett Bay, few see Southeastern New England as a distinct "region". Yet the nature of development and the resource conflicts which result from that development exhibit distinct similarities throughout the SENE region. The region can be described, then, in a variety of physical and human terms, and one of the goals of the SENE Study planning effort has been to gain a better understanding of how these physical and human characteristics interact and to apply these insights to solve some of the region's problems.

The physical characteristics include hydrology, geology and topography, climate, water, and coastal resources. These characteristics have played a major role in the evolution of the human characteristics of the region – the growth and distribution of its people, the structure of the economy, and the nature of the institutions created to manage and develop their resources. Together, these characteristics form the setting within which the Study was conducted and within which its recommendations must be carried out.

Physical Characteristics

Boundaries

The Study region's 4400 square miles include the entire state of Rhode Island and all or portions of Essex, Middlesex, Suffolk, Worcester, Norfolk, Plymouth, Bristol, Barnstable, Nantucket, and Dukes counties in Massachusetts. A small corner of Connecticut lying within the Pawcatuck River basin is also included.

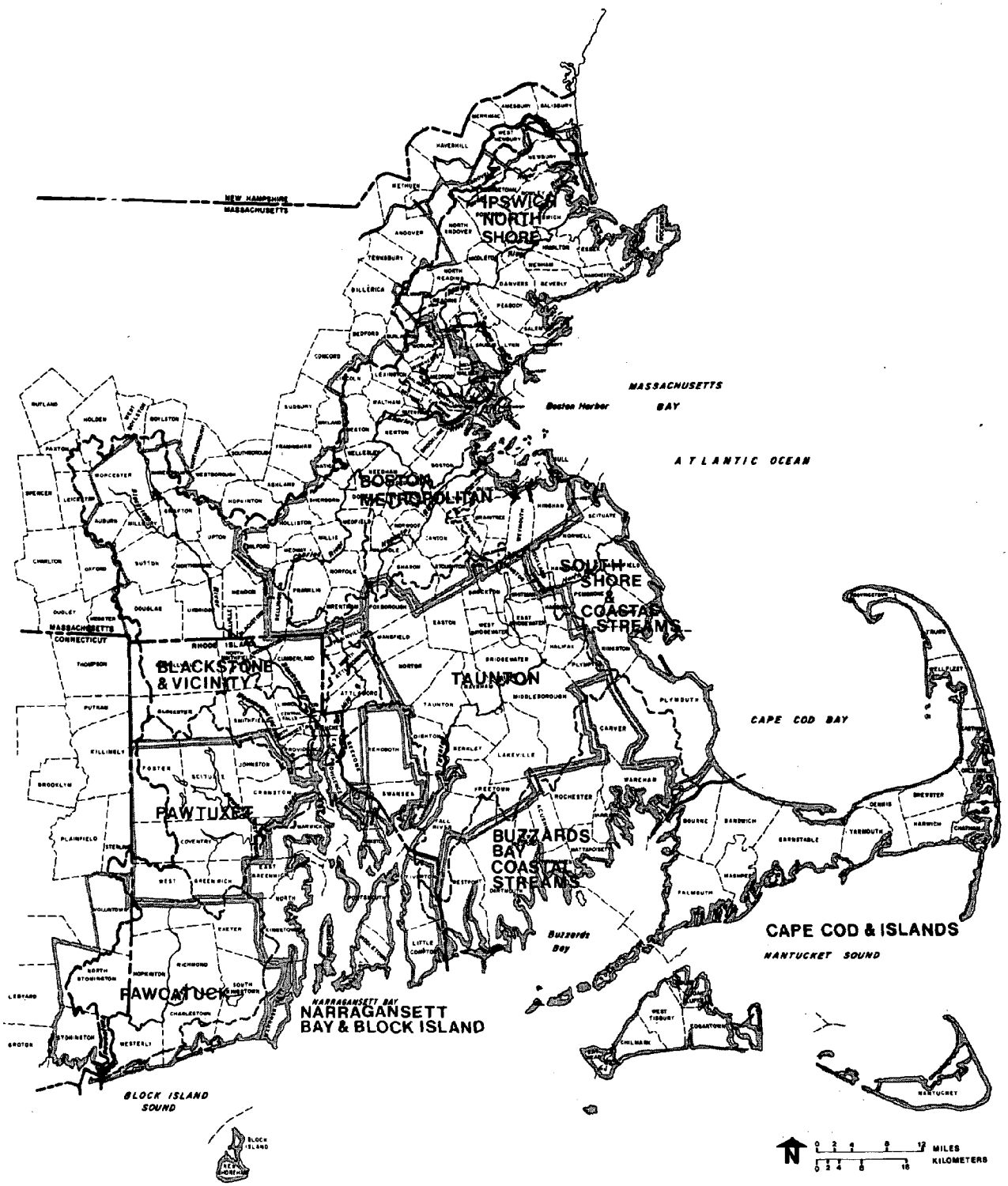
All 39 cities and towns in Rhode Island are included in the Study area, as well as 171 municipalities in Massachusetts, encompassing forty-one percent of the state, and 3 municipalities in Connecticut, encompassing one percent of the state.

Although the Study area contains five separate urban areas and contains four complete Standard Metropolitan Statistical Areas (SMSAs), the Study area was expanded to include information from outside of the Study area wherever significant influence on the region was being exerted by an outside market or supply. The need for this is most obvious in cases determining recreation demands on the Cape and Narragansett Bay, electrical power needs, port facilities, and water supply requirements of the metropolitan Boston area.

In contrast to studies of single major river systems, the actual SENE Study area is composed of some twenty significant river and coastal drainage areas in Rhode Island and Massachusetts. By generalizing the hydrologic boundaries to include whole towns, and by combining basins which drain into the same harbor, the twenty river basins were grouped into ten planning areas. A separate report was produced for each of the ten planning areas. In each planning area report, the policy issues discussed in this Regional Report are refined to a much greater level of detail. As a result, SENE Study recommendations attain a level of specificity not generally found in past regional studies. Figure 2.1 is a map of the SENE region showing the planning areas and the towns within them.

Geology and Topography

The SENE Study area is primarily confined to the low coastal border forming the margin of the interior uplands of the states of Massachusetts and Rhode Island. This seaward-sloping margin is a portion of the New England geologic province known as the seaboard lowland. The principal characteristic of this coastal region is that it is lower and smoother than the adjacent upland areas to the north and west. The smoothness of the surface is locally broken by rock hills rising above the lowland surface north and south of the city of Boston. Topographically, the region presents a mature, gently sloping drainage pattern rising to its highest point of approximately 1400 feet above mean sea level



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

PLANNING AREAS

FIG. NO. 2.1

in the northwesterly portion of the Study area. The crystalline bedrock which underlies much of the region is generally more than 10 feet from the surface, but ranges from hilltop outcroppings to several hundred feet deep in valleys. In contrast to the bedrock, the softer sedimentary rocks of the Boston and Narragansett geologic basins have produced a drowned coast allowing the radial arrangement of streams entering the basins to be navigable even at low tide, a feature which provided early transportation corridors and determined the location of the major population centers of the region.

The surface topography and soils of the region were formed during the advance and retreat of the Wisconsin ice sheet some ten thousand years ago. These glacial movements produced the extensive terminal moraines of Cape Cod and are responsible for the formation of Nantucket, Martha's Vineyard, and the Elizabeth Islands. Till covers the higher elevations in the northern parts of the Study region. Outwash deposits fill valleys in the north and form broad plains in the south.

Each of these landforms and their physical properties establish parameters for economic and environmental planning and development. For example, in water supply planning, deep stratified valley deposits afford excellent opportunities for wells capable of yielding sufficient quantities of ground water for municipal or industrial use. These ground water reservoirs are usually of high quality and can transmit as much as 300 gallons of water per minute or more to individual wells. In contrast, bedrock or till deposits which may lie only a few yards away, rarely yield one hundred gallons per minute and generally are capable of being pumped at only twenty-five gallons per minute. Such wells are adequate only for individual domestic uses.

Septic tank limitations and bearing capacity are also development parameters determined by soils overlying SENE's landforms. In a glaciated region such as SENE, septic tank capability can vary drastically within a few hundred yards. Such physical characteristics have in the past and will continue to present significant limitations and opportunities to shape the location and scope of urban development.

Climate and Water

Although the annual precipitation is relatively high, averaging 44 inches per year and evenly distributed throughout the year, the Study region must still rely on an outside source for some of its water supply. Average runoff is about 2.1 cubic feet per second for every square mile, accounting for roughly fifty percent of the average annual rainfall. The remaining runoff is lost to evaporation, both directly and indirectly through plants and soil.

The low landforms of SENE have other fundamentally important implications in that lack of topographic relief restricts the use of dams for surface water supply reservoirs or for flood control reservoirs. The larger rivers, which have adequate flows for water supply, have been polluted by two centuries of urbanization and industrial development. Consequently, parts of the region, as with virtually every other urban center in the world, have historically supplemented their water supply with imports from outside of the region. The major importer of water in the SENE area is the Metropolitan District Commission which serves the greater Boston area and provides approximately 90 percent of its members' supplies from out-of-region sources.

Coastal Resources

The SENE region's irregular 1540-mile coastline has been its most valuable resource. The bays and coves, carved by glaciers during the Ice Age, offered sheltered anchorages to early fishermen and were later developed by a burgeoning mercantile industry into world-leading ports. Today, there is a great demand for sea-coast land as prime residential or second-home property. Recreational boating, salt water sportfishing and swimming at the many broad, sandy beaches have established a national reputation for the region's significant tourism industry. This combination of coastal ambience, of a physical link to the sea, and a sense of heritage mellowed by the sea, contribute largely to the region's quality of life.

Following the retreat of the ice sheets, the rising ocean chewed into the moraines of sand and gravel. It scoured and molded the Cape and Islands and flooded the Boston and Narragansett basins. Bluffs were eroded and the sand cast up into long barrier beaches backed with saltmarsh estuaries. The rocky headlands of Cape Ann, Marblehead, and Newport project into the Atlantic surf in sharp contrast to the nearby sandy beaches and quiet tidal marshes.

In these estuaries lie an abundance of fishery and shellfish resources. The coastal clam and scallop industries have become nationally known, and as much as seventy percent of the commercially valuable offshore fisheries rely on these same coastal waters as nurseries and feeding grounds.

Population: Today and Tomorrow

As discussed earlier, the physical landscape has had a significant effect on the location and growth of the population centers in the region. SENE's four urban centers are Boston, Providence, Worcester, and New Bedford/Fall River, and nearly 80 percent of the region's approximately five million people have settled in these four areas. While a surprisingly large amount of open space still exists, the average population density is about 960 persons per square mile compared to averages of about 180 for New England as a whole and 60 for the nation.

As elsewhere in the nation, SENE experienced a steady migration of population away from the older central cities to less densely settled suburban areas during the last decade. Predictably, the direction of these movements of people was, and continues to be, strongly influenced by major transportation systems. Yet, with the exception of the Route 128 industrial development around Boston, most of the employment opportunities in the region continued to be in the four urban centers.

However, in the last two years the migration from Boston has reversed and the city is once again experiencing a slow but steady increase in population. While these population movements are discussed in more detail in *Chapter 3, Guiding Growth*, it should be clear that it is just as important to be able to determine *where* people will be as it is to know *how many* there will be.

To determine the magnitude of the demand which can be expected to be placed in the region's resources in the next 20 to 50 years, the Study used the Series E projections made by the federal Office of Business Economics (OBE) and the Economic Research Service (ERS). These projections, called "OBERS E", are based on the very low birth rate that the nation is currently experiencing which may ultimately produce a low population growth rate. However, because of the disproportionately large number of young adults in our population, even this low birth rate will not actually result in a leveling off of the population for almost 50 years.

Any projections, including OBERS E, represent only an educated guess based on observed or expected trends. For the long-range, population projections are likely to be more accurate for larger areas, such as the United States as a whole, or multi-state regions, in which variations in the actual growth of smaller areas will tend to offset each other. Thus, the projections for the Southeastern New England region can be used with some confidence, while the figures for the planning areas and in turn for the towns are somewhat less reliable.

On Table 2.1, the 1990 and 2020 OBERS E population projections are shown for Southeastern New England and for each of the ten planning areas. Also shown for comparison purposes are projections made by state and substate regional planners. The differences illustrate the difficulty in population forecasting, particularly in smaller areas, and point out the need for periodic updating based on actual occurrences and changing trends. Nevertheless, it is believed that the OBERS E projections provide a reasonable and useful basis for anticipating demand for water and related land resources and for developing policies to cope with that demand.

TABLE 2.1 COMPARATIVE POPULATIONS (in 1,000's)

		Past		Projected				
		1960	1970	1990			2020	
	PLANNING AREA	U.S. Census		RPA[a]	State[b]	OBERS[c]	State[b]	OBERS[c]
1	Ipswich-North Shore	514	584	778	705	772	796	1,035
2	Boston Metropolitan	2,064	2,115	2,329	2,242	2,303	2,904	2,399
3	South Shore	77	116	235	218	238	213	461
4	Cape Cod & Islands	80	107	120	152	165	125	251
5	Buzzards Bay	163	178	215	183	200	204	271
6	Taunton	341	399	559	484	512	583	703
7	Blackstone & Vicinity	810	824	--	894	886	--	920
8	Pawtuxet	130	154	--	193	228	--	318
9	Narragansett Bay	231	291	--	372	384	--	553
10	Pawcatuck	54	70	--	102	88	--	118
Southeastern New England		4,464	4,838	--	5,545	5,776	--	7,029
	Massachusetts Portion		3,868	--	4,361	4,605	--	5,590
	Rhode Island Portion		949	--	1,147	1,144	--	1,404
	Connecticut Portion		21	--	37	27	--	35

[a] RPA – Projections by Regional Planning Agencies in Mass.

[b] State – Projections by Mass. Office of State Planning & Management and R.I. Statewide Planning Program (& Southeastern Conn. RPA)

[c] OBERS – OBERS SERIES E projections by Office of Business Economics (U.S. Dept. of Commerce) and Economic Research Service (U.S. Dept. of Agriculture)

The Structure of the Economy

While by definition a water and related land resources planning effort, the Southeastern New England Study was established, and its recommendations are presented, in response to the demands placed on the region's resources by continuing economic growth. As discussed in detail throughout the report, the goal of the SENE Study is to accommodate and guide this growth in a manner which enhances the region's economic opportunities and is consistent with its environmental aspirations. What follows, then, is a brief history of the economy of the region, a more detailed discussion of its current structure, and an examination of the remarkable compatibility between the needs and demands of the region's economy and regional and national environmental goals.

An Historical Sketch of the Economic Base of SENE

America's industrial revolution began in mill towns scattered throughout New England. The metropolitan areas of Boston, Providence, and Worcester which constitute the hub of the SENE region were the most important centers of economic activity even in the 19th century. Farming, the principal occupation of the early settlers in SENE, began to give way to shipbuilding and commerce before the end of the 17th century. Newburyport, Salem, Medford, and North River, which served as primary shipbuilding centers, led the nation in the development of mercantile trade. By the mid-18th century, trading with foreign ports had built major commercial centers all along the region's coast. Newport, which was the chief commercial center on Narragansett Bay, also became a summer resort of note during this period.

Availability of water (and consequently water power) had a crucial role in early industrial location decisions. The significance of the role of water in shaping the economic history of the region may be seen in the following examples.

The rivers of the Narragansett Bay drainage basins were harnessed for power production shortly after settlement began. A communal grist mill was operating on the Moshassuck River at Providence as early as 1646. A grant for a sawmill on the Pawtuxet River was issued in 1669, and in 1671 a water wheel was installed at Pawtucket Falls in the Blackstone River in conjunction with a sawmill, carpentry shop, and iron foundry. Iron works became commonplace and, at the outset of the American Revolution, production in Rhode Island exceeded that in any other colony.

The Old Slater Mill, constructed in 1793 in Pawtucket, was the first successful cotton textile mill in America. Soon thereafter, cotton textile plants were set up in the Pawtuxet Valley at Centerville, Coventry, and Warwick; in Fall River, Massachusetts, at the head of Mount Hope Bay; and in the Blackstone Valley at such places as Woonsocket, Rhode Island and Worcester, Massachusetts. Woolen and worsted textile manufacture came into these river basins more slowly but gained considerable importance during the first half of the 19th century. These industries were further stimulated by the introduction of steam power in the latter half of that century. During this period, leather working and shoe manufacturing became important activities in Taunton and Brockton, Massachusetts.

The needs of these rising industries fostered the growth of other industrial concerns producing steam engines and textile machinery and related items throughout these basins. With the opening of the Blackstone Canal from Providence to Worcester, the completion of the railroad access, Worcester, although not on a natural waterway, grew rapidly and became one of the largest and most diversified manufacturing centers in the United States. The introduction of the railroad in 1833 played a definite role in accelerating, as well as integrating, the productive activity of the growing economy. The economic development of the SENE region began to be handicapped during this stage by the shift in primary transportation from water to land. In addition, electric power transmitted over great distances reduced the role of water power and SENE's streams were generally too small to turn hydroelectric turbines. SENE's ports were overshadowed by the ports of New York, Baltimore, and Philadelphia which were larger, provided excellent overland facilities such as rail connection, and offered a faster and more diversified range of auxiliary services to shippers.

With the loss of comparative advantage in water power and port facilities, as well as several other dislocations, SENE began to lose industry, especially textiles, to southern states. The stage for the decline of the textile industry in New England was set well before World War I, but the sharpest decline came at the end of the first half of this century. Between 1950-1970, the SENE region's share of national textile earnings dropped from 14.7 to 6.0 percent.

Despite the economic dislocations in the older mill towns, the overall economy of the region has continued to fare well, keeping pace with, or occasionally falling slightly below national averages.

Current Structure and Projected Changes in the SENE Economy

An appreciation of regional trends can be gained by examining demographic and employment changes among, and within, industry sectors in the region and comparing these changes with those in the nation. These are summarized in Table 2.2, which appears on the following page, and serve as a basis for the discussion of population and economic trends which follows.

Per Capita Income. Per capita income in SENE, a common measure of economic well-being, has consistently been above the national average. As shown in Table 2.2 in constant (non-inflated) 1967 dollars, mean per capita income was $2,226 in 1950 and rose to $3,775 in 1970. Current projections show an increase to $6,600 in 1990 and $13,900 in 2020 – an almost four-fold increase between 1970 and 2020. Combining this increase in per capita income with population projections produces a five-and-a-half fold increase in total personal income – from $24 billion in 1970 to $135 billion in 2020.

The implications are considerable. Even allowing for normal increases as well as inflationary increases in the relative share of the total income used for food, clothing, shelter, and other necessities, the share available as disposable income will increase significantly. As leisure time and income increase, the demands, both direct and indirect, on the region's resources – land, energy, water – can be expected to increase as well.

Employment. From 1950 to 1970 total employment in SENE increased by over 600,000. Total manufacturing employment expanded very slowly during the period with most rapid growth in the manufacturing sector registered by electronic and related machinery, fabricated metals, and ordnance. By far the greatest growth was in the services and financial sectors, increasing 54 and 50 percent respectively; both above the national rate. Within services, professional services, including private education, research and medicine, and business and repair services including consulting firms, programmers and other highly skilled activities were the fastest growers. The growth patterns indicate a clear movement towards an increasingly specialized, service-oriented, highly technical economy.

Industry Mix. With the highly skilled labor force and the region's reputation as a center for technological and scientific development, the trend towards specialization in professional services is expected to continue. With respect to total earnings, data in Table 2.3 and Figure 2.2 show the changing relative significance of industry sectors for BEA Economic Area 4 and the nation. Figure 2.2 shows that, when measured as a percentage of the region's total earnings in 1950, 1970, 1990, and 2020, the manufacturing sector as a whole shows a decline from 38 to 29 to 22 to 17 percent, respectively. Even within the important manufacturing sector, most of the "dirtier" industries such as textiles, paper, and primary metals are expected to drop in relative importance. The fastest growing sector of the SENE economy is services – primarily health, business, education, and the professions. Using the percentage notation employed above for manufacturing, the services sector is expected to grow from 12 to 19 to 26 to 33 percent of total SENE earnings. Agriculture, forestry, and fishing are relatively low in regional earnings, although significant in their value for ensuring an adequate supply, in quantity and price, of some of the region's food and fiber needs. The other economic sectors which make up about half the region's earnings, are expected to maintain their current shares. In order of regional economic importance, they are the retail and wholesale trade which together provide about a quarter of SENE's earnings, and the following four sectors which share about evenly the remaining quarter: government, finance-insurance-real estate, contract construction, and transportation-utilities. All, except the last two, of these sectors can be characterized as generally clean and environmentally compatible activities.

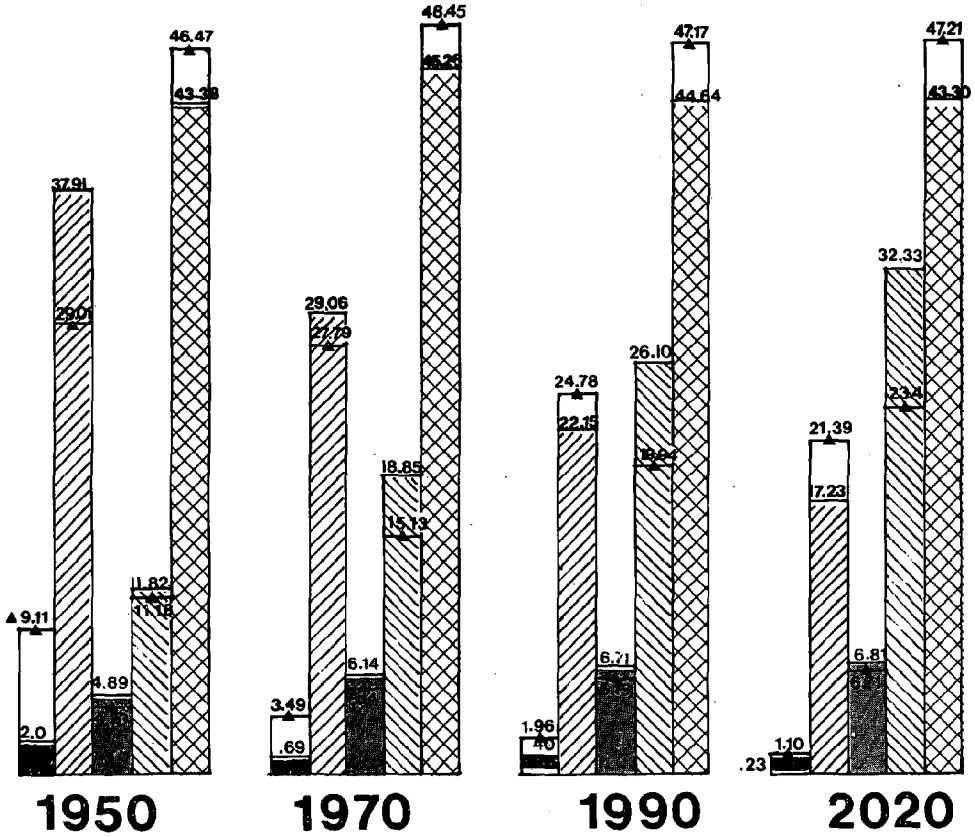
Table 2.4 provides location quotients which reflect regional specialization among selected SENE industries relative to the nation as a whole. The location quotient is determined

TABLE 2.2 POPULATION, PER CAPITA INCOME, EMPLOYMENT, AND EARNINGS: BEA Economic Area 4*; Selected Historical and Projected Years

Indicator	1950	1970	1990	2020
Population, midyear	5,163,100	6,354,600	7,739,800	9,707,900
(Comparative figures for SENE)		(4,836,800)	(5,776,000)	(7,029,800)
Per capita income (1967)	2,226	3,775	6,600	13,900
Per capita income relative (U.S.=1.00)	1.08	1.09	1.08	1.05
Total employment	2,039,058	2,639,691	3,561,700	4,446,900
Employment/population ratio		.42	.46	.46
Employment/population		.39	.43	.44

Source: 1972 Series E OBERS Projection

* Data analyzed for this section are for OBERS (Office of Business Economics and Economic Research Service) Economic Area 4. This area is composed of ten of Massachusetts fourteen counties - Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester; half of New Hampshire's ten counties - Belknap, Carroll, Hillsborough, Merrimack, and Rockingham, and the whole state of Rhode Island. Parts or all of the ten Massachusetts counties, and all of Rhode Island, are included in the SENE Study area. None of the New Hampshire counties are part of the study area. Thus, the OBERS or BEA (Bureau of Economic Analysis) Economic Area 4 does not exactly conform to the study area, but offers an approximate source of statistics useful for purposes of providing perspective.



Agriculture, Forestry & Fishing

Manufacturing

Finance, Insurance & Real Estate

Services

All Others

NOTE: National level figures are denoted by ▲

NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	PERCENTAGE CONTRIBUTION OF SELECTED INDUSTRY SECTORS TO TOTAL EARNINGS: BEA ECONOMIC AREA 4 AND THE U.S.	FIG. NO. 2.2

TABLE 2.3 RELATIVE CONTRIBUTION OF INDUSTRY SECTORS TO TOTAL EARNINGS: BEA Economic Area 4 and the U.S., Selected Historical and Projected Years

Sector	1950	1970	1990	2020
Total Earnings	100	100	100	100
Agriculture, Forestry, & Fishing	2.00 (9.11)*	0.69 (3.49)	0.40 (1.96)	0.23 (1.10)
Mining	0.07 (1.99)	0.05 (1.00)	0.04 (0.62)	0.02 (0.37)
Contract Construction	5.68 (5.97)	6.48 (6.13)	6.24 (6.06)	5.63 (5.53)
Manufacturing	37.91 (29.01)	29.06 (27.79)	22.15 (24.78)	17.23 (21.39)
Transport, Communication, & Public Utilities	6.45 (8.17)	6.26 (7.10)	6.52 (6.90)	6.37 (6.68)
Wholesale & Retail Trade	19.41 (18.94)	17.06 (16.55)	15.54 (15.22)	13.56 (13.65)
Services	11.82 (11.18)	18.85 (15.13)	26.10 (19.94)	32.33 (23.49)
Professional Services	-- --	12.58 (9.28)	19.29 (13.75)	24.60 (17.51)
Government	11.78 (11.39)	15.41 (17.66)	16.29 (18.37)	17.72 (19.97)
Finance, Insurance, & Real Estate	4.89 (4.23)	6.14 (5.14)	6.71 (6.15)	6.91 (6.81)

Source: 1972 Series E OBERS Projection

* Figures in ( ) pertain to the U.S.

TABLE 2.4 LOCATION QUOTIENTS*–FOR SELECTED INDUSTRIES: BEA Economic Area 4, 1950, 1970, 1990, and 2020 (Ranked by 1990)

Selected Industry	1950	1970	1990	2020
Forestry & Fishing	2.41	2.71	2.62	2.57
Miscellaneous Manufacturing	2.35	---	1.65	1.44
Professional Services	1.19	1.36	1.40	1.41
Business & Repair Service	.94	1.3	1.24	1.18
Wholesale & Retail Trade	1.02	1.03	1.02	.99
Utilities	1.00	1.02	.99	.97
Textile Mill Products	4.12	1.71	.97	.63
Electrical Machinery	---	1.19	.96	.82
Apparel & Other Products	1.15	1.12	.81	.61
Paper & Allied Products	1.40	1.05	.75	.62
Food & Kindred Products	.79	69	.69	.70
Transport Equipment	.90	.57	.51	.46
Lumber & Furniture	.59	.56	.44	.38
Chemicals & Allied Products	.55	.46	.46	.44
Primary Metals	.73	.53	.41	.36
Railroad Transport	.47	.31	.32	.31
Nonmetallic Mining	.25	.30	.32	.31
Agriculture	.19	.16	.15	.15

Source: 1972, Series E OBERS Projections

* Location Quotient = Area industry as percent of total area earnings / U.S. industry as percent of total U.S. earnings

by dividing the proportion of earnings stemming from a given industry in a given region by the proportion of national earnings accounted for by this industry. A ratio greater than one means that the industry is proportionately more important in the region than in the nation. This is taken to represent a degree of regional export specialization in that industry, and the larger the ratio, the more export oriented the industry. A change in an industry's location coefficient over time reveals a change in the export specialization in the industry.

A review of Table 2.4 underscores several interesting developments and features of the industrial mix in the SENE economy relative to the rest of the nation. The industries with the largest location quotient in 1950 were forestry and fishing, and textiles. By 1970, the picture was considerably different for textiles. Both textiles and apparel are also the sectors which are projected to greatly decline in specialization between now and 2020. In addition, the region's deficiency in nonrenewable natural resources is emphasized by the extremely low quotient in the mining sector and also in the chemicals sector which, in large measure, depends on the availability of minerals, natural gas and oil, and low-cost energy in the region. On the other hand, the development of greatest significance is the increasing strength of professional services as an export oriented industry. In 1950, its location quotient was 1.19, roughly indicating self-sufficiency. But, by 1970, the quotient had risen to 1.36 and is expected to rise further.

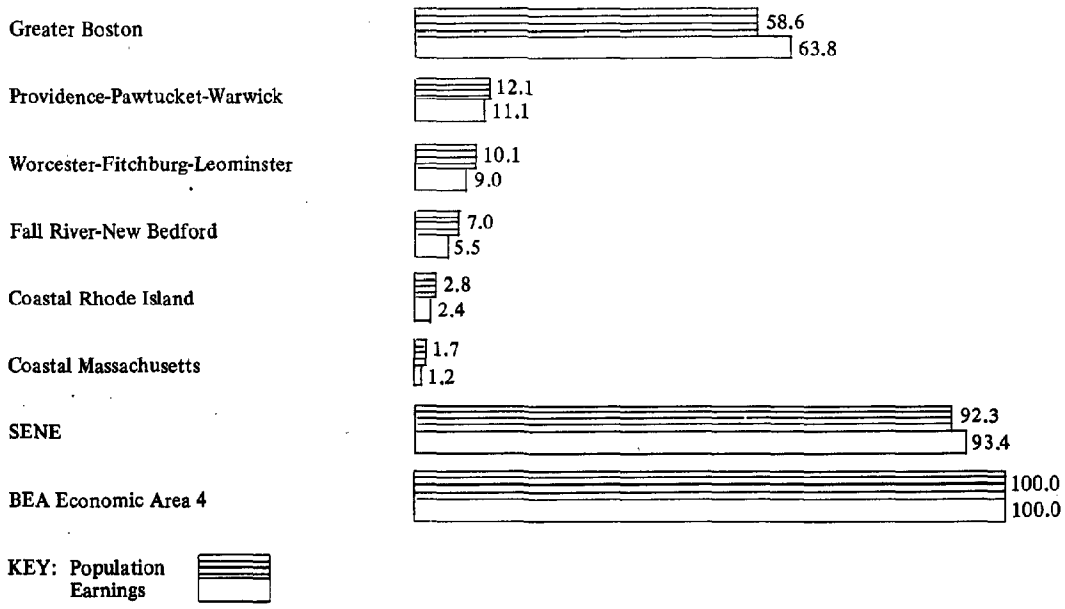
Sub-Regional Differences Within the SENE Economy

While this chapter deals with the SENE economy as a whole, there are marked differences among sub-regions within SENE. For example, coastal portions of Massachusetts and Rhode Island represent small but rapidly growing residential and retirement areas with strong recreation, and until recently, military sectors in their economic structure. In other areas, manufacturing and services play important roles, with greater Boston prominent in this group.

By any measure of population, earnings or per capita income, the greater Boston sub-area dominates the remaining sub-areas of SENE (Figure 2.3). Boston serves as the regional center for government, professional services, finance, insurance, real estate, business, and repair services, wholesale and retail trade, printing-publishing, and technical manufacturing (electrical and computer equipment). No other area in the region enjoys such diversification of economic activity.

Providence-Pawtucket-Warwick, Fall River-New Bedford, and Worcester-Fitchburg-Leominster are important manufacturing areas, although each contains a small amount of services activity. Wholesale and retail trade, finance, insurance, and real estate have recently become more significant in the Providence sub-area.

FIGURE 2.3 POPULATION AND EARNINGS OF SUBAREAS AS PERCENT OF BEA ECONOMIC AREA 4, 1969



Variations in per capita income within SENE are shown in Table 2.5. The higher than average income found in the greater Boston and Providence-Pawtucket-Warwick sub-areas is characteristic of larger metropolitan areas. During the period 1950-1969, greater Boston's per capita income increased from eleven percent to sixteen percent above the national average. This is explained by employment of a larger proportion of population than the U. S. average, higher per capita property incomes than the U. S., slightly higher occupational skill of labor force, and an increasingly favorable industry mix.

On the other hand, the decline in per capita income in Providence from eleven percent to three percent above the national average during the same period, is indicative of the fact that Rhode Island's labor force is not as well-educated or well-trained in high demand skills as the labor force for the region as a whole. Further, that area is in a transition in its industrial mix, moving from an economy based on textiles and military installations to one where durable goods manufacturing and services play more important roles. However, Rhode Islanders are now being trained and educated in the high demand skills. In the meantime, Rhode Island must seek ways of slowing the exodus of its already higher skilled population.

The condition found in the Worcester-Fitchburg-Leominster sub-area and the Fall River-New Bedford sub-area where per capita income declined from above the national average in 1950 to below the national average in 1969 suggests local, but substantial, continuing economic distress. These subregional differences in per capita income reflect a certain amount of non-integration of the economic activity within the region, following the departure of textiles into the 1950's.

In summary, an analysis of the current and projected structure of the SENE economy yields three major conclusions:

(1) Earnings and employment in manufacturing have become relatively, but not absolutely, less important when compared with other sectors. The direction of this structural change is much stronger in SENE than in the nation as a whole. But this is not to say that manufacturing will not continue to be an important employment sector.

(2) Within the manufacturing group, employment in non-durable industries has decreased markedly while employment and earnings in durable goods industries, particularly machinery production, has increased sharply.

(3) Several sectors, such as financial, civilian, government, and services, have expanded at a rapid rate. However, the most substantial increases have occurred in the professional services and business and repair service industries.

TABLE 2.5 PER CAPITA INCOME: SOUTHEASTERN NEW ENGLAND STUDY AREAS; 1967 Dollars and as a Percent of National Average, 1950 - 2020

	Per Capita Income 1967 Dollars			
Study Area	1950	1969	1990	2020
Greater Boston	2,283 * (1.11)	3,965 (1.16)	6,809 (1.10)	14,870 (1.04)
Providence-Pawtucket-Warwick	2,291 (1.11)	3,515 (1.03)	6,281 (1.02)	14,518 (1.02)
Worcester-Fitchburg-Leominster	2,245 (1.09)	3,352 (.98)	6,122 (.99)	14,128 (.99)
Fall River-New Bedford	2,113 (1.02)	3,220 (.94)	5,805 (.94)	13,238 (.93)
Coastal Rhode Island	1,944 (.94)	3,127 (.92)	5,710 (.93)	13,308 (.93)
Coastal Massachusetts	1,949 (.94)	2,781 (.81)	5,181 (.84)	12,407 (.87)
SENE	2,255 (1.09)	3,736 (1.09)	6,530 (1.06)	14,530 (1.02)
BEA Economic Area 4	2,226 (1.08)	3,696 (1.08)	6,600 (1.05)	13,900 (1.02)

Source: U.S. Department of Commerce, Bureau of Economic Analysis

* Figures in ( ) show percent of national average

In short, there is a clear trend away from low skill and non-durable industries and towards high skill, high education, and high technology activities. The region is expected to continue to show a strong orientation in these directions.

As a result of these trends, a fairly clear picture of the region's development atmosphere emerges. There are both positive and negative features. The positive features are:

(a) a mature and highly urbanized economy;
(b) clearly established metropolitan centers of growth;
(c) a relatively highly educated and well trained labor force;
(d) a national reputation as a center of technological and scientific development;
(e) a comparatively good location for import of industrial raw materials; and
(f) an aesthetically pleasing environment within a short distance of the metropolitan areas.

On the other hand the area has certain negative economic features. They include:

(a) declining traditional industries creating temporary labor and capital dislocation;
(b) a higher cost of living than the national average;
(c) a higher than national average rate of property and state taxes;
(d) higher unemployment than the national average;
(e) higher energy costs than the national average;
(f) with the exception of sand and gravel and stone, a lack of economically extractable minerals; and
(g) poor access with respect to national markets.

Implications

In the light of the region's major economic trends and the resulting development atmosphere, what are the implications for future economic development and the demands placed on the resource base?

Relatively Lower Growth in Direct Demand for Natural Resources. The changes in the industrial composition of the region imply that the economic activity related to the production of marketable goods and services will place a relatively lower demand on the region's water and related land resources in the form of direct requirements. This implies that the chances for meeting national environmental goals for cleaner water and air may be somewhat more favorable than one might expect for SENE. This situation tends to underscore at least in one area, the non-conflicting nature of the relationship between the objectives of economic growth, and preservation and management of the environment in SENE.

Moreover, the strong trend towards specialization in professional services and other high-skill industries implies that the economic health of the region is dependent upon its ability to attract creative people and industries which, in turn, is partially a function of the quality of the natural environment. This implies that the *natural resources of the region will gain importance as "consumer" goods as opposed to "producer" goods in the conventional sense.*

Opportunity for Decentralization of Economic Activity. The service sectors are currently concentrated in metropolitan areas (particularly around Boston), yet an opportunity exists for their decentralization without loss in economic efficiency. This is especially true for finance, insurance, and consulting firms. The point may be clarified through the use of the concept of a "foot-loose" industry.

An industry is "foot-loose" if not constrained by the necessity of *close* proximity to its input and output markets. In other words, procurement or distribution costs are not overriding locational factors and, thus, the industry is relatively free to locate anywhere good personnel, transportation, and communication conditions exist.

The nature and requirements of these relatively "foot-loose" industries afford a good opportunity for public policy to influence the development of an overall locational pattern. That is, this kind of industry has the potential for being amenable to public locational controls, and thus offers planners and policy-makers an opportunity to guide growth and enhance the natural landscape without adversely affecting overall economic efficiency.

Therefore, with policy direction, the Worcester-Fitchburg-Leominster, Fall River-New Bedford, and Providence-Pawtucket-Warwick sub-areas may be able to gain a larger share of future economic activity than might otherwise be the case. This may lead to lower and more manageable rates of increase in pressures on land use, and costs of construction in other metropolitan areas.

Continuing Need to Upgrade Region's Labor Force. The trend towards continued growth of professional services also points to a continuing need for programs to upgrade the professional ability of the region's labor force. This, in turn, implies that more and more funds may have to be devoted to expand and improve educational, research, and training facilities. Policy decisions will be needed however to determine where, both geographically and economically, such investments will yield the greatest returns. Rhode Island, for example, is already beginning to train its residents in higher demand skills.

Changed Nature of Economic Fluctuations. A heavy reliance on activities such as education, research, ordnance, and electrical machinery, has led to the expression of some concern that the workers in these industries are

more directly exposed to the vagaries of the public budget processes than workers in other industrial sectors. In any period of fiscal austerity, the problem of unemployment in these industries can be severe, though temporary. However, the long-term economic and social implications of such fluctuations are expected to be much less severe than would be the case if the economy continued to rely heavily on the production of non-durable consumer goods. Moreover, to the extent that the threat of severe economic fluctuation is reduced, a community's willingness to address itself to environmental quality issues will be more likely to increase.

Conflicts between Economic and Environmental Objectives

Unfortunately, the situation may not be as simple as the foregoing discussion indicates. Conflicting demands on water and related land resources exist and must be considered.

As discussed in *Chapter 9* of this report, there are increasing pressures for the location of one or more refineries in the SENE region. The petroleum refining industry is known to be a major water user and discharger of pollutants. Moreover, the region's power generating capacity will have to be expanded, even with strict consumption rate reduction measures. Thus, without strong siting and operating guidance, the water and land requirements of power plants and refineries have the potential to be in conflict with environmental quality objectives.

In addition, the future consumption of land for urban purposes will be an important factor. During the 1960's, about 182,000 acres were developed for residences, businesses, industries, institutions, and transportation facilities while the region was growing by almost 375,000 people. This amounted to a rate of urbanization of about one-half acre per capita during that 10-year period – four times higher than the average rate of land consumption since the Pilgrims landed in 1620.

If this recent rate of urbanization should continue, the projected increase in population in Southeastern New England of 939,000 people between 1970 and 1990 would consume another 470,000 acres, almost equal to the present area devoted to urban uses. Even if the projected population growth occurs, however, the rate of land consumption need not be as high. Both the need and the opportunity for strong environmental management are indisputable.

The likelihood of a significant per capita increase in demand for outdoor recreational facilities from the SENE residents has already been pointed out. Additionally, the region's recreational resources are also going to be pressured by outsiders, 50 million of whom are within an easy one day drive of SENE. The economy of the region benefits from recreational activities through the generation of seasonal and full time employment, tax revenues, and the ready availability of recreational opportunity for the work force. On the other hand, exploitative and unabashed use of the resources for recreational activities will conflict with the objective of restoring and maintaining the quality of the environment. The issue is not merely one of quantity of natural resources to be devoted to recreational uses, but also of maintaining (or even improving) the quality of the recreational experience and the physical environment of the region.

The issue is further complicated by the fact that over 85 percent of the total recreational shoreline in SENE is privately owned and a vast proportion of this land is not accessible for public recreation. This situation is not likely to improve if private market forces are allowed to continue to dominate the allocation of the use of coastal lands.

Conclusion from an Economic-Resources Perspective

It should be apparent from the above discussion that, while the conflict between conventional economic and environmental use of the region's resources has, to some extent, been alleviated by the transition towards a service economy, it has not been resolved completely. While some may construe from the preceding remarks that manufacturing has been completely excluded from further consideration, this is not the case. Manufacturing enterprises which recognize the value of the environmental character of SENE as an important locational determinant, and implement sound natural resources management policies, obviously could provide a balanced mix with the strong service sector and improve the economic position of SENE. Without this mixture which includes light industry, for example, it will be difficult for the service sector to provide employment to keep pace with ordinary growth of numbers of low skilled workers.

The region's physical character is one of its major assets with direct and indirect potential for economic development. The region may be unique in the nation in that regard. Direct resource related industries such as tourism, recreation, forestry, and aquaculture have strong growth potential. Indirectly, the quality of the environment is a potent factor in the region's ability to attract and retain the highly skilled, highly selective, and amenity-oriented labor force, and the growth industries which employ them. Having lost its initial competitive advantage in manufacturing, the future economic health of the region depends in large part in maintaining the competitive advantage it now enjoys in services and "foot loose" industries. To maintain that advantage the region must maintain its natural landscape, the main attraction. To improve its competitive advantage, the region must improve its natural landscape. Growth achieved by the misuse of the quality of the region's water and related land resources will have adverse effects on its long term economic stability. The contribution that the remaining natural resources in the SENE region can make to the economy is significant. *The recog-*

nition of the mutual importance of economic growth and environmental quality in the SENE area is a key to enlightened natural resource policy-making and is the fundamental theme of this Study.

Resource Management Institutions

In order to further understand the dynamics of the region, it is important to have a sense of the actors and institutions which make natural resources decisions in SENE. This section will briefly describe the governmental responsibilities in the region. More detailed discussion is found in *Chapter 10.*

Federal

A large number of federal agencies are involved in resource planning, regulation, technical and financial assistance, and policy development. Areas of resource management include water, land, air, and wildlife. Because of the number of agencies involved in these activities, a discussion of all of the specific federal programs would be impractical at this point in the report. However, the agencies involved in carrying out functional recommendations are discussed in the chapters which follow in this report.

Interstate and Regional

The most prominant interstate bodies in the SENE area include the New England Regional Commission and the New England River Basins Commission. The former, established under Title V of the Public Works and Economic Development Act of 1965, is responsible for strengthening regional economic development. The latter, established under Title II of the Water Resources Planning Act of 1965, serves as the principal agency at the regional level for coordination among the major federal-state natural resource decision-making programs, and is charged with the preparation of a comprehensive, coordinated, joint plan for management of water and related land resources of the region. This is carried out by the Commission through its studies of regional problems and needs as inputs to state decision-making processes, and through its comprehensive, multipurpose management programs such as the Southeastern New England Study, the Long Island Sound Study, and the Connecticut River Basin Program.

The New England Governors' Conference, which is composed of the six New England governors, also exists to coordinate state activities with regard to natural resources. A Federal Regional Council has also been established for the New England region. This council is to improve the administration of federal grant programs in the region by improving program operations, developing funding programs in cooperation with state and local officials, and encouraging joint and integrated grant applications. Finally, other special-purpose organizations, such as the New England Interstate Water Pollution Control Commission, exist to coordinate specific functional activities in the region.

State

The role of the states of Massachusetts, Rhode Island, and Connecticut in resource management decisions in the region is a potentially strong one. Federal committment to this policy is evidenced by the role the states play as a result of such key legislation as the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA, 1972), and the Coastal Zone Management Act. An example from the FWPCAA of 1972 characterizes the state role:

> "It is the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of states to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources. . . ." (Section 101).

State level agencies are currently involved in program administration, provision of funding, and technical assistance, and regulatory activities in resource management. Because of the primary role the states will be playing in natural resource management, it is worth reviewing the current responsibilities of the existing institutional framework for the two states which comprise the largest portion of the SENE area.

Massachusetts. In Massachusetts, policy development for the state's physical resources is currently the responsibility of the Cabinet, replacing what was formerly the responsibility of Resource Management Policy Council (RMPC). This Council was designed to aid program coordination among state air quality, water quality, coastal zone, land use, and rural development programs.

The RMPC's Coastal Zone Task Force, under the direction of the Secretary of Environmental Affairs, prepared the state's application for federal funding under the Coastal Zone Management program. Funds have now been awarded to the Office of Environmental Affairs for planning and program development. The RMPC Task Force on Land Use, under the leadership of the Department of Community Affairs, developed alternative comprehensive land use strategies for the state as a whole, including some of the features of the recently enacted Martha's Vineyard law which provides for regional review of development and areas of critical concern.

Under the state government reorganization, the Executive Office of Environmental Affairs has been authorized to plan

and carry out the state's environmental policies, and has combined the functions of the Department of Natural Resources, the air quality programs of the Department of Public Health, the solid waste functions of the Department of Public Works, the Department of Agriculture, and the Metropolitan District Commission (MDC) into five major departments: Environmental Quality Engineering, Environmental Management, Food and Agriculture, Fisheries, Wildlife and Recreational Vehicles, and the MDC. The state has also recently created an Energy Facilities Siting Council authorized to review long-range plans and proposed site locations for electrical power generation and natural gas refinement.

Water management programs are currently the responsibility of the Water Resources Commission and administered in that Commission by the Division of Water Pollution Control and the Division of Water Resources.

Rhode Island. In Rhode Island, the State Planning Council composed of state, local, and federal representatives, provides overall resource policy direction insofar as it reviews and adopts elements of the State Guide Plan. The State Guide Plan outlines policies for land use, water and sewer service, water quality, transportation, recreation, economic development, and historic preservation. The plan is prepared by the Statewide Planning Program, the central planning agency for the state government and the clearinghouse for federal grant administration. The Department of Natural Resources administers many programs related to parks and recreation areas, forests, fish and wildlife, agriculture, land acquisition, freshwater wetlands, shoreline and tidewaters. Close coordination between the activities of the Department of Natural Resources and the Coastal Resources Management Council (CRMC) is maintained since the department, through its Division of Coastal Resources, provides staff to the CRMC.

The CRMC is responsible for planning and management of coastal resources, and administers programs in the coastal area such as those for wetlands. It also regulates selected uses and activities in that area, such as power plants, sewer treatment plants and solid waste plants, so as to assure consistency of uses with standards and plans for protection of coastal resources. The CRMC is also involved in the state's coastal zone management program under the Coastal Zone Management Act.

Water quality, air quality, and solid waste disposal are regulated by the state's Department of Health. The Department of Community Affairs provides technical planning assistance and administers federal grants to local governments. The Solid Waste Management Corporation is responsible for planning and rearrangement of the solid waste resource recovery system.

Long-range water resources planning is conducted by the Water Resources Board, which also approves water supply distribution systems. With the approval of the Governor, this Board is authorized to acquire dams and construct or purchase reservoirs. Finally, the Economic Development Corporation, designed to stimulate industrial and economic growth in the state, is authorized to construct and develop utility facilities and port projects.

Local

As is typical of the rest of New England, the SENE region is characterized by a tradition of strong local involvement in resource decision-making. Local governments make many of the most critical water and related land management decisions. Local governments regulate the many land uses (including flood plains) through the administration of zoning ordinances, bylaws, subdivision controls, and permit systems for a variety of developments and land-disturbing activities. The existence of local conservation commissions gives a focal point to local environmental interests, and by law in Massachusetts, they are charged with responsibility for administering the wetlands protection program and also have a role in open space acquisition. With one or two notable exceptions, water supply is also a local matter, usually limited to supply development on a town-by-town basis by municipal agencies and private water companies in conformance with state standards to ensure protection of public health and water quality. Though, in Rhode Island, more than half the communities are served by regional systems, four are only served by local systems, and four are served by both. Special interest organizations, such as the various watershed associations and citizen groups, proliferate at the local level and have played a vital role in influencing decision making. Because the communities ratify actions proposed by their selectmen at town and city council meetings, the cities and towns can bring significant pressure to bear on resource management in Southeastern New England. In light of this political and social reality, special emphasis on local issues and control must be given to the design of any water and related land management program for SENE. The SENE region contains more than two hundred municipal bodies which makes the securing of local consensus on resource management an extraordinarily difficult task.

Although county government does exist in the SENE region, it is largely an anachronism. Substate regional institutions are not altogether lacking, however. In the SENE portion of Massachusetts there are eight regional planning agencies whose responsibilities include, in addition to reconciling various local plans within their jurisdiction, a role in reviewing local grant applications as part of their designation as A-95 clearinghouse agencies. In Rhode Island, the Statewide Planning Program provides these functions over the entire

state. A number of special purpose organizations, such as watershed districts and sewer districts also exist in both states. In the Boston metropolitan area, water supply, wastewater management, and other municipal services are performed by the Metropolitan District Commission. Although it is a creature of state government, MDC services and supplies only the Boston metropolitan region.

Current Public Perceptions

More often than not, the perceptions of the planner and the general public on priority natural resource problems differ. The planner in metropolitan Boston is worried about the area's critical water shortage. The citizen whose faucet continues to yield water is not. The citizen is angry that he cannot swim in local streams and rivers. The planner knows that water quality improvements are proceeding well. For a plan to work, it must recognize and address these differences in perception.

Southeastern New England's people are unusually well acquainted with environmental issues. Organizations such as the Audubon Society and Ecology Action for Rhode Island are examples of active organizations. In Massachusetts especially, the town conservation commissions keep environmental concern near the forefront of public discussion. As a result a proportionately larger segment of the general public in SENE can be considered citizen environmental activists than in the nation as a whole.

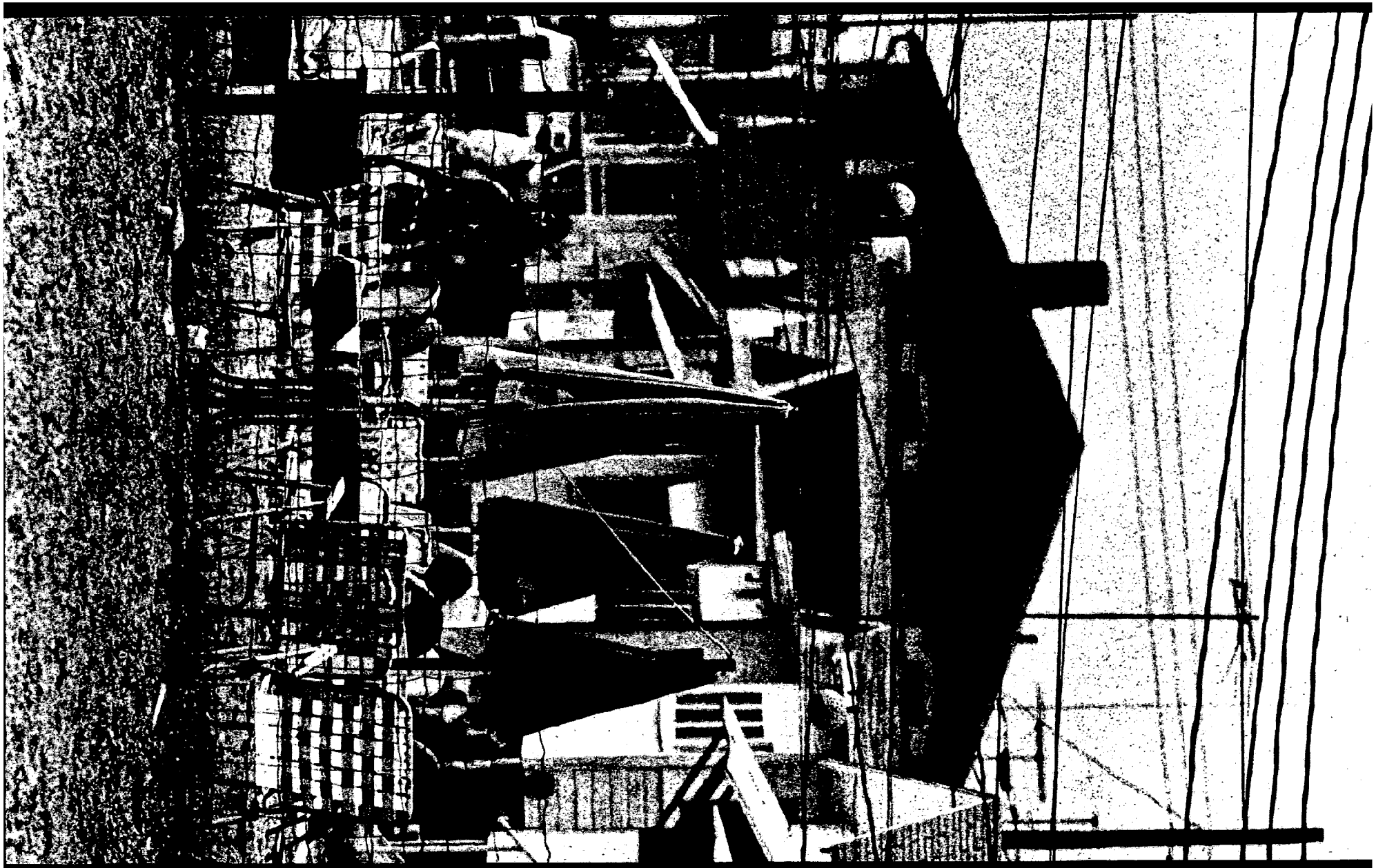
To understand their perceptions of the key resource issues and determine their preferences among the many alternative solutions to these problems, the SENE Study created a regional Citizens Advisory Committee and ten individual river Basin Advisory Committees, and held meetings throughout the Study region at each critical step in the planning effort. It was not always easy for planners and citizens to reach consensus. On occasion interest flagged and attendance at meetings dropped. But on the whole, both planners and citizens benefited, and to a great extent the Study's recommendations reflect the key concerns and preferred solutions of those many citizens who chose to take advantage of the opportunity to participate.

While variations in emphasis exist from one sub-area of the Study region to the next, there was surprising unanimity among those citizens who attended SENE's many workshops and public meetings. Sprawl and the related effects of uncontrolled growth is their major concern. Within the limits of reasonable economic opportunities, most people prefer some method of directing future growth in such a manner as to preserve some sense of open space and the natural beauty which drew them to, or kept them in, the region in the first place. In most areas of the Study region, participants agree about the value of enhancing recreation opportunities for the tourism value but worry more about the general disappearance of natural areas. They are uniformly concerned about the slow pace of water quality improvements and unwilling to make commitments, whether financial or otherwise, to actions which depend on clean streams and rivers. Finally, the citizens who participated, probably more so than the general public are less concerned about the future availability of water supplies than they are about the effect water supply development can have on patterns of growth.

While the several major issues as described above, surfaced at most public meetings, SENE is unique in that its public is primarily concerned with its perceptions of local issues. Active watershed associations, and other citizen groups identify with their own concerns: growth and its effect on water supply and wastewater management on Cape Cod; water supply in the Ipswich-North Shore and Greater Boston area; and management of regional beach opportunities in the Pawcatuck Planning area in Rhode Island are a few examples. The perceptions of the public based on understanding of its locale are as fundamental to resource planning in New England as the recognition that local government is a major decision force.

This chapter has described the setting of the Study area in terms of its geography and its people. The changes toward a service based economy in SENE may alter some preconceived notions about the potential for a continuing and increasing threat of serious pollution problems. The steady shift in the industrial composition of the region to one which places a lower direct demand on the region's water is encouraging. The past decade has been characterized by a significant environmental awareness. The next decade, given the current state of economy, may see a shift in the other direction. As shown in this chapter, the complementarity does exist between economic growth and the maintenance of a quality environment.

The Study was guided by these concerns and its recommended resource management program, to a very great degree, responds directly to them. Ultimately, if the recommendations are to be implemented, they must be responsive.



Guiding Growth

3

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CHAPTER 3 GUIDING GROWTH

The Setting

The growth of a region and the quality and quantity of its water and related land resources are closely interrelated. The link may be somewhat less direct than it was when most of the people in Southeastern New England farmed or fished for their livelihood, but it is there nevertheless. New development creates demand for water – for drinking, for waste disposal, for recreation, and many other purposes. New development consumes land and often encroaches on such water related lands as flood plains, wetlands, and lands overlying ground water. The degree to which water demand and land consumption becomes a problem depends not simply on the amount of development, but also on its type, density, and location. When water demand and land consumption do become problems, the effects of growth become inhibitors of future growth, and the quality of life suffers.

Decision-making which affects the character of growth is multi-faceted. Decisions by *private* landowners, developers, businesses, and others have the prime impact on land use, determining the exact location, type, and timing of development according to their needs. *Local governments* have the primary responsibility for governmental regulation through zoning, subdivision controls, building codes, and other regulations; local investments in streets, sewers, and water facilities also strongly influence development patterns.

Substate regional planning agencies, like those in Massachusetts, presently are responsible for planning on a multi-town basis but have no power to execute the plans. Their role is increasing and may include greater authority to represent the concerns of their constituents in state program decisions. Other *substate* agencies, such as transportation authorities, regional water and sewer authorities, and counties, influence development through public investments; some specially formed institutions such as that on Martha's Vineyard have broad land use regulatory authority.

State government plans and regulates to varying degrees; Rhode Island has adopted a land use policy and plan, and regulates only with respect to certain resources such as those in the coastal zone and wetlands. Massachusetts has enacted comprehensive regulation on Martha's Vineyard in addition to regulations for power plant siting and wetlands preservation, but has not formulated a land use policy or plan. Comments during review of this Study showed strong public sentiment that such policies are badly needed. Currently the Commonwealth is working on such a framework. States also influence development through other regulatory programs, investment decisions, acquisitions, and fiscal policies.

Federal governmental agencies, such as the Environmental Protection Agency through its air and water quality programs and funding of interceptor sewers, influence the location of development. The Corps of Engineers also plays a role in protecting water related resources through recent regulations of discharge of dredged or fill material in navigable waters or ocean waters pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972. The new regulations extend federal jurisdictions, regulations, and permitting authority to virtually all wetlands, swamps, rivers, lakes, and streams of the United States. While this Study directs its attention to water related factors, present or proposed land use patterns and their attendant activities have a major impact upon the type and amount of air pollution generated over a region. The federal government is also deeply involved in land use and growth decisions in connection with its management of federal holdings in the region such as wildlife refuges and the National Seashore. These examples underscore the need for effective coordination among all responsible agencies with respect to guiding growth.

This brief summary has shown the multi-faceted nature of decision making which affects growth. Proposed national land use legislation would put the states in firmer control through state review or guidance of significant local actions.

This chapter concentrates on setting forth basic principles upon which an overall strategy for natural resources management can be built. It draws on *Chapter 1, Goals and Approach*, and *Chapter 2, The Setting*, which provide a framework and an order to deal with water and related lands from an integrated, resource perspective. Many cross-references to other portions of this report are made, emphasizing the strong interrelationships which exist with functions covered in other chapters. The material presented in this chapter is fundamental to virtually every other chapter in this report. This is demonstrated in *Chapter 11, Tying the Recommendations Together.* There, the interrelationships of all Study recommendations are set forth on tables in summary fashion.

The principles and rationale set forth in *Chapter 3, Guiding Growth,* provide a sound basis for guiding growth not only in Southeastern New England, but in other regions in the nation as well. The institutional structures necessary to implement these recommendations will vary according

to location; they are treated in *Chapter 10, Strengthening the Management System for Natural Resources,* near the conclusion of the Regional Report.

The objective of *Chapter 3, Guiding Growth,* is to suggest strategies for protecting the critical water and related land resources of Southeastern New England while accommodating future economic activities; and to suggest ways that growth might be guided to preserve the amenities of the region and the quality of its resources. The chapter first investigates recent growth trends in Southeastern New England and examines the effect that growth has had on the region's resources. Second, alternative ways of protecting critical environmental areas and guiding growth to areas suitable for development are examined. Finally, several recommendations are made to provide for the expected growth of the region in a manner which is sensitive to the development capabilities of the region's water and related lands and to the contribution they make to the quality of life in Southeastern New England.

This chapter does not present a comprehensive land use plan for Southeastern New England because major growth concerns, such as housing, transportation, education, and economic development, which should be part of such a plan, were considered only to the extent of their interrelationships with water resources. However, the detailed analysis of the several steps recommended to control the use of water and related land resources while accommodating needed growth, constitute a basic first step in the development of a regional growth policy and comprehensive land use plan. The decision to stress water resources in this Study does not infer a diminished role to other planning factors, but, rather, is the result of the scope of the New England River Basins Commission's authority.

The Situation

General Growth Trends

Land Use Changes. Table 3.1 shows that between 1960 and 1970 lands used for urban development (1,000 people per square mile) increased by almost 50 percent, primarily at the expense of agricultural and forest lands. In 1970, of SENE's 2,865,000 acres, 5 percent was in water, about 56 percent was covered by forest (a 5 percent reduction from

TABLE 3.1 LAND USE CHANGES IN SENE, 1960 to 1970

Category	Acres (in 1000's) 1960	Acres (in 1000's) 1970	% Total Area 1960	% Total Area 1970	% Change By Category
Water Area	133	144	4.6	5.0	+ 8.3
Land Area	2,732	2,721	95.4	95.0	- 0.4
Fprest*	1,693	1,601	59.1	55.9	- 5.4
Open	(160)	(161)	(5.6)	(5.6)	(+ 0.6)
Salt Wetlands *	51	44	1.8	1.5	-13.7
Freshwater Wetlands*	71	67	2.5	2.4	- 5.6
Other incl. Recreation	38	50	1.3	1.7	+31.6
Agriculture	(459)	(350)	(16.0)	(12.2)	(-23.7)
Agriculture	287	205	10.0	7.2	-28.6
Open Transitional	172	145	6.0	5.0	-15.7
Urban	(420)	(609)	(14.7)	(21.3)	(+45.0)
Low Intensity	22	37	0.8	1.3	+68.2
Medium Intensity	71	98	2.5	3.4	+38.0
High Intensity	261	382	9.1	13.4	+46.4
Transportation	30	42	1.0	1.5	+40.0
Industry	19	26	0.7	0.9	+36.8
Extractive & Disposal	17	24	0.6	0.8	+41.2
Total Area	2,865	2,865	100%	100%	0%

Source: See Methodology

* Forest figures include forested freshwater wetlands which totaled 224,000 acres in 1970.

1960), about 6 percent was open space (an increase of 0.6 percent, but the category includes a 9 percent decrease in wetlands), about 12 percent was in agriculture (a decrease of 24 percent), and the remaining 21 percent was urban. Similar disaggregations are shown in Table 3.2 for each planning area. These figures emphasize, as noted in *Chapter 2, The Setting,* the conflict between the simultaneous demands of a growing population for land for development and for preservation of the natural areas that make for a pleasant living environment.

Why has the use of land changed and why will it continue to change? The reasons are found by examining a number of important trends.

Population Growth. Between 1960 and 1970, SENE's population grew from 4,460,000 to 4,838,000, an 8.5 percent increase. As might be expected, however, this growth was not evenly distributed. Of the major urban centers, the area encompassing Boston and its southern suburbs grew the fastest with a 15 percent increase. The Providence metropolitan area followed with an 11 percent rise. Fully 81 percent of SENE's population now lives in urban areas. Some of the less densely populated parts of the region, however, experienced much higher rates of growth. Barnstable County registered a 38 percent increase.

Land Consumption. Since 1946, new residential development has consumed land at an increasingly rapid rate. Between 1960 and 1970, land in SENE was consumed at the rate of one-half acre for every new addition to the population, compared to an historical average rate of only one-eighth of an acre per person.

Populations for SENE and its ten planning areas for 1990 and 2020 were shown in *Chapter 2* on Table 2.1. The 0.8 percent annual rate of population growth during the 1960's is expected to continue through 2020. If projected populations are accommodated in the SENE region at densities similar to those experienced in the 1960's, about 37 percent of the region will be urbanized by 1990, and about 50 percent by 2020.

Sewering and Water Supply. Of the region's 1970 population of 4.8 million, 70 percent lived in dwellings which were connected to public sewers. As shown in Table 3.3 sewer service varied from a high of 87 percent of the population in the Boston Metropolitan area to only 12 percent on Cape Cod and the Islands. The remaining population was dependent on individual on-lot systems (cesspools or septic tanks) for disposal of wastewater. It is estimated that more than half of these individual disposal systems will have to be replaced by sewer connections because the lots are too small to assure continued protection of surface and ground water.

In 1970, 95 percent of SENE's 4.8 million people were served by municipal water supply systems; the remainder relied on individual wells for their water. Municipal water supply systems served a high of over 99 percent of the South Shore planning area population and a low of 61 percent of the Pawcatuck planning area population.

TABLE 3.2 LAND USE IN SENE PLANNING AREAS IN 1970

	Acres	Percent (%) of Planning Area				
Planning Area	(in 1000's)	Water	Forest*	Open	Agriculture	Urban
Ipswich-North Shore	274	6	47	11	10	26
Boston Metropolitan	421	3	42	5	9	41
South Shore	172	5	61	7	8	19
Cape Cod & Islands	378	9	57	8	11	15
Buzzards Bay	205	6	57	6	17	14
Taunton	351	5	60	4	13	18
Blackstone & Vicinity	410	3	59	3	13	22
Pawtuxet	180	4	73	2	9	12
Narragansett Bay	212	5	41	5	24	25
Pawcatuck	262	4	72	4	12	8
SENE	2,865	5.0%	55.9%	5.6%	12.2%	21.3%

Source: See Methodology

*Figures for forest include forested freshwater wetlands

Employment. The core cities and the metropolitan areas are still the employment centers, but their share of the region's employment is decreasing. The urban and urbanizing centers of Boston, Narragansett Bay, Buzzards Bay, Cape Cod, and Worcester, still account for almost 80 percent of the growth in employment in the region. The fastest growing area was Cape Cod where employment grew 13 percent faster than population during the 1960's.

Development Pressure. The direction of future urban expansion – development pressure – is influenced by the location of existing residential development, and economic and cultural activities, the relative cost and length of travel time between residences and jobs, and the amount and location of land available for development at any given time. Seven indices can be used to estimate the potential development pressures that may affect each community: (1) absolute and (2) relative population change 1960-1970; (3) absolute and (4) relative employment change 1960-1970; (5) relative accessibility by automobile to population and (6) to employment in all other municipalities in the region; and (7) the acreage of developable land having moderate to no septic tank limitations.

Figure 3.1 was developed by applying these indices to each town in SENE. The figure gives an indication of the probable levels of development pressure over the next 20 years. Note that the pressures are generally high in the towns peripheral to the major cities. Figure 3.2 is a generalized picture of towns with population density exceeding 1000 people per square mile in 1970, with projections through 1990 and 2020. This density was selected because it is equivalent to one acre residential lots covering half of the area of a town, with the remaining half devoted to commercial, industrial, institutional, and transportation uses or to undeveloped land.

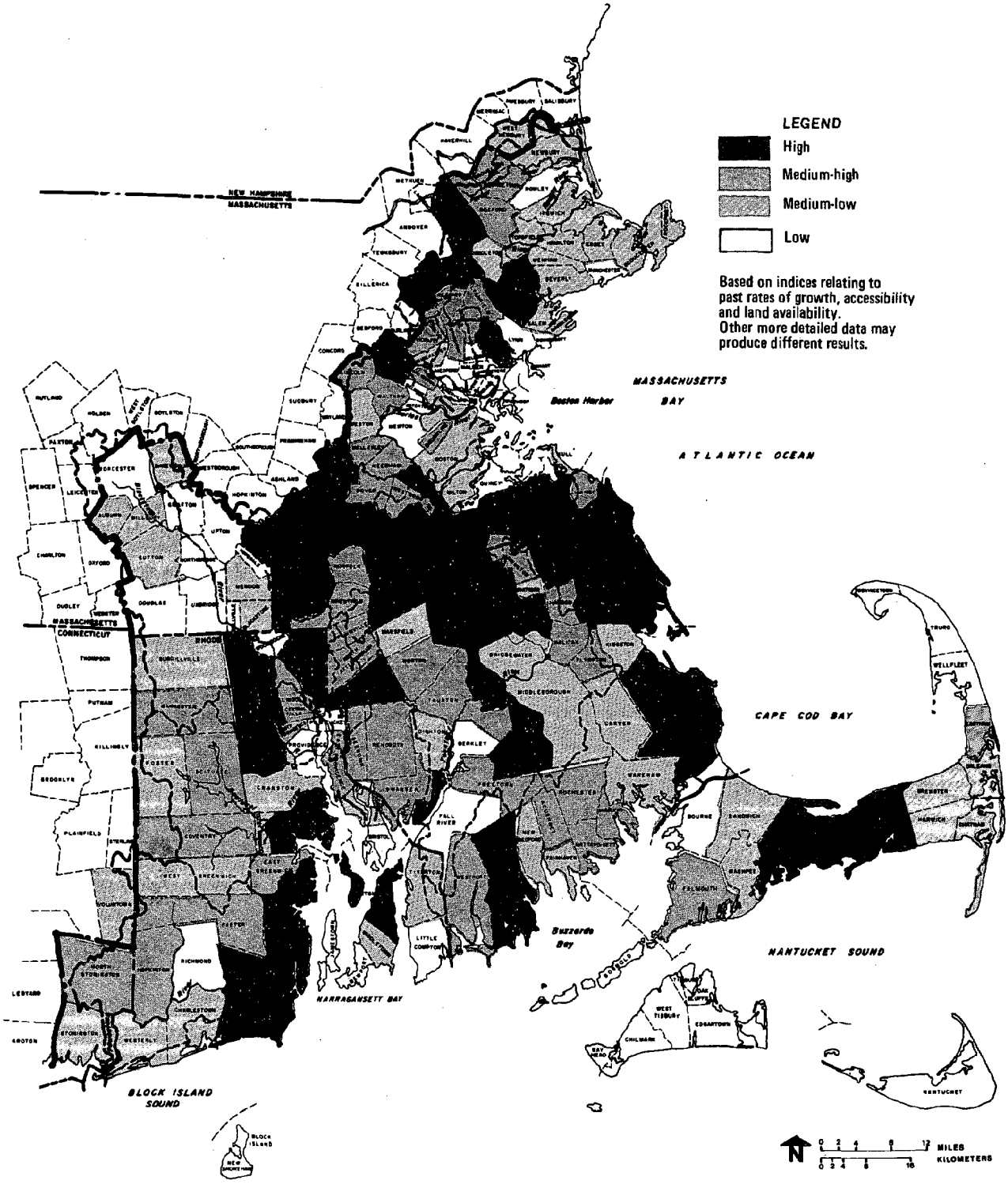
Figures 3.1 and 3.2 give some indication of the location and extent of development that can be expected to occur in SENE if urbanization proceeds in the future according to the patterns which have occurred in the past. Figure 3.1, in particular, if modified by state, regional, and local land use planners based on their more intimate knowledge, can be used to anticipate future pressure on critical water and related lands.

TABLE 3.3 POPULATION SERVED BY SEWERS IN SENE PLANNING AREAS

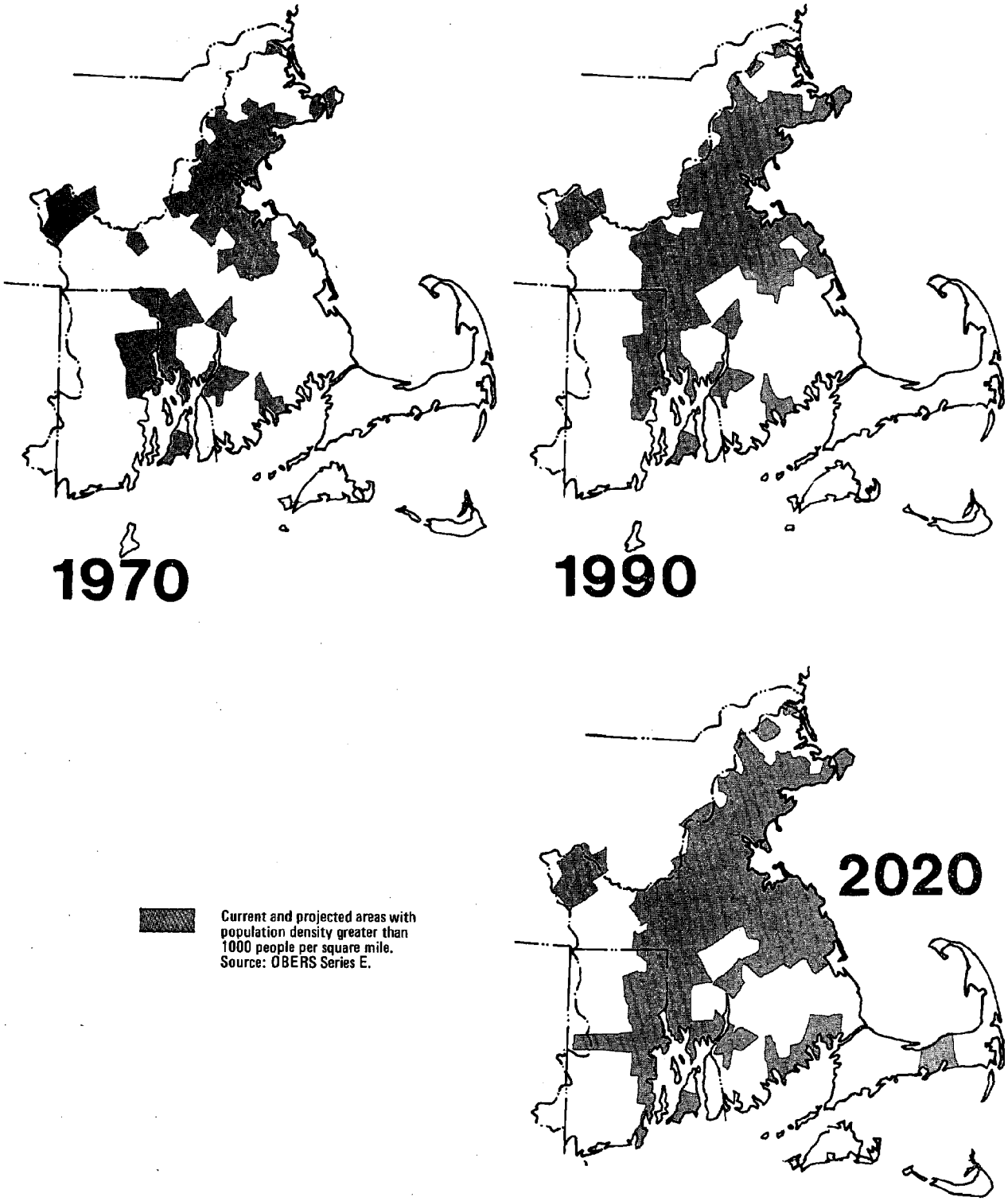
	1970 Population (in 1,000's)			
		Served by Sewers		Unserved but
Planning Area	Total	No.	%	Requiring Sewers*
Ipswich-North Shore	584	410	70	101
Boston Metropolitan	2,115	1,832	87	183
South Shore	116	19	16	52
Cape Cod & Islands	107	13	12	14
Buzzards Bay	178	123	69	25
Taunton	339	219	55	115
Blackstone & Vicinity	824	609	74	145
Pawtuxet	154	91	59	36
Narragansett Bay	291	75	26	168
Pawcatuck	70	15	21	15
SENE	4,838	3,406	70%	854

Source: See Methodology

* Assuming that all unserved dwellings on lots of 1/2 acre or less will require sewer service to protect water resources.



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	DEVELOPMENT PRESSURES	FIG. NO. 3.1



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	URBANIZATION PATTERNS OF THE SENE REGION	FIG. NO. 3.2

Effects of Growth on Water and Related Land Resources

The SENE Study is concerned primarily with the relationships between growth and water and related land resources. Water related lands are generally those which, because of their soil characteristics and/or location over, under, or near water resources, are important for use, protection, management, or development of that resource. Such water related lands include, but are not limited to: wetlands, reservoir watersheds, flood plains, ground water recharge areas, soils with septic system limitations, shellfish flats, well sites, and beaches.

The development capability of such lands is limited for a number of reasons. Some are vital to the preservation of drinking water supplies. Others are sites for a necessary segment of production of food and fiber, the marine food chain, or serve as wildlife habitats. Still others would create a threat to public health and safety if developed. The decision as to whether such lands are to be developed or preserved involves weighing the benefits of development against the benefits of preservation (or the costs of development). Each of these water related lands is examined in greater detail below.

Wetlands. Wetlands are among the most fragile of the region's water and related land resources. According to Table 3.1, salt water wetlands decreased by 13.7 percent between 1960 and 1970. Fresh water wetlands decreased by 5.6 percent in the same period. Both Rhode Island and Massachusetts now protect these areas by law, but the current level of regulation and enforcement may not be sufficient to reduce the rate of loss significantly.

Wetlands perform several basic functions: they recycle nutrients used by fish and wildlife, serve as nursery areas for many species, and provide habitat for wildlife. Coastal wetlands act as buffers for storms and as stabilizers of shorelines, and inland wetlands serve as natural storage areas for excess flows, releasing them slowly and modifying downstream flood stages. The Corps of Engineers, in a recent study, determined that a forty percent loss of Charles River wetlands (Boston Metropolitan planning area) could increase flood stages in the middle and upper river from two to four feet, for a flood of the magnitude experienced in 1968. According to studies conducted at the University of Massachusetts, wetlands common in SENE are capable of holding and transmitting .25 to 3.0 million gallons of water per day. The slightest alteration of the delicate balance of waters, land, and vegetation can significantly diminish the ability of wetlands to perform these functions.

It is worth noting that coastal wetlands are valuable for water quality enhancement because of the flushing action caused by the normal change of tide. The water quality benefits of inland wetlands are less certain, however, because of their tendency to collect decaying vegetation which increases oxygen demand, thereby to some degree negating filtration benefits. Inland wetlands do, however, aid water quality in rivers through their capacity to release stored water gradually, providing an even flow.

More detailed discussion of the characteristics above are included in *Chapter 7, Marine Management*, and *Chapter 8, Flooding and Erosion.* The recreational value of wetlands is discussed in *Chapter 6, Outdoor Recreation.*

Beaches, Dunes, and Bluffs. The region's coastal beaches, dunes, and bluffs are major aesthetic attributes; they attract literally millions of tourists annually. They are also the region's first line of defense from coastal storms and tidal flooding. Development on these often critically eroding lands has disrupted their ability to perform these functions. The problem is critical along such areas as Plum Island (Ipswich-North Shore planning area) and Scituate (South Shore planning area) in Massachusetts, and along the southwestern coast of Rhode Island (Pawcatuck planning area). For the region as a whole, over 70 miles of shoreline is eroding at a rate of more than three feet per year; 55 miles of this total is along the beaches and bluffs of the Cape Cod and Islands planning area.

Problems associated with the development of these critical areas are discussed more fully in *Chapter 8, Flooding and Erosion* and in the appropriate planning area reports.

Water Bodies. Programs of water quality preservation and restoration in SENE should improve the region's capability to provide and hold the skilled personnel it needs to maintain its economic well-being *(Chapter 2, The Setting).* Water bodies must be protected not only for their aesthetic value, but for their irreplaceable benefits such as recreation sites and sources of water supply. Many of the region's inhabitants are without access to clean, natural water bodies. Land use measures needed to protect water quality include control of non-point source pollution, particularly polluted stormwater runoff from urban concentrations, and sediment from erosion. Management of present and proposed reservoir watershed lands must ensure that significant pollutants do not enter the water bodies. Development must be restricted in these areas in order to protect water quality. More complete treatment of surface water sources (storage, not distribution sites) could permit more use of their surrounding watershed lands. However, the growing trend toward complete treatment of all surface sources should not preclude a general policy of water quality protection.

Well Sites. In addition to surface water sources, well sites must be shielded from development. Pollutants entering the ground in these locations may filter directly into water supplies. Details are discussed in *Chapter 4, Water*

Supply, particularly with respect to the pressures being placed on existing and potential well sites as a result of population growth.

Estuaries. Tidal rivers and their associated salt water wetlands are also vulnerable to deterioration and outright destruction due to careless land use practices. In some planning areas in SENE, most of the salt water wetlands that once existed are already gone. All but one of SENE's tidal estuaries have been dammed, and the remaining one, the North River, is noted for its high-quality sport fishery and is the site of the first salmon restoration project in the region. Many of SENE's estuaries are also adversely affected by wastewater treatment plant discharges and other types of water pollution. Significant amounts of shellfish beds have been closed for public health reasons due to inordinately high pollution levels (see *Chapter 7, Marine Management).* In addition to these "estuary related" species, however, many more are in some manner "estuarine-dependent". Sources at Woods Hole Oceanographic Institute estimate that about 70 percent of New England's commercially-valuable fish species are either directly or indirectly dependent upon estuaries at various stages of their life cycles. While these offshore species may never actually enter estuarine waters, they feed on the many species which do, and are therefore tied to estuarine habitats through the food chain. Unfortunately, these species are being threatened by continued loss of these coastal habitats and by pollution of coastal waters. Estuaries and other areas critical for marine life are discussed in more detail in *Chapter 7, Marine Management.*

Flood Plains. Some water related lands can retain their usefulness under limited kinds of development. Flood plains, discussed in *Chapter 8, Flooding and Erosion,* are capable of supporting certain limited forms of development, including agriculture and recreation. Such development would neither impede natural flood flows nor incur substantial damages if flooded. But encroachment of larger scale development, which occurs in several parts of the region, not only escalates local damages and loss of life, but by altering flood stages causes greater damage both upstream and downstream. The National Flood Insurance Program of the Department of Housing and Urban Development will be of some assistance, but because it does not require prohibition of development (except in the floodway), it may encourage development in some flood plain areas by enabling property owners to obtain insurance.

In the last few years, steadily increasing development in flood plains, particularly in the Pawtuxet and Blackstone planning areas, has greatly increased the potential for heavy flood damages. Recurrence of floods of record in these two planning areas alone could cause an estimated $53 million in damages. New development, even flood-proofed, in flood plain areas, will cause the present flood levels to rise and subject areas to flooding that had not been exposed before.

Prime Agricultural Lands. The availability of high quality agricultural soils is decreasing rapidly in SENE. According to the Massachusetts Governor's Commission on Food, the acreage of farms in the state has declined from 2 million in 1945 to about 700,000 today. In SENE as a whole, 29 percent of the region's prime agricultural land was converted to urban use (Table 3.1) between 1960 and 1970. This rapid conversion of agricultural land threatens to pose serious problems for the long-range production of food and fiber. But significant potential exists for increasing the proportion of the regional food market held by local production, thereby reducing cost to the consumer and the vulnerability of the region to disruptions in the distribution system.

Prime agricultural lands are also important to the production of non-food renewable resources such as forest products. Fifty-six percent of Southeastern New England is covered by forest, most of which is second growth, and not nearly as productive as it could be under good management. As with agricultural lands devoted to food production, the vast majority of these areas are small, privately owned parcels which make commercial harvest difficult. Yet it has recently become clear that on a worldwide scale there is no such thing as excess agricultural capacity or an over-abundance of massive resources. Therefore it is incumbent upon all decision makers to preserve whatever capacity this region may have for production.

In addition to their food and fiber function, agricultural lands may serve as important recharge areas for ground water, produce habitat for wildlife, and are important factors in the physical attractiveness of the region. New England depends on the ever changing landscape created by active agriculture to provide a mixture of land use diversity which contributes to the heritage and culture of this area. Prime agricultural lands, both non-forested and forested, can be utilized indefinitely, provided that they are managed in ways which take into account their inherent capabilities.

Unique Natural and Cultural Areas. As a coastal region, many of the unique natural and cultural areas are water related. Although a minor portion of the region's total area, these areas play a major part in the high quality of life characteristic of Southeastern New England.

Unique natural areas consist of resources such as unusual geologic and hydrologic areas, unique examples of flora and fauna. Examples include Natural Landmarks such as Gay Head Cliffs or Martha's Vineyard and Lynnfield Marsh, and Acushnet Cedar Swamp in Bristol, Rhode Island. Cultural areas include historic elements such as structures, sites and districts on local, state, and national registers as well as important archeological and educational sites such as museums. Examples are Minuteman National Historic

Park in Lexington, Paul Revere's House and Arnold Arboretum in Boston.

Preservation and management of unique natural and cultural sites not only adds to the diversity of the overall environment, but because of their status, can place certain limitations and requirements on nearby development possibilities and patterns. While this Study has incorporated many sites from existing sources such as the New England Natural Resources Center survey, inventory and identification of new sites by others, such as the National Park Service's program on Natural Landmarks will continue. Therefore, this is a resource category that will need continuous cross-checking on the part of planners.

Aquifer and Recharge Areas. As explained more fully in *Chapter 4, Water Supply,* ground water is now, and will continue to be, an important source of water supply for many of the region's people. But in many areas of the region, development of lands which serve as recharge areas for aquifers threatens the future viability of ground water quality and therefore the viability of water supplies. High density development increases the possibility of pollutants infiltrating the aquifer. Moreover, the greater the percentage of pavement and other impervious surfaces, the lesser the replenishment of ground water supplies by rainfall. Other hazards to ground water quality and quantity include sanitary landfills, highway deicing salt, industrial wastes, agricultural runoff, and sand and gravel mining where extraction goes below the water table.

Upland Wildlife Habitat and High Landscape Quality Areas. Productive upland wildlife habitat is usually found along edges of field, forest, and wetland. Urbanization has continuously encroached on these lands, steadily reducing the region's total wildlife habitat. Other land uses are almost always judged to have higher economic returns than wildlife production. Similarly landscape quality rarely counts in land use decisions. In 1970, best upland wildlife habitat and areas with high landscape quality – defined by land use diversity and relief – accounted for somewhere between 10 and 20 percent of the total area of SENE.

Soils with Development Limitations. Some areas can sustain many types of development, but they have values that will be lost without careful management of that development. For example, soils with limited capacity to absorb septic wastes, and areas of steep slopes or ledge – all common in SENE – can bear only limited development before deteriorating or creating health hazards.

The production and management of the water and related land resources outlined above are a major concern of the SENE Study. Both deliberate and unconscious evolutionary land use decisions have deleterious effects on these resources. Most of them come under the heading of "critical environmental areas" as detailed by the Coastal Zone Management Act, the National Environmental Act, and proposed federal land use legislation.

Developments of Regional Impact

Just as it is important to protect or manage critical water resources and related lands, it is important to guide the development of facilities which will have greater than local impact on people and their resources. The Study defines developments of regional impact as those likely to present issues of statewide or regional significance as a result of their magnitude or of the magnitude of their direct or indirect effects. Included within this definition are key facilities, such as power plants, oil receiving or refining sites, and airports; large scale or growth inducing development, such as housing projects, industrial parks, and shopping centers; and major public facilities, such as highways, interchanges, mass transit terminals, and water and sewer line extensions. All are important to the continuing economic health of the region and the well-being of its people. They also have a history of more or less negative effects on natural resources and environmental quality. In a region as densely populated and rapidly growing as SENE, both the need to find sites for, and the concern over the impacts of, such major facilities are steadily increasing. Such key facilities must be dealt with using approaches which are more creative and less environmentally harmful than the forms they have taken in the past.

Key Facilities. It is the SENE Study's conclusion, explained more fully in *Chapter 9, Locating Key Facilities,* that the same priority should be given to the identification and preservation of sites for such key facilities as power plants, petroleum facilities, solid waste disposal sites, and sand and gravel extraction operations, as is given to the identification of fragile natural areas. Both kinds of areas are critical to the public health and safety and the long-term health of the region's economy. The most important step needed is to place such decisions within a statewide – in some cases regionwide – context. Decisions which affect all the people of the region should not be left to one municipality.

Large Scale or Growth Inducing Development. In some cases the sheer magnitude of a development can have long-range impacts on water and related land resources. Such projects as major shopping centers and industrial parks, apartment complexes, and highway and interchange construction have a history of far greater than local impacts. Perhaps the classic example is the industrial development which appeared along Route 128 as it encircled Boston. The same phenomenon is repeating itself on either side of the

more distant Route 495 in rural towns far less able to cope with the new development. As with key facilities, the long-range impacts of large scale development on resources and people, on commercial and industrial activity, and patterns of residential development, dictate that detailed resource capability analysis be conducted prior to initiation of any project and that the local decision be shared with state or substate regional agencies able to recognize the potential for regional impact.

The SENE Resource Development Capability Analysis

It became clear that if the Study was to provide any guidance to the region for its future economic growth, some system was needed for displaying not only the location of the region's water and related land resources, but also how the characteristics of those resources presented opportunities or limitations to growth.

The Study's Resource Development Capability Analysis and the maps which are the product of that analysis (Plates 1, 2, and 3) provide that needed information.

Criteria for Classifying Resources. Federal and state Study participants mapped and analyzed dozens of

TABLE 3.4 THE SENE RESOURCE DEVELOPMENT CAPABILITY SYSTEM

CRITICAL ENVIRONMENTAL AREAS REQUIRING PROTECTION

Water Bodies (Category A), blue. [Includes estuaries, shellfish flats, and fish spawning areas.]
Priority Protection Areas (Category A), dark green: wetlands, well sites, beaches, and critical coastal erosion areas.
Other Protection Areas (Category B), light green: flood plains, class I and II agricultural soils, unique natural and cultural sites, [proposed reservoir sites and related watersheds, and upland erosion areas] excluding all "A" areas.

DEVELOPABLE AREAS REQUIRING MANAGEMENT, Excluding All A & B Areas

WATER RESOURCE LIMITATIONS
Aquifers and/or Recharge Areas (Category C_1) black dots: highest yield aquifers in each basin.

WILDLIFE AND SCENIC RESOURCE LIMITATIONS
Wildlife Habitat (Category C_3), black diagonal lines: best upland wildlife habitat other than publicly owned land and [commercial fishing grounds].
Landscape Quality Areas (Category C_2), black vertical lines: land characterized by high landscape quality other than categories C_1 and C_3.

SOILS RESOURCE LIMITATIONS
Ledge and/or Steep Slope (Category C_5), brown: land with slope greater than 15 percent and/or with rock near the surface.
Severe Septic System Limitations (Category C_4), orange: land with severe septic system limitations other than Category C_5.
Moderate to No Septic System Limitations (Categories F and G), yellow: land with moderate or no septic system limitations.

PREEMPTED USE AREAS

Urban Areas (Category E), gray: residential[5] institutional, commercial and industrial development.
Publicly Owned Lands (Category D), beige: major public parks, forests, watersheds, and military lands.

Notes:

1/ All categories above, except those within brackets, are depicted on the Development Capabilities Maps (Plates 1, 2, and 3 in the rear pocket of this report).
2/ Categories in brackets are included to show where they would fit in the overall classification hierarchy, were they included on the plates in the pocket.
3/ All categories above, including those within brackets, are depicted on large-scale, unpublished maps available for inspection as part of the SENE Files.
4/ Categories C_1, C_2 and C_3 overlap with categories C_4, C_5, F, or G. Thus, Category C_3-C_4 is a wildlife habitat located on ledge or steep slopes.
5/ Mapped urban areas (Category E) include all-residential development, although the legend on Plates 1, 2, and 3 reads "residential areas on less than one acre lots."

discrete water and related land resources. The resources were subsequently grouped into one of several development capability classifications on the basis of five criteria:

Intrinsic Resource Values: Resources which provide services to man, as wetlands provide natural valley flood storage; renewable resources including prime agricultural lands, which are needed for production such as food, fiber, and wildlife habit; non-renewable resources such as sand and gravel needed in construction; and resources which have amenity value such as scenic, recreational, or educational areas.

Resource Sensitivity and Retrievability: Resources which are particularly vulnerable to development, such as barrier beaches or shoreward dunes, or are not easily retrieved once developed such as filled-in wetlands and or urbanized forested or non-forested prime agricultural lands.

Threat to Public Health and Safety: Resources on which development would present a threat to public health and safety, such as the threat of flooding presented by flood plain or beach development.

Resource Scarcity or Uniqueness: Resources which are particularly scarce, unique and therefore valuable, such as high yield aquifers in ground water dependent areas, scenic promontories in generally flat landscapes, habitats for rare and endangered species, or regionally or nationally significant historical sites and natural landmarks.

Institutional Criteria: Resources which are similarly regulated or which have already been classified by such acts or guidelines as the:

- Water Resources Planning Act of 1965
- National Environmental Policy Act of 1969
- Federal Water Pollution Control Act Amendments of 1972
- Coastal Zone Management Act of 1972 and related Committee Reports
- Rural Development Act of 1972
- U. S. Water Resources Council, Principles and Standards
- Proposed federal land use bills
- Massachusetts Wetlands Act
- Massachusetts Environmental Policy Act (MEPA)
- Martha's Vineyard Land Use Act
- Proposed Nantucket Sound Islands Trust
- Rhode Island Statewide Land Use Plan
- Federal and State legislation on historic sites and districts.
- Federal Wild and Scenic Rivers Act
- Massachusetts Scenic River Act

A Water and Related Land Use Classification System. On the basis of these five criteria and sound understanding of resource capability analysis techniques, the water and lands of Southeastern New England were grouped and mapped into eleven development capability subcategories, each with its own color or pattern of lines, and placed into three major classifications: Critical Environmental Areas, Developable Areas Requiring Management, and Preempted Use Areas. The large multicolored plates (in pockets in the back of this report) are drawn at a scale of one inch equalling two miles (1:125,000) and, in addition to the resource data, display every municipality in the region, and all major existing and proposed highway, rail, airport, and ferry transportation systems. Table 3.4 summarizes the land and water elements of the classification system and is, in fact, identical to the map legend. A brief description of each subcategory of resources, grouped according to their suitability for development, follows, in the same order as they appear in the legend on Plates 1, 2, and 3.

Critical Environmental Areas. Resources which have been classified as Critical Environmental Areas include the following:

Water Bodies. Displayed in blue, the region's water bodies have as high a priority for protection as the following categories and are included in category A, Priority Protection Areas; however they are separated for mapping purposes. Included in this category but more difficult to pinpoint were certain salt water areas – shellfish flats, estuaries, fish spawning areas.

Priority Protection Areas. Displayed in dark green, this category (A) includes those fragile resources which have the lowest tolerance for development and highest value for water resource protection. Uncontrolled or incompatible use of these lands would result in the loss or reduction of resource productivity and would pose a resultant risk to public safety and welfare. The category, as shown on Plates 1, 2, and 3, contains well sites, coastal and inland wetlands, beaches and critical erosion areas which were mappable at the scale used. Together they constitute 445,000 acres or 16 percent of the region's land area.

Other Protection Areas. Displayed in light green, resources in this category (B), within the classification of Critical Environmental

Areas, are suitable for certain kinds of extremely limited development, such as recreation. These areas should be carefully analyzed for such uses on a case-by-case basis. The category includes riverine and tidal flood plains, class I and II prime agricultural soils, and unique natural and cultural sites. Proposed reservoir sites and related watersheds, and upland erosion areas, though not included on the Development Capability Maps, are included in this category and have been delineated on maps in the SENE files. Note that Category B areas such as flood plains which are also wetlands are excluded from Category B and included instead in Category A. Category B lands constitute about 421,000 acres or 15 percent of the region.

Developable Areas Requiring Management. Again, on the basis of five criteria, all of the region's remaining undeveloped resources were classified for development suitability. Within this classification, which corresponds to map categories C, F, and G, the resources were further classified by factors which, in varying degrees, limit their development: water resource limitations, wildlife and scenic resource limitations, and soils resource limitations. Together the three sub-categories described below consititute about 1,044,000 acres or 36 percent of the land area of the SENE region.

Water Resource Limitations: The first sub-category under Developable Areas Requiring Management is:

Aquifer and/or Recharge Areas. Displayed on the map as a pattern of black dots overlaying the soils information, high yield aquifers and their recharge areas (Category C_1) (other than those recharge areas under Categories A and B) can sustain a limited degree of development, but must be strictly managed in ways which protect the quantity and quality of ground water beneath them. As mentioned earlier, and as discussed in detail in *Chapter 4, Water Supply,* ground water is available to most of the towns in the region and will be needed to meet 1990 water demands. At the same time, however, *where surface water is readily available for long-term needs, towns may wish to trade off the benefits of protecting ground water aquifer and recharge areas in favor of more intensive development, provided this trade off will not interfere with the ground water resources of an adjacent town.*

Wildlife and Scenic Resource Limitations include the following sub-categories:

Wildlife Habitat. Displayed as a pattern of diagonal black lines overlaying the soils information, lands in this category (C_3) include the best upland wildlife habitats, other than publicly owned land or wetlands, which are in other categories. For this report, best upland wildlife areas are defined in terms of a range and transition of vegetation cover. However, the character of these lands changes rapidly, and local decision makers using their own more detailed information may wish to vary the degree to which development can be permitted or restricted as conditions change.

Landscape Quality Areas. Displayed as a pattern of black vertical lines also overlaying soils information, lands in this category (C_2) include areas of striking variation in topography, land use diversity, and vegetative cover. These lands are capable of supporting a number of development uses, if those uses are designed in a manner compatible with the intrinsic value of the resource.

Soils Resource Limitations* include the following three sub-categories:

Ledge and Steep Slope. Displayed on the maps in brown, lands in this category (C_5) have bedrock within three feet of or at the surface, or have slopes greater than 15 percent. Both these characteristics pose difficult development problems. Steep slopes are often susceptible to erosion when disturbed, and septic tanks have only limited feasibility on either type of land, except at high cost.

Severe Septic System Limitations. Displayed in light orange, lands in this category (C_4) are suitable for development as long as sewers are installed or density is limited to prevent overloading the land's ability to absorb wastewater. Without such precautions, the threat of contamination to local ground water, among other things, is considerable.

* Based on interpretation of soils maps by the Soil Conservation Service, U.S. Department of Agriculture. That agency, located in each state, should be contacted for operational soil surveys for detailed town level information. About 60 percent of the SENE region has been mapped in detail.

Moderate to No Septic System Limitations. Displayed in yellow, lands in this Category (F and G) have almost unlimited development capability. They are generally flat and well-drained and, because of ease of development and virtually unlimited capability to accommodate septic systems, have a tendency to be developed as a "sprawl". Yet their developability gives them great flexibility for many other kinds of development as well.

Preempted Use Areas. To a greater or lesser degree, the suitability for development of a significant portion of the region's total land area has already been preempted. These lands are either already urbanized or publicly owned.

Urban Areas. Displayed in gray, lands in this Category (E) include all urban land uses. However, even though urbanized, portions of this urban land remain vacant. Because much of the land in this category is already served by infrastructure – water and sewer service, transportation systems – it represents a valuable opportunity for future development if problems preventing its development are identified and overcome.

But significant difficulties exist. Assembly of parcels large enough for development is difficult, prices are high, neighboring development may be unattractive, and municipal opposition may be encountered. Municipal financial incentives and preferential zoning can help, but major problems remain under any redevelopment scheme. Assessing the specific capability of SENE's urban lands to absorb further development was a level of detail beyond this Study, although the land use policies advanced by the Study can be applied to larger parcels. Yet the potential, and opportunity, remains and deserves detailed study. Further recommendations on urban land uses (for example buffer strips in *Chapter 5, Water Quality;* urban waterfront redevelopment in *Chapter 7, Marine Management)* can be found throughout the text.

Publicly Owned Areas. Displayed in beige, lands in this category (D) are predominantly in federal or state ownership. Some are open space and recreational areas or water supply watershed holdings. A few large government holdings – such as Otis Air Force Base on Cape Cod – may be released from public ownership and become available for other uses. In that event, they can be readily reclassified under the foregoing system – in fact all such areas have already been mapped by the SENE Study. The public can contact the New England River Basins Commission for this

TABLE 3.5 PERCENT OF LAND AND WATER RESOURCE CATEGORIES IN EACH PLANNING AREA

Planning Area	Total (in 1000's of acres)	Percent (%) of Planning Area: Critical Environmental Areas A*	B*	A & B	Developable Areas C, F, G*	Preempted Use Areas D, E*
Ipswich-North Shore	274	19	13	32	34	34
Boston Metropolitan	421	14	9	23	30	47
South Shore	172	17	13	30	43	27
Cape Cod & Islands	378	10	23	33	32	35
Buzzards Bay	205	17	16	33	47	20
Taunton	351	19	22	41	37	22
Blackstone & Vicinity	410	10	11	21	38	41
Pawtuxet	180	11	7	18	41	41
Narragansett Bay	212	16	16	32	34	34
Pawcatuck	262	27	12	39	40	21
SENE	2,865	16%	15%	31%	36%	33%

Sources: See Methodology in the Regional Report.

* The location of these lands is depicted on the multi-colored development capabilities maps in the rear pocket.

information in order to assess present use compatibility with resource capability and to plan for possible future changes in use of such areas due to changing ownership or need.

It is important to note that Plates 1, 2, and 3 are a final composite of dozens of maps produced during the course of the Study. These originals, many at greater levels of detail, are available in the files of the New England River Basins Commission. *Table 1.1 in Chapter 1* summarizes the data available.

The Implications of the Development Capability Analysis for Accommodating Growth. Table 3.5 displays the percentage of critical environmental area, developable area and preempted use area in each planning area and for the region as a whole. The table indicates that while generally similar distributions prevail throughout most of the region, some disproportions exist. A higher percentage of the Taunton planning area is in critical environmental areas than in the other planning areas, and the lowest percentages are in the Blackstone and Pawtuxet planning areas. The highest percentage of developable land is in Buzzards Bay with the Boston Metropolitan lowest. However, it is important to note that while the percentages of land classified as critical environmental area vary significantly, the availability of developable land is surprisingly uniform from planning area to planning area. The Boston Metropolitan planning area has the greatest amount of land in preemptive use while the Taunton and Pawcatuck have the least.

Table 3.6 translates percentages to acres. According to this table, roughly one-third of the region's land area can be classified as in preempted use, one-third in critical environmental areas, and one-third developable.

The most significant implication of the analysis, however, can be found in Table 3.7. The conclusion of the analysis is that *enough legitimately developable land (categories C,*

TABLE 3.6 AMOUNT OF EACH LAND AND WATER RESOURCE CATEGORY BY PLANNING AREA

	Acres (in 1,000's)						% of Total SENE Area					
	Critical Environmental Areas			Developable Areas	Preempted Use Areas;	Total Land & Water	Critical Environmental Areas			Developable Areas	Preempted Use Areas;	Total Land & Water
Planning Area	A	B	A&B	C,F,G	D, E*	Area	A	B	A&B	C, F, G	D, E*	Area
Ipswich-North Shore	52	36	88	92	94	274	1.8	1.3	3.1	3.2	3.2	9.5
Boston Metropolitan	61	38	99	124	198	421	2.1	1.3	3.4	4.3	7.0	14.7
South Shore	29	23	52	74	46	172	1.0	0.8	1.8	2.6	1.6	6.0
Cape Cod & Islands	36	89	125	122	131	378	1.2	3.1	4.3	4.3	4.6	13.2
Buzzards Bay	34	33	67	98	40	205	1.2	1.2	2.4	3.4	1.4	7.2
Taunton	68	78	146	129	76	351	2.4	2.7	5.1	4.5	2.6	12.2
Blackstone & Vicinity	42	45	87	154	169	410	1.5	1.5	3.0	5.4	5.9	14.3
Pawtuxet	19	13	32	74	74	180	0.7	0.4	1.1	2.6	2.6	6.3
Narragansett Bay	34	34	68	71	73	212	1.2	1.2	2.4	2.5	2.5	7.4
Pawcatuck	70	32	102	106	54	262	2.4	1.1	3.5	3.7	2.0	9.2
SENE	445	421	866	1044	955	2865	15.5	14.6	30.1	36.5	33.4	100.0%

* Some public lands are included in Categories A, B, and C, F, and G. Thus, the Prempted Use Column, D-Public & E-Urban, is understated.

F, and G) exists to accommodate the development demands of the SENE region through the year 2020, even at the very high consumption rate (one-half acre per capita) of the past decade. Moreover, if OBERS projections of a leveling off of population due to the declining birth rate are accurate, the 2020 population may be the largest the region has to accommodate. Some sub-regional inconsistencies to this rule are to be expected. For example, if the land consumption rate of one-half acre per person continues, the Ipswich-North Shore, South Shore, and Narragansett Bay planning areas would occupy all their developable land by 1990-2020. On the same basis, developable lands would last until about 2020 in the Boston Metropolitan, Taunton, and Pawtuxet planning areas. Four planning areas would have abundant developable lands long after 2020 – Cape Cod and the Islands, Buzzards Bay, Blackstone and Vicinity, and Pawcatuck.

However, patterns of growth which use up land at the recent high rate of one-half acre per person eventually would mean that only critical environmental areas such as wetlands, flood plains, and agricultural lands would be left. The rest of the area might be subject to low density sprawl, hardly representative of a "New England flavor." The people of this region clearly will reject that kind of future. Therefore, we must begin now to manage Southeastern New England's water and related land by protecting critical environmental areas, respecting the resource capabilities of developable areas, and making better use of our urban lands. This makes long-range sense economically, socially, and environmentally.

TABLE 3.7 PROJECTED POPULATION INCREASES IN SENE PLANNING AREAS COMPARED TO THE POPULATION CAPACITY OF THEIR DEVELOPABLE LANDS AND SEWERED LANDS (in 1,000's)

	Projected Increase (OBERS E)		Unused Capacities	
Planning Area	in 20 years 1970-1990	in 50 years 1970-2020	Developable Lands *	Existing and Proposed Sewers **
Ipswich-North Shore	189	451	185	(-22)
Boston Metropolitan	188	284	248	349
South Shore	122	345	148	91
Cape Cod & Islands	58	145	244	79
Buzzards Bay	22	92	195	45
Taunton	113	303	259	122
Blackstone & Vicinity	62	97	308	127
Pawtuxet	74	164	148	92
Narragansett Bay	93	263	143	32
Pawcatuck	18	49	212	24
SENE	939	2,193	2,090	939

* These figures represent the number of people that could be accommodated on developable lands (categories C, F & G) if the average rate of land consumption in Southeastern New England between 1960 and 1970 (i.e., 0.5 acre per capita) were to continue.

** Unused sewer capacity is the design capacity of existing and proposed treatment facilities less the 1970 population already served or needing service on lots of 1/2 acre or less.

The Solutions

It bears repeating that the SENE Study is a water and related land resources study and that while comprehensive in scope with respect to these resources, it does not purport to be a comprehensive land use plan for the region. Nevertheless, we have seen that these resources are deeply affected by growth, that they may often determine how much we can grow, and that we can use their capability to support various forms of development as tools for guiding growth.

Alternatives

Within this context, the Study examined three alternative strategies for guiding the future growth of the region to guarantee the protection and wise use of its water and related lands. Guiding that growth rather than placing limitations on it seemed a more realistic objective, given the scope of this Study. Such considerations as population control by regulation of birth rate or migration patterns, and political and socioeconomic controls such as modifications in income tax deductions based on family size, are but a few of the factors which can affect growth. Social legislation of this type is needed for effective growth control, but is not within the scope of this water and related land study. Therefore the three alternatives examine the desirability of a more integrated and comprehensive approach to management of resources. Even when limited to water and related land resource issues, our problem is, nevertheless, very complex—and like all complex alternatives, those presented here are not mutually exclusive. The three alternatives described do, however, provide different degrees of emphasis on what were judged to be viable solutions to the problem at hand – to effectively guide growth while protecting water and related lands:

1. Continuing current programs and regulations;
2. Increasing protection of critical environmental areas; and
3. Improving management of developable areas.

The Study's detailed resource development capability analysis will be a useful tool for each of these alternatives. While the analysis is most closely associated with the second and third alternatives, it is just as applicable to the continuation of existing programs, particularly state coastal zone management and land use planning and management efforts.

The three alternatives approach the problem of accommodating growth and protecting valuable resources from decidedly different directions. The first recognizes that in many ways state and local governments in Massachusetts and Rhode Island have a history of leadership in resources management. This alternative emphasizes continued use of available tools on an ad hoc basis to manage the future growth of the region. Some might describe this as a "take no action alternative" – but this would be a misnomer; relevant programs and regulations currently exist and are continually being modified. The second alternative goes a step further by defining certain critical environmental areas and removing these areas from consideration for most forms of development. While this alternative guides growth away from critical environmental areas ensuring integrated maintenance of the future quality and quantity of water resources, it still permits relatively unrestricted use and development of most other lands. The third alternative concentrates on these other lands. No new controls are considered for "critical environmental areas" other than current programs and regulations. Rather, this alternative seeks to guide growth on the basis of ability of the region's water and related lands to support a variety of forms of development, to increase the efficiency with which public investments in services needed to accommodate growth are made, and to control the location of those forms of development having major impacts on the region's water and related land resources.

1. Continuing Current Programs and Regulations. The region's growth is determined for the most part by individual private development decisions, but the extent to which that growth is directed depends on public regulatory programs. It is therefore important to understand how the various levels of government currently influence the region's development. To do this it is necessary to examine the nature of federal, state, and local controls and then to evaluate what is currently being done as one alternative method to guide growth.

The Federal Program. Some federal government decisions, such as those on locations of federal installations, have direct impacts on location of growth. Generally, however, the federal government has created inducements to growth rather than making decisions as to its location. Indeed, federally insured mortgages, for example, were to a large degree responsible for the suburban boom during the 1950's and 1960's; federal highway aid also encouraged this movement which continues today. Most importantly, the Environmental Protection Agency (EPA) grants for construction of wastewater management facilities have made funds available to communities, expanding

their capacity to accept new development. Any directed growth program must coordinate the location of infrastructure under this program with the desired location of growth. EPA air quality standards will also influence the location of growth, especially through regulations establishing antidegradation standards and limiting permissible pollution levels from automobiles and indirect sources. Section 208 of the 1972 Water Pollution Control Act Amendments requires that areawide wastewater management plans be formulated consistently with regional growth policy. Finally, since 1954, the Department of Housing and Urban Development (HUD) has been administering grant programs to enable the preparation of community master plans, and most recently, has assumed responsibility for administering the Flood Insurance Program, designed to prevent inappropriate development of flood plains.

State Efforts. The most important function of the state is one of setting development policies and goals. The Massachusetts Resources Management Policy Council had been in the process of adopting policies respecting state growth (this function will now be undertaken by the Cabinet), while the Rhode Island State Planning Council, based on the Statewide Planning Program's State Guide Plan, has adopted its official policies.

Many state agencies and other bodies with responsibilities greater than the municipality also influence development directly by investing in facilities and utilities, and in some cases, state regulatory processes intervene in local decisions. For example, both states have strong regulatory programs protecting water quality, including standards and permit systems directing the location of well sites, sanitary landfills, septic tanks, and dredged materials disposal. State legislation also exists for protecting wetlands, beginning in most cases with administrative process before local conservation commissions. Through the Massachusetts Energy Facilities Siting Council and the Rhode Island Coastal Resources Management Council, both states are beginning programs to regulate power plant siting.

The state also manages and can acquire a great number of resources, which indirectly influences the pattern of development, including park and recreation facilities, and nature preserves. Also, the state's capacity to construct highways, mass transit, and port facilities provides the necessary infrastructure to support new development. Under the Massachusetts Environmental Policy Act, state actions significantly affecting the environment must be accompanied by environmental impact reports. As with federal agencies under NEPA, this requirement has helped to sensitize government officials to the environmental consequences of their decisions.

Emerging state programs in coastal zone management and areawide waste management also indicate the direction that states are taking to manage critical areas and resources and at the same time provide a vehicle to coordinate various functional activities to guide growth.

To the extent that the state provides financial assistance to municipalities through its Department of Community Affairs, its ability to coordinate local planning efforts serves to give some direction to state growth policies.

State level fiscal policy, too, influences development decisions. State policy respecting capital investments attracts development indirectly and real property tax policies do so directly. Both states' farmland assessment acts, designed to encourage retention of farmland in agricultural uses by allowing its tax assessment to remain low, are examples of the latter policy.

At the regional level, and only in Massachusetts, substate regional planning agencies such as Old Colony Planning Council, Metropolitan Area Planning Council, and Merrimack Valley Planning Commission have prepared open space, sewer, and water supply plans which are important vehicles guiding growth. Also the new Massachusetts Martha's Vineyard Land Use Act creates a prototype regional mechanism for regulating critical areas and developments of regional impact.

Local Authority. By far, municipalities have had the primary responsibility for guiding growth and development. Traditionally, the state has delegated powers to local governments, through home rule provisions, to enable them to act on their own and to regulate activities to further the public health, safety, and welfare. Generally, local governments regulate land and other resource use under police power authority; the extent of regulation, however, must meet certain constitutional requirements. Then, too, local governments are empowered to acquire land for public purposes by eminent domain under authority delegated by the state.

Zoning, subdivision controls, and development or use permits are the traditional regulatory tools of local government. Zoning establishes districts in which categories of uses are allowed, but within broad limits the exact location, timing, and type of use is determined by the market. Administrative solutions

to variations in uses and conditions are often necessary and because of the issuance of variances or amendments, some areas bear little resemblance to the original zoning. Building codes and other ordinances are also typical tools used to control the type of development which occurs. In fact, in Petaluma, California, growth is limited by controlling the number of building permits issued each year.

Theoretically, local zoning is based on, and implements, the local plans for growth prepared by local planning boards. Local plans, however, often either do not exist or are dissimilar to the zoning schemes. They do attempt to describe the types and location of particular developments which the community wishes to encourage.

In form, these regulations have not generally changed since their origin early in this century, when they were designed to protect private property from the nuisance of incompatible uses. With greater understanding, some regulations are now being made which recognize the interrelationships of land uses and the consequences of their locations in terms of soil, infrastructure, and other requirements.

Impact zoning is an example of this approach. As adopted in Duxbury, Massachusetts, uses are permitted depending upon their impact on site topography, soil, and required municipal services. The most notable example of this concept has been in Ramapo, New York, which established a use permit rating scheme, discussed later in this chapter. Other land use control innovations such as cluster zoning, planned unit development, and incentive and compensatory zoning, provide benefits to the landowner if he responds positively to zoning requirements; these have not yet been used extensively, however.

The other authority which municipalities exercise to influence the location of growth is that of acquisition. Public ownership of land not only protects critical resources, but allows public use, and the amenity value may influence the location of other development. Municipal acquisition may take many forms. Outright purchase, purchase of easements, and purchase of options are all well within local authority.

Municipal bonds may be authorized to raise funds for acquisition: installment contracts can be used to space payments to the landowner to spread his capital gains over a period of years. If the benefits of a land purchase will occur in the future, discount bonds can be authorized to defer payment of both interest and principal. To reduce cost, partial interest in the land such as a conservation easement, can be leased or acquired. Finally, the use of saleback or leaseback provisions, in which the municipality sells or leases back the land to the original owner, offer financial advantage and a device to control development. Such measures have been used to retain farm land for agricultural uses.

Purchase costs may also be reduced by acquiring development rights or conservation easements, which at the same time act as a growth restricting tool. Transferable development rights (TDRs) are also used to influence development, especially its density. Although TDRs have been enacted in Sunderland, Massachusetts to preserve agricultural lands, state enabling legislation may be required to make their application widespread.

Tax measures can be used to encourage or discourage certain types of uses. Preferential assessment can be used to ease maintenance of land in open condition (e.g., farmland, flood plains) but it is difficult for communities to do this to any large extent, since it reduces tax revenues.

Opportunities and Limitations. It should be clear that not only is much already being done to direct growth, but also that governmental authority to do so is extensive. Both states have in the past been leaders in resource management programs in general, and wetlands preservation in particular, and there is no reason to think they will not continue to remain so.

Nevertheless, the framework in which those programs exist does require some improvement for effective growth management. First, because of the number of agencies and programs involved in land use policy making, regulation and management decisions and programs tend to be uncoordinated and isolated from one locality to the next. Without a clearly enunciated state policy for growth, development, and conservation, resource decisions will continue to be unguided.

Second, it is inherent in current regulatory processes at the local level that they fail to consider the impact of decisions which may be felt beyond local boundaries. There is no present process which incorporates greater than local participation in regulatory decisions. As a result, immediate benefits to a community are given greater weight than the external economic and environmental costs it imposes on the region.

Third, municipal resources have been inadequate and ineffective in the past in dealing with the problems of urban growth. Present controls lack enforceability with any degree of certainty or do not directly deal with current problems.

It is evident that although the continuation of present programs is important, it is even more important to develop integrated, coherent approaches to growth management.

2. Increase Protection of Critical Environmental Areas. This alternative seeks to improve on existing, somewhat fragmented, programs by providing a stronger, more integrated approach to the protection of those resources which are critical to the provision of adequate future supplies of high quality water or which provide protection from the forces of nature. Highest priority is given to those highly fragile resources which have the lowest tolerance for development and the highest value for water resource protection:

a. Priority Protection Areas. Permissible uses of Category A resources (water bodies, wetlands, well sites, critical erosion areas, beaches, estuaries, shellfish flats, and fish spawning areas) are strictly limited to water supply, fish and wildlife production, scenic and open space and extensive recreation (nature study, hiking, etc.)

Second priority is given to those resources slightly more tolerant to limited types of low density use but still having very high value for water resource protection and related land resource management.

b. Other Protection Areas. Permissible uses of Category B resources (riverine and tidal flood plains, Class I and II agricultural soils, unique natural and cultural sites, upland erosion areas, proposed reservoir sites and related watersheds) which are somewhat more tolerant to use under strictly managed conditions, include forest and agricultural production, more intensive recreational use than permitted on Category A lands, and in some cases very low density residential development. Because of the severe pressures on the region's remaining prime (Class I and II) agricultural soils, special efforts could be made to apply the experiences gained in Sunderland, Massachusetts, where the concept of transferable development rights is being experimented with; in New York where special "agricultural districts" have been established with restrictions on other forms of development, though this approach may have limited applicability in this region because of the smaller size of agricultural parcels; in Vermont where special capital gains taxes are being levied on land speculators; and in Long Island where public acquisition of development rights is being attempted. In Connecticut, the Governor's Task Force for the Preservation of Agricultural Land has proposed state purchase of development rights within agricultural reserves designated by towns according to state guidelines.

Unique natural and cultural sites, upland erosion sites, proposed water supply facilities all have a common characteristic, as do areas subject to flooding and agricultural land: their identification and careful classification as to long-term values can be pivotal to the innumerable conceptual plans and ultimate project proposals being generated by many decision makers.

This alternative emphasizes protection of the natural functions of a few critical resources – for providing water; forest, agricultural, fish and shellfish products; natural protection from erosion and flood damages; and a variety of recreational opportunities. On the surface, the alternative appears to be highly "protectionist", that is, heavily biased in favor of environmental preservation. Upon closer inspection, however, it becomes clear that unless growth and development are guided away from such resources both society and the economy will incur heavy losses. Expensive new sources of water may have to be developed, damage to property and loss of life due to flooding will escalate, the availability of indigenous products (wood, fish, agricultural products) will decrease, and the cost of replacing them will be high.

Communities having significantly higher amounts of critical environmental areas than developable lands as defined by the Study will run into severe income difficulties if the current property tax structure is continued. A number of revisions of the property tax structure have been suggested including state takeover of the tax system and major expenditure burdens (such as schools) and regional pooling of certain tax revenues. Regardless of the system chosen, a revision is long overdue. Without substantial reform, implementation of this alternative would be difficult in many parts of the region.

This alternative does not place limitations on development in lands other than Category A and B. It represents a kind of middle ground – stronger, better integrated than existing programs and regulations, yet not as comprehensive as a program which would also manage growth on less fragile developable lands.

3. Improve Management of Developable Areas. While Alternative 2 emphasized direct protection of critical environmental areas, leaving the management of development on other lands to the current system, Alternative 3 emphasizes just the opposite. Further regulation of critical environmental areas is bypassed. Instead pressure on the region's most critical resources is relieved by guiding development directly to those areas most capable of supporting it, based on the information gained from the resource development capability analysis. The first management step under this alternative, discussion of the types and densities appropriate to the several categories of "developable areas" in the analysis, is presented in two forms. Permissible uses are suggested first, followed by a detailed chart entitled "Guidelines for Appropriate Use of Developable Areas" which displays suggested intensities of use. The second management step under this alternative is a series of measures designed to increase the efficiency of public investments in services to accommodate growth. The third management step under this alternative is the regulation of development of regional impact.

a. Develop According to Resource Capability. The analysis groups in the six categories of developable areas presented on Plates 1, 2, and 3 by three limiting factors: water, wildlife-scenic, and soils. Permissible uses are grouped accordingly.

Water Resource Limitations. To protect *recharge areas* for *aquifers* (black dots, C_1) needed for water supply, density of development without sewering should be strictly limited. Higher densities are permissible with sewering but must be clustered to allow for continued recharge. Other permissible uses include agriculture and forestry. Development of these lands presents several difficult problems. Uses which threaten the quality of the aquifer – such as sanitary landfill, highway deicing salt, industrial waste disposal and excessive use of septic systems – must be prohibited. And while sewering would eliminate this threat to quality, it serves to remove water from the area, reducing the ability of the aquifer to meet future needs, unless ground disposal techniques are employed.

Wildlife and Scenic Limitations. Limited residential development is permissible on both *upland wildlife habitat areas* (diagonal lines, C_3) and *landscape quality areas* (vertical lines, C_2). The latter is also able to support limited commercial development if planned to minimize conflict with the landscape.

Soils Resource Limitations. Development on ledge and steep slope (brown, C_5) areas must be strictly limited and special precautions taken to control erosion and septic tank seepage. Permissible uses of areas with *severe septic system limitations* (orange, C_4) due to slow permeability are highly flexible, varying from low intensity commercial and limited residential use without sewering, to relatively unlimited commercial/industrial and residential uses with sewering. Permissible uses of areas with *no to moderate septic system limitations* (yellow, F and G) include the full range of residential, commercial, and industrial uses from medium intensity commercial/industrial and low density residential without sewering to high intensity commercial/industrial and high density residential with public sewering and public water.

Table 3.8 presents suggestions for appropriate uses of developable areas, displaying residential and commercial/industrial development intensities, both with public water and sewer facilities and without, for every possible combination of soil limitations (yellow, orange, and brown) and other resource limitations (black line overlays) displayed on Plates 1, 2, and 3. While these guidelines include clustering, other forms of development controls such as zoning, when coupled with sound engineering, can provide a great deal of flexibility of application. The Soil Conservation Service (U.S. Department of Agriculture) can provide detailed soils maps and guidelines to assist with engineering design. The U.S. Geological Survey and Fish and Wildlife Service (U.S. Department of Interior), along with locally based state offices can provide additional data for site planning.

b. Public Investment Efficiency Options. On the first page of this chapter, The Setting, decision making factors which affect growth have been described. There is every indication that the competition for capital between major social programs, the need to develop new energy sources, improvement of mass transit facilities and environmental quality programs, will continue into the indefinite future and the factors which affect growth will become more complex. It is not sufficient, therefore, merely to provide an alternative method to guide future growth based solely on resource development capability; if public investments in growth can be made more efficient, every effort must be made to do so. Consequently, this alternative of improving management of developable areas also examines three options for improving public investment efficiency:

Use excess capacity of existing infrastructure. Table 3.7, referred to earlier in this chapter, indicates that, for the region as a whole, the unused capacity of existing and proposed sewer systems is sufficient to accommodate expected growth for the next 20 years. The excess capacity varies from planning area to planning area. The Ipswich-North Shore

TABLE 3.8 SUGGESTED* GUIDELINES FOR USE OF DEVELOPABLE AREAS SHOWN ON PLATES 1, 2, and 3

MAP COLOR	MAP PATTERN / Other Resource Limitations / Soils Limitations	NONE (color only)			
		No other Resource Limitations	High Landscape Quality (Category C_2)	Upland Wildlife Habitat (Category C_3)	Aquifer and/or Ground water recharge areas (Category C_1)
YELLOW	Moderate to No Limitations for septic system disposal (Category F & G)	- PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.0 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At Least 1/2 ac/DU Unclustered - . Med. Intensity I/C . At least 1/2 ac/DU Unclustered or no PW & PS - . No I/C . At least 3 ac/DU**
ORANGE	Severe septic system limitations caused by conditions other than slope and ledge soils (Category C_4)	- PW & PS . Any I/C . Any Res. - PW only . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PS only . Med. Intensity I/C . At least 1/2 ac/DU - PW only . No I/C . At least 3 ac/DU
BROWN	Ledge and/or steep slope greater than 15% (Category C_5)	- PW & PS . No I/C . At least 1/2 ac/DU *** - PW only . No I/C . At least 2 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU

* These are designed to provide a framework for designing guidelines of increasing specificity by state, regional, and local planners, and consultants more intimately knowledgeable with local circumstances.

** In many cases suggested guidelines for development, particularly for ground water, are estimates of probable safe controls made in the absence of greater knowledge of the effects of development on the pollution of aquifers.

*** Erosion control measures should accompany other restrictions on slopes over 15%.

Med. & Low Intensity - refers to water use/effluent discharge/building coverage

Clustering – refers to percent impermeable land surface area which may adversely effect the resource.

PW - Public Water Supply System
PS - Public Sewer System
I/C - Industry/Commercial
Res. - Residential
ac - acre
DU - Dwelling Unit

area is already severely overtaxed, but the present and proposed facilities in the Boston metropolitan area have unused capacity to accommodate expected growth over the next half century. Based on water related infrastructure alone – the Study did not investigate other non-water related infrastructure – urban areas are capable of absorbing a vast amount of the projected growth for the next two decades with far less public investment than is required by the continual outward spread of development to unserviced fringe communities. The decreased dispersion could also facilitate mass transit development and reduce dependence on the automobile. Total air pollution (though probably not urban peak concentrations) and overall energy consumption could be reduced, as could the need for more highways.

Use new infrastructure as a tool to guide growth. It is only another small step to move from making maximum use of existing infrastructure to using expansion of infrastructure as a tool to guide growth. Using infrastructure in this manner can be either reactive or direct. The town of Ramapo, New York, for example, reacting to a major development proposal, decided it would not issue a permit for construction unless an array of services – or infrastructure – was already available at the site. The New York Court of Appeals sustained the controversial ordinance, which was accompanied by an 18 year plan for public capital investments. But use of infrastructure can also be direct. Town or city planners may decide to channel public investments in new infrastructure – water lines, sewer lines – to those areas in which they wish to encourage development. The U. S. Environmental Protection Agency released a report in 1974 which indicated that EPA's funding for wastewater interceptor sewers with excess capacity served as a subsidy to future land development and encouraged sprawl. Half the land to be served by the sewers was vacant. Yet despite what appear to be clear cut opportunities for directly influencing the broad goal of guiding growth through the provision, withholding, or maximum use of infrastructure, the legal precedents are limited. In fact there are none at a more-than-local level.

Clustering. A technique requiring far less regulation than the previous two options for reducing overall infrastructure costs is *clustering.* The Real Estate Research Institute recently completed a study for the President's Council on Environmental Quality and HUD, entitled *The Costs of Sprawl,* in which it examined several different combinations of high, medium, and low density housing patterns in a hypothetical community. As would be expected, the high density (10 units per acre) clustered community cost much less, environmentally as well as economically, than a low density (2 units per acre) unclustered community. More open space was available in the high density community because over half of it remained completely undeveloped. The low density community contained open space in private yards, but all of its land was at least partially developed. Improved but vacant land was left by "leapfrogging" development. Stormwater pollution and sedimentation as well as downstream flooding decreased in the high density clustered community. The clustering patterns turned out to be both resource efficient and public investment efficient. Water consumption was reduced 6 percent by clustering alone, and 35 per cent by high density clustering as a result of more efficient distribution systems. Energy consumption dropped 14 percent by clustering, and 44 percent when clustering was combined with high density. High density produced lower demands for residential heating and air conditioning, and both density and clustering lowered the use of automobiles. Lowered use of energy for heating and automobiles also improved air quality. Public investment costs were lowered by both high density and clustering. Expenditures for roads and utilities were 55 percent less in these communities.

Given the expected increase in population in the next few decades, the opportunities for cost effectiveness suggested in the above study are important. Accommodating the region's projected growth under current land consumption patterns, even though the study has shown that the land is available, will require an enormous public investment. It appears to be both environmentally and fiscally irresponsible to continue making those investments.

c. Regulate Developments of Regional Impact.

Within the alternative of improving the management of developable resources, special attention is given to those key facilities or major growth inducing developments having greater than local impacts. Defined and discussed earlier in this chapter, these briefly include key facilities such as power plants, large scale or growth inducing developments such as shopping centers, and major public facilities such as highways and water and sewer line extensions. While all are vital to the continuing health of the region's economy and, for that matter, to the well-being of the region's people, their effects on the natural environment have generally been negative. The importance of these facilities and the magnitude of their local and regional impacts have been specifically recognized in both the federal Coastal Zone Management Act and the Fed-

eral Water Pollution Control Act Amendments of 1972. Two strategies for guiding the location and controlling the impacts of such developments on the developable areas of SENE have received attention. Two other states in New England have adopted procedures for siting developments of regional impact. Also the Model Land Development Code created by the American Law Institute (ALI) of the American Bar Association contains such procedures.

Under Maine's Site Selection Act, licensing is required for any proposed commercial, residential, or industrial development which would occupy area in excess of 20 acres, excavate natural resources, or include a structure with a ground area of more than 60,000 square feet. The license may be obtained only if the proposal can pass a state-level review of: (a) financial and technical capacity to meet state air and water pollution control standards, to provide adequate solid waste disposal, to control odors, and to secure sufficient water; (b) traffic patterns generated; (c) effects on the natural environment, including existing uses, scenic character, natural resources, and property values; and (d) suitability of soil types for the proposed development. Vermont's Act 250 also includes a review by district commissions of developments and subdivisions of certain types and sizes, and of any development on land on elevations over 2,500 feet. Massachusetts and Rhode Island are both considering various means of providing state input into developments of regional impact. The recently approved Martha's Vineyard Land Use Act was largely based on the ALI code.

A more effective and far more direct way to regulate the location of some key facilities is advance acquisition of sites having the greatest environmental and economic suitability for these uses. By designating appropriate sites, protecting them from preemption by other uses, and either providing interim recreational use or leasing them for short-term use, the region could be assured an adequate supply of suitable sites. This alternative, while expensive in the short-run, would pay off handsomely in the long-run – in land costs, and in infrastructure costs if properly sited. Another alternative would be to provide interim leasing or transfer of development rights. With these alternatives even the short-term costs could be reduced.

It should be noted that while noise and air pollution abatement is not the responsibility of the New England River Basins Commission, the impacts produced by many forms of development may result in such undesirable effects on adjacent areas. And air pollution, depending on the toxicity and level of its constituents in precipitation and storm water runoff, could adversely impact water quality. New development of any degree must be planned with all environmental factors taken into account, as well as social and economic consequences. The U.S. Environmental Protection Agency has promulgated three sets of regulations which could impact the development of air pollution emitting sources. These regulations address air quality maintenance plans, indirect source review, and prevention of significant deterioration. They all recognize that new development must be planned and accomplished in a manner which will protect health and welfare related air quality standards. These examples underscore the necessity for effective coordination of development among all responsible agencies in regulating developments of regional impact.

Recommendations.

The SENE Study's Development Capability Analysis has shown that while occasional shortages may occur in individual planning areas, overall, enough developable land exists to accommodate growth through 2020, even if land is consumed at the high rate of the last decade. However, in the section of this chapter entitled *"Effects of Growth on Water and Related Land Resources,"* it has been shown that as a result of the past decade of development if growth continues along the same dispersed patterns without careful guidance, significant loss of critical environmental areas will occur. It is the conclusion of the Study that a land use plan is badly needed in Southeastern New England. The Study's Development Capability Analysis and the following recommended program constitute an important element of such a plan – one which focuses on water and related land uses.

The recommended program is a strategy for guiding growth in a manner which protects the critical natural functions of the region's water and related lands, yet assures adequate land for economic development. As discussed in *Chapter 2, The Setting,* this program is designed to provide support for the growing emphasis on services in the region's economy.

The recommended program draws on all three alternatives discussed in the last section. It emphasizes the integrated protection of Critical Environmental Areas and suggests ways to minimize negative impacts of development on Developable Areas. At the same time, however, the recommendations support and encourage a number of ongoing programs, recognizing the practical advantage of building upon the firm base of existing institutions.

The major recommendations are:

1. **Increase and Integrate Protection of Critical Environmental Areas**

2. **Improve Management of Developable Areas**

Both are extremely complex management issues, involving a wide variety of management and regulation tools and many key actors. The actors have not been designated for each recommendation below. Almost all of these recommendations can be acted upon immediately by communities, with technical and financial assistance from regional planning agencies and state and federal agencies. However, because of the earlier stated need for integrated, coherent resource management, a comprehensive system should be developed involving state, substate regional (in Massachusetts), and local levels of government. Alternatives for such systems to carry out the following recommendations are explored in *Chapter 10, Strengthening the Management System for Natural Resources.*

1. **Improve Protection of Critical Environmental Areas.** **The region's water bodies, well sites, inland and coastal wetlands, critical erosion areas, beaches, fish spawning areas, shellfish flats, and estuaries have been classified Priority Protection Areas (category "A" resources). The region's flood plains, prime agricultural lands, coastal flood hazard areas, and unique and scenic sites have been classified second priority Other Protection Areas (category "B" resources). Together they form the Critical Environmental Areas in the region – those lands either too fragile to support any development or whose development would constitute a hazard to public health and safety. All these lands should be carefully analyzed for compatible uses on a case-by-case basis to ensure proper protection.**

Priority Protection Areas

Protect water bodies from non-point source pollution by:

- **Subdivision regulations requiring storm water detention ponds for ground water recharge, and where feasible, other methods listed under recommendations for ground water recharge areas. Municipalities, regional planning agencies, and states should develop standards for control of runoff and sediment, assisted by federal agencies such as the Soil Conservation Service (USDA) and the Environmental Protection Agency (EPA).** *(See Chapter 4, Water Supply, and Chapter 5, Water Quality).*

- **Stream bank and lake shore forest buffer strips obtained through acquisition of fee simple or of easements (including interceptor rights-of-way) or town shoreline ordinances along stretches designated for anti-degradation and where erosion and runoff are particular problems.** *(See Chapter 5, Water Quality, and Chapter 8, Flooding and Erosion. See Chapter 5, Water Quality for the recommendations on point-source pollution.)*

Protect wetlands by:

- **Revision of wetlands legislation as detailed in** *Chapter 8, Flooding and Erosion.*

- **Acquisition of the most valuable wetlands.** *Chapter 6, Outdoor Recreation* **identifies a number of wetlands having particular value for recreation as well as for flood storage, ground water recharge and wildlife. Acquisition is appropriate because of their multiple values and is necessary to provide public access for recreation.**

- **Regulation of development on uplands surrounding important wetlands through acquisition for recreational use or conservation easements or other zoning methods.**

- **For coastal wetlands, inclusion on flood hazard maps for HUD's Flood Insurance Program, and regulations prohibiting development in those areas** *(Chapter 8, Flooding and Erosion).*

Protect critical coastal erosion areas by zoning ordinances prohibiting development and any other use that creates health and safety problems or accelerates erosion rates *(Chapter 8, Flooding and Erosion).*

Protect beaches and their immediately adjacent lands by erosion control regulations, prohibition of development, or acquisition for recreational use *(See Chapter 6, Outdoor Recreation, and Chapter 8, Flooding and Erosion).* **These area must be managed so that uses do not degrade the resource. Fragile wildlife areas and dunes must receive special attention and protection from overuse.**

Protect estuaries, fish spawning areas, and shellfish flats though not mapped on the De-

velopment Capabilities Maps, by prohibiting outfalls of wastewater treatment facilities, power plants, or any other major producers of effluent in these locations. Prohibit dredging, sand and gravel mining, installation of pipelines, and any other disturbing activity within these areas. *(Chapter 7, Marine Management and Chapter 9, Locating Key Facilities).*

Other Protection Areas

Protect riverine and tidal flood plains by prohibiting adverse development and discouraging reconstruction after substantial storm damage. Acquire flood plains for public uses such as recreation, relocate public facilities as they are expanded where structural protection is not available or practical. *(Chapter 6, Outdoor Recreation and Chapter 8, Flooding and Erosion.)*

Protect agricultural sites by legislation which would establish appropriate policies, provide for the acquisition of significant sites, and set standards for appropriate regulations. The Massachusetts and Rhode Island state agencies concerned with management of agriculture and natural resources, in cooperation with the U.S. Deptment of Agriculture should work to:

- Identify prime sites for production of both food and non-food (forest) products using available U.S. Department of Agriculture mapping and state university produced land use maps.
- Provide management assistance through cooperative federal-state foresty and soils programs.
- Provide guidelines for local zoning ordinances to protect prime agricultural sites based for example, on U.S. Forest Service forest land suitability criteria such as dispersed recreation use capacity, wood product, production capability, and wildlife habitat potential; guidelines for flexible zoning controls, including PUD's, to create incentives to allow prime agricultural sites to remain undeveloped; and establishing an early warning and review system which would notify authorities of a developer's intent to alter farmlands.
- Clarify authority for local agencies to enact transferable development rights.
- Evaluate (given the small size of agricultural operations in SENE) and prepare an approach which might lead to the establishment of "agricultural districts" where appropriate.
- Protect through local acquisition or provide for limited local acquisition of development rights for highest priority lands most likely to be lost to urbanization.
- Provide federal-state cost-sharing arrangements similar to the U.S. Department of Interior's Land and Water Conservation Fund for the purpose of assisting communities in acquiring prime agricultural sites.
- Actively promote, in Massachusetts, Chapter 61, the Forestland Assessment Act, and Chapter 61A, the Farmland Assessment Act, in order to lower the burden of property taxes on active commercial agricultural operations.
- Actively promote, in Rhode Island, (Chapter 44-27 of the General Laws) which enables preferential assessments for open lands, farm, and forest lands.
- Reform tax laws, in both states, including strengthening the preferential assessment laws by establishing penalties for change of use, providing investment credits for farm related capital costs, sales tax breaks, and/or reducing the extent of reliance on the property tax.

Protect Unique Natural and Cultural Sites by acquisition of conservation or historic easements, development rights, or fee simple, financed by the National Historic Preservation Act and other public and non-profit funds. State and local governments could adopt protective measures similar to, and as extensions of, federal approaches. Use of other techniques is described in the Natural Areas Project of New England Natural Resource Center. These sites are critical features and therefore could be pivotal in conceptual plans and ultimate project proposals.

Protect Proposed Reservoir Sites and Their Related Watersheds, though not mapped on the Development Capabilities Maps, by prohibition of all but low intensity uses such as agriculture or forestry. Monitor the use of tributaries and their banks. *(Chapter 4, Water Supply).*

Protect Erosion Areas also not mapped, by local sediment and erosion control ordinances. *(Chapter 8, Flooding and Erosion).*

2. Improve Management of Developable Areas. The recommendation has three parts which deal with management of all Developable Areas, both within existing developed areas, and in areas yet to be developed: there are no Developable Areas in which management of some kind is not required.

Develop According to Resource Capability. Those lands suitable for development to varying degrees of intensity under several different levels of management control were classified by the Study as Developable Areas (category C, F, and G resources). The region's future growth must be guided to these lands to probihit destruction of Critical Environmental Areas.

Maximize Public Investment Efficiency Options. Wherever possible and desirable guide growth to maximize use of existing excess capacity of infrastructure in already developed areas and in areas to be developed to achieve desired patterns of future growth; and use clustering, planned unit development, and impact zoning to increase the efficiency of resource use and decrease the cost of public investments in services.

Regulate Developments of Regional Impact. Establish criteria for economically and environmentally suitable sites for key facilities, large scale or growth inducing developments, and major public facilities, all of which have greater than local impact on people and resources. To prevent preemption by other uses of the most critical sites, acquire or designate for future public use and lease or specify interim uses.

A more detailed elaboration of the above, generalized recommendation for improving management of areas suitable for development is as follows:

Develop According to Resource Capability.

Manage recharge areas for aquifers necessary for local water supply by:

- Zoning ordinances and subdivision regulations restricting density so that septic systems will not endanger quality of the ground water; densities requiring sewers should be allowed only after analysis of the economic and environmental feasibility of artificial recharge, unless studies show that the aquifer will not be depleted. *(Chapter 4, Water Supply, and Chapter 5, Water Quality).*

- Subdivision regulations ensuring maintenance of water level. Storm water detention ponds with ground water recharge should be required where feasible. Increase recharge in urbanized areas by channeling runoff from roofs back to the soil, installing drains with filters for runoff from streets, driveways and parking lots, use of permeable drainage ditches and maximum open space. *(Chapter 4, Water Supply, Chapter 5, Water Quality, and Chapter 8, Flooding and Erosion).*

- Special precautions incorporated into regulations to restrict activities hazardous to ground water quality such as sanitary landfill, highway deicing salt, industrial wastes, agricultural runoff, and sand and gravel mining below the level of the water table. The operation of sand and gravel mining must be carefully regulated to prevent subsequent fill by polluting substances. *(Chapter 4, Water Supply, and Chapter 9, Locating Key Facilities).*

Manage best upland wildlife habitat (C_3) and areas of high landscape quality (C_2) by zoning ordinances limiting residential development to extremely low density or by encouraging clustering. In high landscape quality

areas large scale developments should not be located on bluffs or hilltops but should be absorbed in forested regions of lower areas to lessen their visual impact. Developments that would tend to preempt the resource values of wildlife habitat and landscape quality should be carefully evaluated to ensure that adverse impacts are fully taken into account.

Manage land with ledge and/or steep slopes by zoning ordinances and subdivision regulations to limit residential densities. Densities on areas with ledge at, or within three feet of, the surface should be determined by feasibility of either septic systems or sewers.

Manage land with severe septic system (C_4) limitations by zoning ordinances and subdivision regulations limiting residential densities unless sewers are present. Higher densities with sewers should be encouraged because many of the other land resource categories are only suitable for low density use.

Manage lands with moderate (F) to no septic system (G) limitations by regulating development on moderate soils according to sewer availability.

Take Advantage of Public Investment Efficiency Options

Maximize use of excess capacity of existing infrastructure in urban areas (category E) which are vacant and suitable for development or redevelopment. It will be necessary for local or state agencies to determine and act on problems which have previously prevented their development. Efficient use and reuse of urban areas will reduce pressure on undeveloped areas.

Use new infrastructure as a tool to guide growth on Developable Areas by locating water and sewer systems where growth is desired. The timing of development could be controlled by providing or withholding provision of infrastructure as well.

Use clustering, planned unit development, and impact zoning to control distribution and density of development, thereby increasing the efficiency of resources use and public investment in services.

Regulate Developments of Regional Impact

Establish criteria for location of such key facilities as power plants and petroleum facilities, and large scale or growth inducing development such as apartment complexes, recreational development, and highway interchanges. These criteria should take into consideration the environmental and economic ramifications of the siting, and should be incorporated into a review and regulation process.

Identify and protect specific sites for key facilities with particular locational needs. For those significant facilities for which few sites meet their requirements with a minimum of environmental degradation, sites identified should be protected from preemption by other uses. The process of site identification should provide opportunity for public review and comment, ensure orderly development of the facilities, and allow multiple uses where possible, such as in transmission line corridors. It should be based on careful consideration not only of the immediate locational factors (needs and impacts of the facility) but also of the regional needs for the uses and the impacts on desired growth.patterns. Sites could be protected by:

- Advance land acquisition for future facility uses, through purchase, interim leasing for compatible uses, and subsequent transfer to the appropriate user.

- Designation of land for future public use and specification of interim uses consistent with the purposes, making use of provisions spelled out in the American Law Institute's Model Land Development Code.

Implications

The SENE Study's detailed Resources Development Capability Analysis indicates that both Rhode Island and Massachusetts have sufficient developable land to meet their needs through 2020. The Study's recommended program is a method for ensuring that the future growth of the region is guided to those areas most capable of supporting new development, and for preserving those water and related land resources critical to protection of the region's water supplies or important for ensuring public health and safety. The recommendations have important implications for national and regional economic development, environmental quality, and overall social well-being. Moreover, they form the foundation for the rest of the SENE program.

The recommendations, if implemented, will have significant positive effects on national economic efficiency, chiefly by reducing the resource and public investment costs of growth. By maximizing the use of the excess capacity of existing infrastructure, the cost of accommodating new development can be significantly reduced. The clustering of new development, in those areas of the region with only limited developable land, will bring savings in construction costs, in energy consumption, in water consumption, and in the cost of expanding and constructing new infrastructure – water, sewer, and transportation facilities. By taking the steps outlined in the recommendations, the region can be assured protection of certain critical resources and yet still have opportunities for new economic development.

It follows that by protecting certain critical environmental areas, the overall environmental quality of the region will be enhanced. Perhaps more important, however, since both states have already taken steps to protect some of these resources, if future growth can be directed to those lands most capable of supporting it, the traditionally negative effects of development – erosion, flooding, loss of wildlife habitat and open space, pollution or loss of water supplies– can be minimized.

Enhancing the region's natural landscape through the implementation of these recommendations will have important benefits for the region's economy as well. The Study emphasizes encouraging economic activities most appropriate to New England. The trends toward light manufacturing and the increasingly dominant services sector depend on the attractiveness of the region's environment to draw and hold skilled personnel. By taking the recommended steps to build where the land can support it, and protect land that cannot, the region's amenity values – in fact its major competitive economic advantage – are ensured and improved. We know, through the resource development capability analysis, that enough legitimately developable land exists to meet our needs. It only makes sense, economically *and* environmentally, to guide growth to those areas.

The recommendations, and the development capability analysis that backs them up, were designed to fit into ongoing state resource management and development programs and the intent of recent federal legislation. Together the recommendations constitute a useful framework through which local, regional, and state planners can carry out their increasingly complex resource management responsibilities and set priorities for future action – a framework which, for the most part, depends on existing programs and institutions.

In the end, the region's people benefit most. The program, if nothing else, provides choice and opportunity: choice of lifestyle – from urban living through clustered suburban development to the more traditional, if highly wasteful, low density sprawl; and opportunity and flexibility for many forms of industrial and commercial development. Southeastern New England is a good place to live and work. The recommended program for guiding growth through resource development capability is designed to keep it that way.

While this chapter concentrated on implementation suggestions which fit within the framework of existing programs and institutions, as noted above, opportunity does exist for improvement. These opportunities are presented in *Chapter 10, Strengthening The Management System for Natural Resources.* In that chapter a number of alternative strategies are presented with a view toward organizing the decision making process in ways which make more effective use of present and potential state planning and regulatory functions for water and related land resources. In order to truly be effective in guiding growth, some realignment of the powers assumed by the state, the region, and the municipalities will be necessary. *Chapter 10* contains the principles for such legislative change.

Water Supply

4

CHAPTER 4 WATER SUPPLY 4-1

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CHAPTER 4 WATER SUPPLY

The Setting

In 1970, 95 percent of the 4.8 million people living in SENE were served by municipal water supply systems. The remainder of the population relied on individual private wells. While municipal systems provided 655 million gallons of water per day (mgd) in 1970, the total average demand in 1990 is expected to be about 890 mgd. In 2020, the projected demand will probably be between 1200 mgd and 1400 mgd. New resources must be developed to supply these needs.

Development, Management, and Delivery of Water Supplies

Massachusetts and Rhode Island differ somewhat in their institutional arrangements for planning, developing, managing, and delivering water, although the general characteristics of institutions in both states are similar. Municipal water supply is generally provided by local institutions. The largest locally-managed regional system in SENE is the Providence Water Supply Board. On the other hand, the region's largest supplier of water, the Metropolitan District Commission (MDC) is not a local institution, but instead is an arm of the state under Massachusetts General Law, Chapter 92.

Local Institutional Arrangements. Local institutional arrangements take several different forms. The most common institutions are public municipal water supply systems, usually created by local legislative action and developed and managed by local water departments. Other forms include private water companies chartered by the state and special water supply systems created by special acts of the legislature to meet the joint needs of a number of communities. Some communities rely wholly or partially on privately owned wells for their municipal water supply.

Historically, municipalities in SENE have depended either on private wells or on a local water supplier who developed and managed their water resources. This arrangement is most appropriate when local ground water is the source of supply. Local water supply systems allow municipalities to remain independent of regional systems. This historical preference for "home rule" in SENE communities must be considered when planning the development of water supplies.

State and Federal Arrangements. Most water supply planning, development, and management is accomplished at the local level; regional, state, and federal agencies have little effective control over water supply planning and implementation policy. However, at certain points in the decision-making process, non-local agencies have significant powers. In *Massachusetts* these non-local powers currently include:

- *The General Court.* Local water supply agencies must seek legislative approval for development outside of local jurisdictions and for diversions out of watersheds.
- *The Office of Administration and Finance.* Local water supply authorities require state approval for many types of capital expenditure.
- *The Department of Public Health.* This department has important approval and veto powers over decisions relating to municipal water supply, quality, and allocation.
- *The Executive Office of Environmental Affairs.* This office directly influences water supply development under its Department of Environmental Management, Division of Water Resources and effectively controls the volume and quality of water supply through the control of wastewater disposal under its Department of Environmental Quality Engineering, Division of Water Pollution Control.
- *The Water Resources Commission.* The WRC coordinates the formulation of state water resource policy and programs.
- *Regional Planning Agencies.* Regional planning agencies in Massachusetts may identify the need for changes in proposed developments through their review powers under A-95 and comparable state review processes.
- *The Courts.* The courts may resolve particular water supply controversies.

In *Rhode Island*, the degree of non-local involvement is similar. Additional institutions and requirements include:

- *The General Assembly.* Local water supply agencies must seek legislative approval for development out-

side of local jurisdictions and for diversions out of watersheds.

- *The Water Resources Board (WRB).* This board supervises the development and conservation of the state's resources. It accomplishes this objective through long-range, comprehensive planning and implementation programs. The WRB is authorized to acquire sites and to construct and operate facilities for water supply.

- *Public referenda.* A public referendum is required on General Obligation bond issues for water supply development projects.

Two *federal* agencies also exercise some control over water supply management:

- *The U. S. Environmental Protection Agency (EPA).* The EPA may require Environmental Impact Statements from federally funded water developers; it also administers water quality permits. In addition, the new Safe Drinking Water Act, gives EPA the authority to set and enforce national drinking water standards.

- *The Department of Housing and Urban Development.* This federal agency may require the satisfactory achievement of certain water supply requirements for eligibility for federal grants-in-aid.

Planning for Water Supply and Water Quality

As outlined in *Chapters 1 and 2* of this report, the SENE Study has developed a series of recommendations which are based on the use of existing institutions and programs. *Chapter 3, Guiding Growth,* provides a framework in which water supply and water quality plans are developed in the context of other water and related land resource policies. Planning for water supply and water quality, if the basic policies discussed in *Chapter 3* are followed, must be accomplished in an integrated manner.

Water supply and water quality are intimately related. Just as the amount of water used by a community affects the efficiency of its wastewater treatment plant, so, too, does the amount of sewering in a community affect the level of its ground water resources and its stream flows. Therefore, basic policies involving water supply and water quality issues must be resolved in a spirit of coordination and cooperation.

Ideally, *Chapter 4, Water Supply, and Chapter 5, Water Quality,* should be treated together. However, because water supply and water quality institutions are generally separate in the SENE region, it seemed desirable to provide each group with information which emphasized its particular concerns. The Study's recommendations, while fully recognizing the interrelationships between water quantity and quality, can be implemented by the existing water supply and water quality institutions themselves.

At the same time, every effort has been made to stress water supply and water quality interrelationships through numerous cross-references in each chapter. The section in *Chapter 4, entitled "Improving Water Supply and Water Quality Management"* discusses methods by which greater cooperation between water supply and water quality institutions might be achieved. In *Chapter 5, a section entitled "Areawide Management"* also deals with this topic. Moreover, *Chapter 10, Strengthening the Management System for Natural Resources,* contains a discussion of long-range efforts for regional, integrated management of each state's water quality and supply.

It must be emphasized that the reader cannot gain a clear perspective on water supply or water quality in the SENE region without also reading the other chapters cross-referenced in the text. For example, *Chapter 4* builds upon the principles presented in *Chapter 3, Guiding Growth,* by recommending policies and actions designed to protect Critical Environmental Areas and by discussing the various constraints on land use imposed by the necessary protection of significant ground and surface water resources. Cross-references to other chapters such as *Outdoor Recreation (Chapter 6)* have also been made. *Chapter 11, Tying the Recommendations Together,* summarizes the interrelationships between objectives and recommendations designed to meet water supply needs and those proposed in other chapters of this report.

The Situation

The major objective of the SENE water supply program is to meet municipal needs for adequate supplies of fresh water in the most economically feasible and environmentally sound manner. In addition, wherever possible, the Study has attempted to accomplish this objective through consideration of local preferences. The objective was considered in light of alternatives such as demand management, the use of surface and ground water sources, local self-sufficiency, reliance on emerging technology, improved water resources management, in-basin and inter-basin transfers, and improved institutional management.

In 1970, public water supply systems in SENE supplied 655 million gallons per day (mgd) to 95 percent of the people living in the region. The estimated 1990 and 2020 water consumption needs for the SENE region have been calculated on the basis of the Bureau of Economic Analysis OBERS "Series E" population projections. These projections estimate a population of 5.8 million in the region by 1990 and 7.0 million by 2020. They reflect a significant decrease in the rate of population growth in the region.

Using these figures and assuming historical trends, a one percent (1.0%) per capita increase in water use per year through 1990, the total average demand in 1990 is expected to be approximately 890 mgd (Table 4.1). If such a trend in consumption were to continue, the projected demand in 2020 would be about 1,400 mgd. In this case, about 700 mgd would have to be developed over 1970 supplies. However, it may be reasonable to assume a lower rate of increase in water consumption after 1990. The present rate of consumption, occasioned by the widespread use of appliances such as air conditioners, dishwashers, and washing machines will probably level off somewhat in the next 20 years. Industrial consumption may level off as well, as higher water quality will allow more industries to recycle their water. The number of water-using industries in the region may also decrease in the future as SENE becomes more "services-oriented" *(Chapter 2, The Setting)*. In addition, water conservation and the increased use of efficient water saving appliances will probably also slow the increasing rate of water consumption. If a lower per capita increase in consumption, for example 0.5 percent per year, is assumed after 1990, the projected average demand for water will be about 1,200 mgd by 2020. Even so, the deficit between 1970 and 2020 will be about 500 mgd. New resources must be developed if the residents of the SENE region are to be supplied with sufficient water in the future.

The Solutions

Alternatives

In order to satisfy the objective of meeting municipal needs for an adequate supply of fresh water, the SENE Study has considered a number of alternative measures:

- Managing water demand;
- Developing ground water;
- Developing surface water;
- Achieving self-sufficiency;
- Using emerging technology;
- Improving water supply and water quality management;
- Making interbasin transfers;
- Expanding or forming regional systems; and
- Improving institutional arrangements.

TABLE 4.1 AVERAGE DAY WATER USE PROJECTIONS BY PLANNING AREA*: 1990 and 2020 (in mgd)

Planning Area	1990 Use	2020 Use
Ipswich-North Shore	108.91	189.64
Boston Metropolitan	407.23	525.61
South Shore	31.10	80.38
Cape Cod & Islands	27.40	55.01
Buzzards Bay	31.49	61.50
Taunton	70.20	121.11
Blackstone & Vicinity	141.83	197.09
Pawtuxet	26.38	44.69
Narragansett Bay	40.89	80.50
Pawcatuck	8.27	17.08
TOTAL:	893.70	1372.61

* Planning area totals based solely on projected average day water needs at an increase in use of 1% per capita per year.

The following discussions will consider each of these alternatives in turn. Generally, a combination of the above measures will provide the best solution for a specific situation.

Managing Water Demand. Even if the SENE population stabilizes sometime during the 21st century as presently appears likely, a decrease or stabilization in the water consumption increase rate will be necessary to slow down the region's demand. Anticipated demands can be significantly reduced if water conservation measures are instituted. Unfortunately, despite recent public concern for the conservation of natural resources and the need for planning to address environmental issues, the public has not been willing to save water, except in situations of extreme emergency. The low cost of water – for example, approximately 1 cent for 50 gallons in communities served by the MDC – may be primarily responsible for the lack of a water conservation ethic.

Because of the environmental, economic, social, and legal constraints which hinder increasing water supplies in SENE, there is a strong need for managing not only supply but water demand as well. Since demand is, for some high volume users of water, a function of price, some basic changes in the present structure of water rates should be considered.

The price of water should not merely represent the sum required for its transmission to home or business. Under the criterion of economic efficiency, water should be priced in such a way as to ensure its allocation to those uses for which its value exceeds the cost of increased supply. To ensure that this occurs, price needs to be set equal to the marginal cost of production. Those users who value additional water more than its marginal cost will use it, while those who value it less will tend to conserve it. If paying the full marginal cost of production precludes certain uses and restricts others, it may be argued that those uses are not in the best economic interest of society when water resources are scarce. Marginal cost pricing tends to clear the market for water at the point of maximum net benefit to society. Therefore, it can be an important instrument of public policy aimed at efficient allocation of water resources.

Where the demand for water is elastic (its use drops significantly with rising prices), price increases can substantially affect not only the total amount used, but also the patterns of use over time and the allocation of water resources among different uses. These adjustments in turn, can strongly influence the size and timing of incremental additions to supply capacity, as well as the valuation and distribution of net benefits from incremental capacity expansion.

It is generally recognized that the demand for water for domestic, institutional, and commercial uses is price inelastic – even doubling the price would probably not have a significant effect on demand by the private sector. On the other hand, the price of water is generally elastic for large industrial and agricultural users. Replacing the decreasing block rate structure presently charged to these high-volume users with a higher metered flat rate or a schedule of increasing block rates, would help bring the prices offered to high-volume users more in line with the cost of developing new sources of supply. The short-run effects on commercial and industrial users would be largely income-distributional. However, in the longer run, high-volume users would have an incentive to invest in water-saving equipment and conserve usage in other ways. Voluntary compliance with the uneconomical aspects of the pricing policy by water utilities is unlikely, however. Therefore, legislation would be required to implement pricing alternatives.

Some industries are now investigating the feasibility of recycling their own wastewater in their manufacturing processes. Such a "closed cycle" would have a marked effect on the amount of water used by industry, and would free supplies for municipal use. The new effect of such a practice will vary with the percentage of municipal water supplies used by industries. If industrial use requires 40 percent of municipal supplies, increasing block rates and subsequent reduction of industrial use could result in a significant reduction of total municipal water consumption. However, if only 20 percent or less of municipal supplies is required, even large reductions on the part of industrial consumers would not result in substantial net savings.

Although in general, residential use of water would not be affected by all but the highest rate increases, some water demand management policies could be instituted for this sector. A case exists for charging the full marginal cost price to all users during the peak-load season (June – August). Maximum-day demands (about 160 percent of average-day demands) occur during this period. This fact assumes significance once it is realized that the water supply systems are designed to meet projected maximum-day demands rather than average-day demands, and the additional unit cost of this capacity expansion is considerably higher than average. Next, certain peak season demands such as lawn sprinkling are known to be price elastic (Howe and Linaweaver, 1967, Water Resources Research, Vol. 3 #1, pp. 13-30). Finally, seasonal rates can be applied administratively, without requiring any special meters.

If other institutional pricing mechanisms fail, a progressive sales tax on retail water sales could be instituted. The

proceeds from such a tax could be placed in a special fund established for the purpose of financing future water supply and wastewater treatment developments, or to compensate the communities whose environment is disturbed by large water supply systems.

In this context, it is important to note that although water supply and wastewater treatment are closely related issues, consumers should not be charged twice for wastewater treatment by their sewer and water bills. At the same time, however, consumers should be aware that an interrelationship does exist between water quantity and quality and that their patterns of water use affect both situations. A program of public education, outlining the advantages of conservation in maintaining water supplies and protecting water quality is another form of "demand management" not accomplished by economic means.

Additionally, a form of demand management for the private sector can be achieved by requiring the use of water-saving devices when their efficiency has been proved. It has been estimated that nearly 50 percent of household consumption of water is accounted for by toilets. Similarly, some washing machines use twice as much water as some others. It appears desirable, therefore, that proven water-saving fixtures be considered in all new buildings whenever the cost of water saved would exceed the cost of the conservation device. Again, a public education campaign on the benefits of such fixtures could increase their use and reduce unnecessary waste of water.

In conclusion, it may be said that although the case for water demand management has not been accepted by the public in water-plentiful parts of the country like the Northeast, it has been shown to be effective in other water-short parts of the country. Additional study to determine the true cost of water, including its social and economic costs, must be carried out. Policy guidelines are also needed for using the revenues collected for social and environmental improvements. Although it will not solve all our water conservation problems, water demand management appears to be a useful tool in developing a water conscious society and in encouraging a more efficient use of water.

Developing Ground Water. Even if the rate of increase in water consumption can be reduced or stabilized within the next 15 to 25 years, additional sources of supply will still have to be tapped to meet the 1990 and 2020 SENE water demands. As in the past, ground water and surface water will be the two major sources of additional future supplies. Figure 4.1 shows which of those sources are proposed to supply the towns of the SENE region. Development of either of these sources presents advantages or problems, according to the specific situation under consideration. Municipalities with a choice between ground and surface sources must balance these pro's and con's before choosing either alternative or a combination of both. This section discusses the ground water alternative, while the next section will examine surface water.

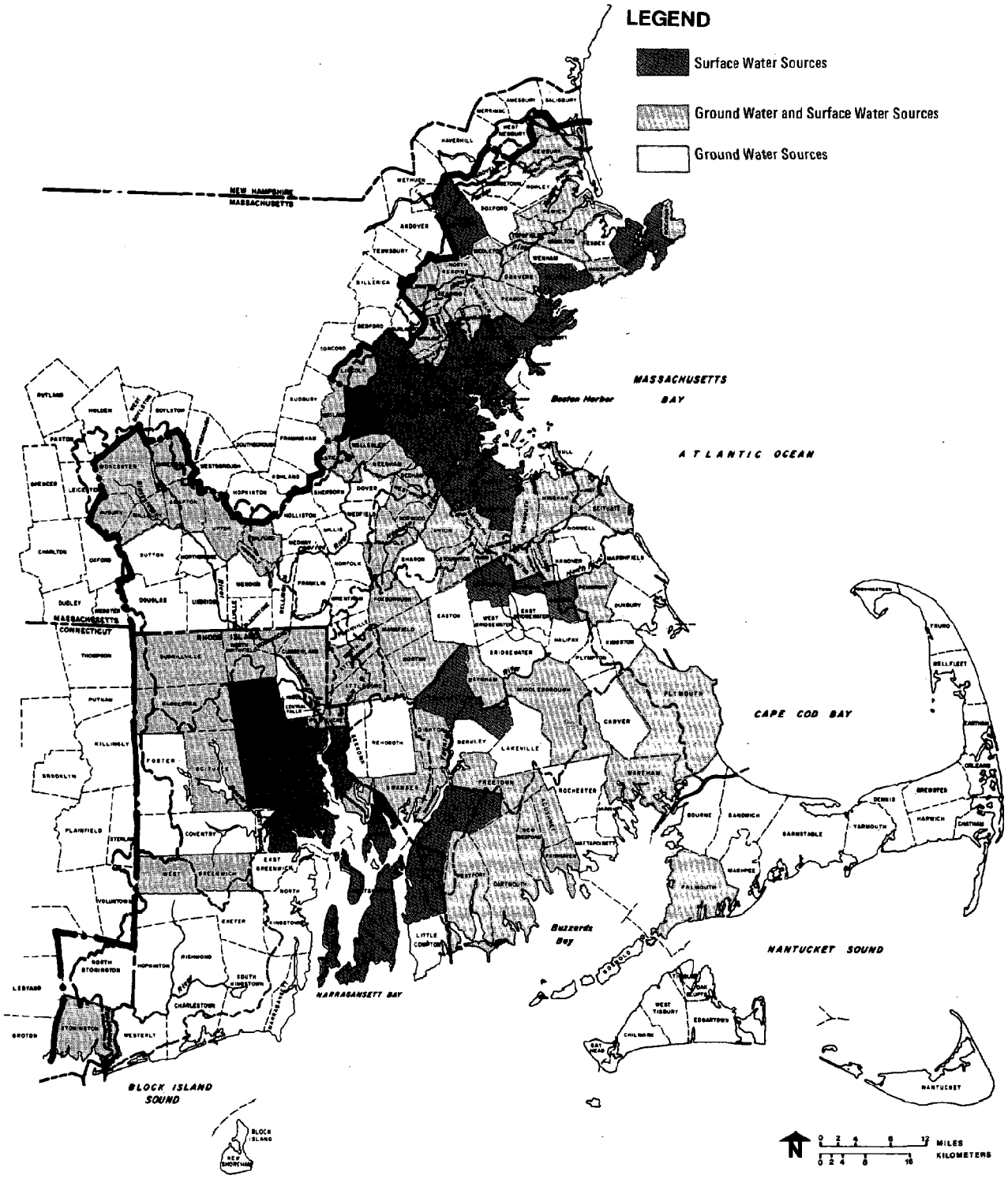
In many cases, ground water is presently the most economical source of supply. At a very general level, the cost of developing ground water might be expected to amount to approximately $100 per million gallons. This figure includes the costs of a limited amount of exploration and the development and operation of wells at a local level. It includes the price of chlorination, but does not include the price of ground water treatment for removal of iron and manganese. Even the cost of this treatment, which could increase the price of ground water by about 40 percent, might still be less expensive in many cases than development of surface water sources. Moreover, the desirability of ground water development is further enhanced by the opportunity for municipalities to spread out capital expenditures over time through phased construction of wells.

Ground water resources are particularly appropriate when supplies are developed and delivered at a local level. The preference of many of the SENE communities for local autonomy has previously been emphasized. Rural communities in the SENE region are the most likely to continue their reliance on ground water supplies. Not only do they have the necessary recharge areas and the limited demands, but these communities also tend to have the strongest feelings about "home rule" and local independence from regional water districts.

However, municipalities which rely on ground water as a local source of supply must be aware of the importance of maintaining and improving their supplies. They must also be aware of the environmental and economic impacts which result from ground water use. However, they must develop new sources of ground water, if possible.

The drought of the sixties (1963-1966) revealed that many municipal ground water supplies were insufficient under extreme drought conditions. All too many SENE communities have been unwilling to spend the money to develop supplies until it has been demonstrated that they do not have an adequate safe yield to meet conditions such as drought or increased demand.

The *Central Massachusetts Water Supply Study* has recommended that all communities with the potential for locating and developing additional ground water sources should undertake continuing programs of well exploration, testing, and site acquisition. The objective would be to completely



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

PROPOSED
WATER SUPPLY SOURCES

FIG. NO. 4.1

evaluate the ground water resources of these municipalities within a five-year period. Where sufficient water is available, communities should acquire well sites at least adequate to supply projected 2020 demands as soon as possible; even wells requiring some treatment should be acquired if they are the best available. If the municipalities acquire water supply resources now, and protect and preserve them to meet future demands while encouraging compatible interim use, then eventual social, economic, and environmental costs should be significantly reduced.

In many municipalities, especially in the Blackstone, Pawcatuck, and Cape Cod planning areas, geologic conditions are favorable for ground water development, and ground water is the most economical alternative. For communities such as these, the Central Massachusetts Water Study has recommended that the Water Resources Commission, in cooperation with the U. S. Geological Survey (USGS), conduct a survey of ground water location, quantity, and availability in the region. In Rhode Island, the same projects are being carried out by the Water Resources Board and the USGS. Such a survey would provide information to help municipalities design their well-site exploration programs and to assist regional agencies in evaluating future needs to supplement ground water. In addition, the survey would provide data necessary for the regulation, protection, and preservation of ground water resources.

Such a program could enhance the economic outlook of communities relying on ground water by allowing them to use this economical source of supply to its maximum extent. The communities would benefit from the expertise of the Water Resources Commission and the U. S. Geological Survey in preserving existing resources and in developing additional supplies. A recent referendum in Barnstable County has authorized the County Commissioners to appropriate funds for such a program on Cape Cod. The program will be jointly financed by the Divisions of Water Pollution Control and Water Resources of the state's Water Resources Commission, Barnstable County, the U. S. Geological Survey, and the National Park Service. Figure 4.2 shows all areas in SENE where ground water studies and management should be implemented.

As development encroaches on recharge areas, many kinds of activities tend to threaten the quality of ground water supplies. The protection of these recharge areas in communities relying on ground water is therefore extremely important. Activities shown to be hazardous to ground water quality, such as operating sanitary landfills, storage and use of highway deicing salt, and industrial waste disposal, to name only a few, should be restricted from recharge areas of both existing and potential sites for public supply wells.

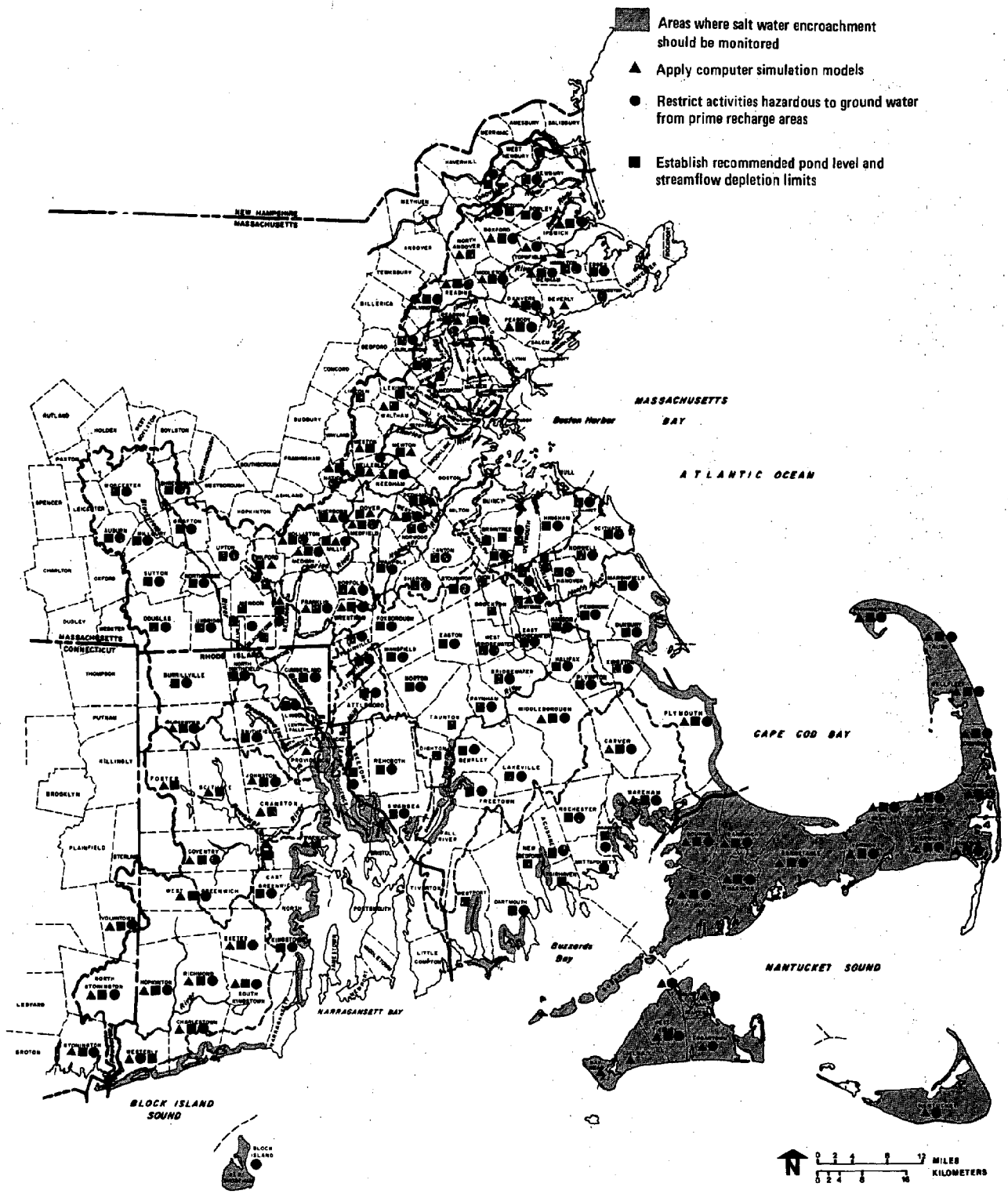
This alternative would enhance social well-being and environmental quality by protecting valuable ground water sources from pollution. In addition, it corresponds in part with the land use recommendation included in *Chapter 3, (Guiding Growth)*, protecting portions of "*Developable Areas Requiring Management*" some of which are aquifers and recharge areas, (Category C on Plates 1, 2, and 3).

It is important that such land use policies be formulated as soon as possible by the communities involved, in order to avoid degradation of these resources. Municipalities relying on ground water could receive economic benefits from this low-cost source. However, they must pay the price for this advantage by restricting land development over recharge areas and perhaps by regulating housing density or by sewering areas which might otherwise affect ground water quality.

In order to maximize the potential of ground water resources, it will be necessary for municipalities to maintain ground water recharge and to prevent contamination from natural as well as man-made sources. Coastal communities relying on ground water should be encouraged to monitor salt water encroachment and to define acceptable limits for encroachment caused by well withdrawal. A legal and institutional framework should be established to prevent violation of these limits. Monitoring will provide an early warning system to safeguard ground water quality for future use. After the necessary legal authority is provided, individual municipalities or a regional water management agency, such as the one discussed for Cape Cod in a following section, could maintain ground water levels and control and limit salt water intrusion by requiring permits for ground water withdrawal in excess of 50,000 gallons per day. *Further water management actions are outlined in the Cape Cod and Islands Planning Area Report.*

Regulating ground water withdrawal is also a method of protecting streamflows and pond levels. All rivers in the SENE region are highly dependent on ground water discharge for their flows, especially during the summer months. Examples of streams which could be particularly sensitive to depletion caused by existing or potential ground water development are the Ipswich River, the Charles and Aberjona Rivers (Boston Metropolitan planning area), Abbott Run (Blackstone planning area), the Chipuxet and Usquepaug Rivers (Pawcatuck planning area), and the Ten Mile River. Even though some aquifers have a high theoretical safe yield, withdrawal of too much of their water can result in excessively low streamflows or pond levels. Pumping permits should be required to control streamflow depletion and pond level lowering in these cases.

The Rhode Island Water Resources Board currently sets stream depletion standards in that state. For communities relying on ground water, municipalities or water management authorities should establish recommended pond level and streamflow depletion limits based on the value



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	AREAS FOR GROUND WATER MANAGEMENT	FIG. NO. 4.2

not only of water supply, but of other water uses as well. Maintaining specific streamflows and pond levels will correct many social and environmental problems of low or irregular flows. Water quality will tend to improve, recreational uses such as boating and fishing will not be impaired, and fish and biota will live in a more favorable environment. Furthermore, higher streamflows will provide downstream surface sources with a more dependable water supply. (Note. These same advantages can be achieved by programs of low flow augmentation). *(See Chapter 5, Water Quality.)*

Maintenance of ground water recharge in municipalities with increasing development is an important problem. Increased development in many towns has covered recharge areas with houses, roads, shopping centers, and other impermeable surfaces. In order to maintain their ground water supplies, these communities can create new rapid recharge areas where infiltration may be concentrated. The low cost of ground water may be enough to offset the extra costs in maintaining its supply. Again, trade-offs must be made by the municipalities, restricting development in the new recharge areas so that they may compensate for the recharge lands previously lost to development.

A topic of some controversy in SENE at the present time is the land application of treated wastewater. *(See Chapter 5, Water Quality).* This process has the benefit of recharging ground water from sources (stormwater and wastewater systems) which would otherwise carry their water out of the basin. However, land application is also a potential source of water quality degradation, and careful attention must be given to the water quality and health aspects of such disposal. If future study shows that land application is economically, environmentally, and medically sound, spray irrigation of treated wastewater would be particularly appropriate in the Taunton and Cape Cod planning areas.

This topic is discussed more fully in the Water Supply and Water Quality sections of the individual planning area reports.

In conclusion, where ground water is available, it is an economical source of supply. It also allows municipalities to make the most of local resources and to remain independent of regional water supply systems. However, in some parts of the SENE region there may be "too much of a good thing". For example, Burrillville, Rhode Island has seven independent water supply systems. In many cases, local systems may have inadequate financial resources for maintenance of their property or the expansion of their service areas. The benefits of local autonomy for these systems must be balanced against the economic and environmental losses due to inefficient management. Municipalities which choose to use ground water must also be sure to avoid harmful environmental impacts. Moreover, they must take decisive steps to maintain or improve the quality and quantity of their resources. If this is accomplished, their water supply policy will retain a flexibility greater than that of municipalities which have abandoned their local ground water sources for other supplies.

Developing Surface Water. Many municipalities do not have additional supplies of available ground water, or if available, its low quality may require a prohibitively costly degree of treatment. Because of the large quantities of surface water available for use, it is an extremely important source of supply, though it is often more costly than ground water. While the development of local surface water supplies may be convenient, this action generally proves to be extremely expensive. While local ground water supplies may cost about $100 per million gallons *(see above)* comparable local surface water developments may roughly cost as much as $500 to $700 per million gallons. Acquisition of land, construction of dams, aqueducts, and water mains, as well as system maintenance and water treatment, can be more efficiently handled by a group of municipalities working together. These municipalities will realize economies of scale by joining other cities and towns in regional water supply systems. A rough estimate for the cost of developing regional surface water systems, comparable to the local surface and local ground water systems discussed above, would be approximately $400 per million gallons. SENE's largest regional system, the MDC, is able to realize significant economies of scale. It charges about $240 for a million gallons of water. Of the surface sources in SENE, the Ipswich and Taunton Rivers in Massachusetts and the Big (Pawtuxet planning area) and Tarkiln (Blackstone and Vicinity planning area) Rivers in Rhode Island, appear to be particularly appropriate as sources of regional water supply.

Regional surface water supply systems can provide economies of scale where local systems prove to be inefficient. Cost sharing, operational efficiency, and quality control are benefits provided by the regionalization of surface water supply systems. For surface water dependent areas, regionalization of systems should be encouraged. At the same time, it must be noted that regionalization sacrifices the local autonomy of individual municipalities for economic rewards and the long-term security of inter-municipal cooperation. Several regional water supply systems have been recommended for the SENE region. Some of these are discussed briefly in a following section, and *all are discussed at length in the separate planning area reports.* Among the recommendations are proposals for establishing systems in the Ipswich River, Taunton River, South Shore, and Blackstone planning

areas. Extensions of service for existing water supply systems such as the MDC, the Providence Water Supply Board, and the Brockton Water Commission, have also been proposed and are discussed in greater detail in the appropriate planning area reports. It thus appears reasonable that, where local water supply development has proven insufficent, where growth is expected, and where sources of supply are limited, certain municipalities should be encouraged to join existing regional systems, or to form new ones for their organizational and economic benefits. Figure 4.3 shows the existing and proposed regional water supply systems in SENE.

Surface water, like ground water, must be developed and managed to provide adequate supplies for future needs. Most important, municipalities having existing sources of supply should maintain the quality and yield of those sources to ensure their continued use as long as it is technically possible and environmentally and economically feasible. It must be stressed that maintenance of existing water supplies generally provides the most efficient resource use and usually offers high long-term cost benefits. In addition, to preserve future options for development of water supply resources, key watersheds should be acquired or managed *(See Chapter 3, Guiding Growth).* Management of watersheds should include monitoring of tributaries to ensure that sources of pollution are restricted from the area. A municipality should not foreclose its future water supply alternatives by failing to purchase or protect areas which have a potential for further water resource development. Proposed reservoirs and their watersheds are classified as *"Other Protection Areas"* (Category B) in *Chapter 3,* and they should be carefully managed to avoid an irretrievable commitment of resources.

In the past, emphasis has been placed on the protection of surface water resources. However, future state requirements will tend toward complete treatment of all surface sources. With the emphasis on treatment rather than on preservation, municipalities may, in the future, be able to develop some water sources of low quality which are not presently used. Moreover, if complete treatment is mandatory, the large amount of watershed acreage now required for reservoir protection may not be necessary. Instead, some of the land could be used for limited recreational purposes *(See Chapter 6, Outdoor Recreation).* Appropriate steps must be taken, however, to assure that recreation activity will not conflict with the primary use of these resources, i.e., the provision of safe, palatable drinking water.

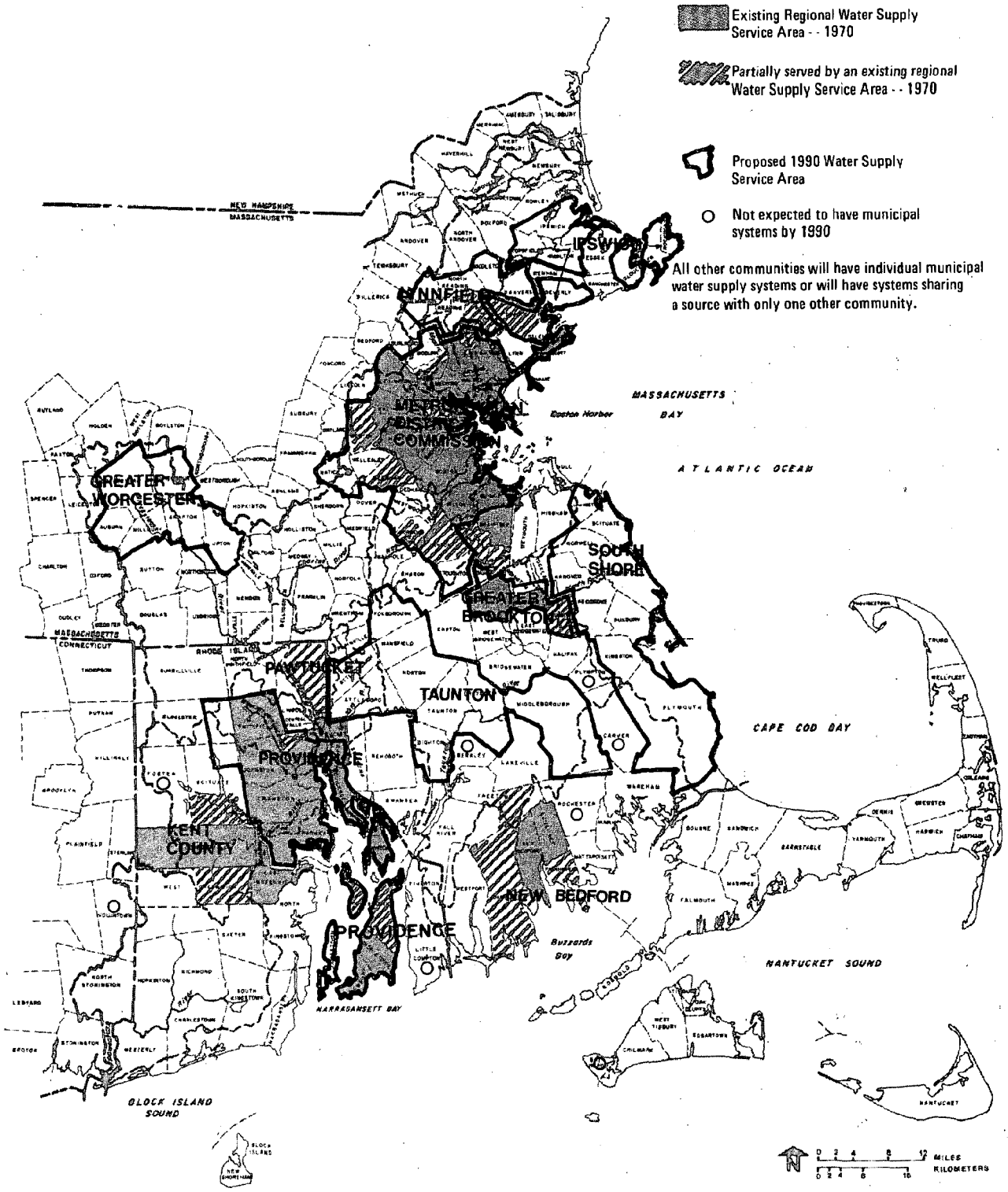
Surface water, then, will continue to serve as a major source of supply in SENE. In general, the smaller, more local water systems will be able to develop ground water more cheaply than they would surface water resources. However, the larger the system, the more likely it is that surface water will be a more economical source of supply.

Achieving Self-Sufficiency. In the two previous sections, a great deal of emphasis has been placed on alternatives which maintain or encourage development of existing local resources. The alternatives to be considered in this case are self-sufficiency and dependence on out-of-community or out-of-basin resources. In general, local self-sufficiency is a more flexible and more popular, but often a more costly alternative than dependence on outside systems. In order to achieve a "hydrologic balance", water should ideally be used and disposed of in the basin from which it was withdrawn. Moreover, the economic and social complications of interbasin transfers, to say nothing of the legal complications of interregional transfers, can impede the transport of water and minimize its quantity. The use of local ground water or in-basin regional surface water supply systems are the alternatives which best achieve the goal of self-sufficiency. They allow a flexibility in water supply policy which is lost if in-basin sources are not used to their maximum extent.

If carried to extremes, however, a policy of self-sufficiency can militate against concentrated growth patterns – held to be the basis of a rational SENE land use policy in *Chapter 3.* Local self-sufficiency should not be encouraged to the point where it identifies the environmental, economic, and social consequences of scattered growth. After judicious use of in-basin ground water and regional in-basin surface water, interbasin transfers will be the only alternative for supplies to be developed in the near future. Figure 4.4 illustrates the existing and proposed water supply transfers in SENE. It is apparent that many of them cross hydrologic boundaries. *Further discussion of specific in-basin and interbasin transfers may be found in the ten planning area reports.*

Using Emerging Technology. By 1990 or 2020, research into wastewater recycling, spray irrigation of treated wastewater, and desalination may have made them feasible alternatives to reservoir construction for sources of water supply. As far as wastewater recycling is concerned, the Engineering News Record centennial edition of April 30, 1974 stated:

> "Under present AWT (advanced wastewater treatment) technology, the cost of bringing secondary effluent to drinking water quality is about 40 cents per 1,000 gallons in a 10 mgd plant. As the volume increases, the price falls. . . ."

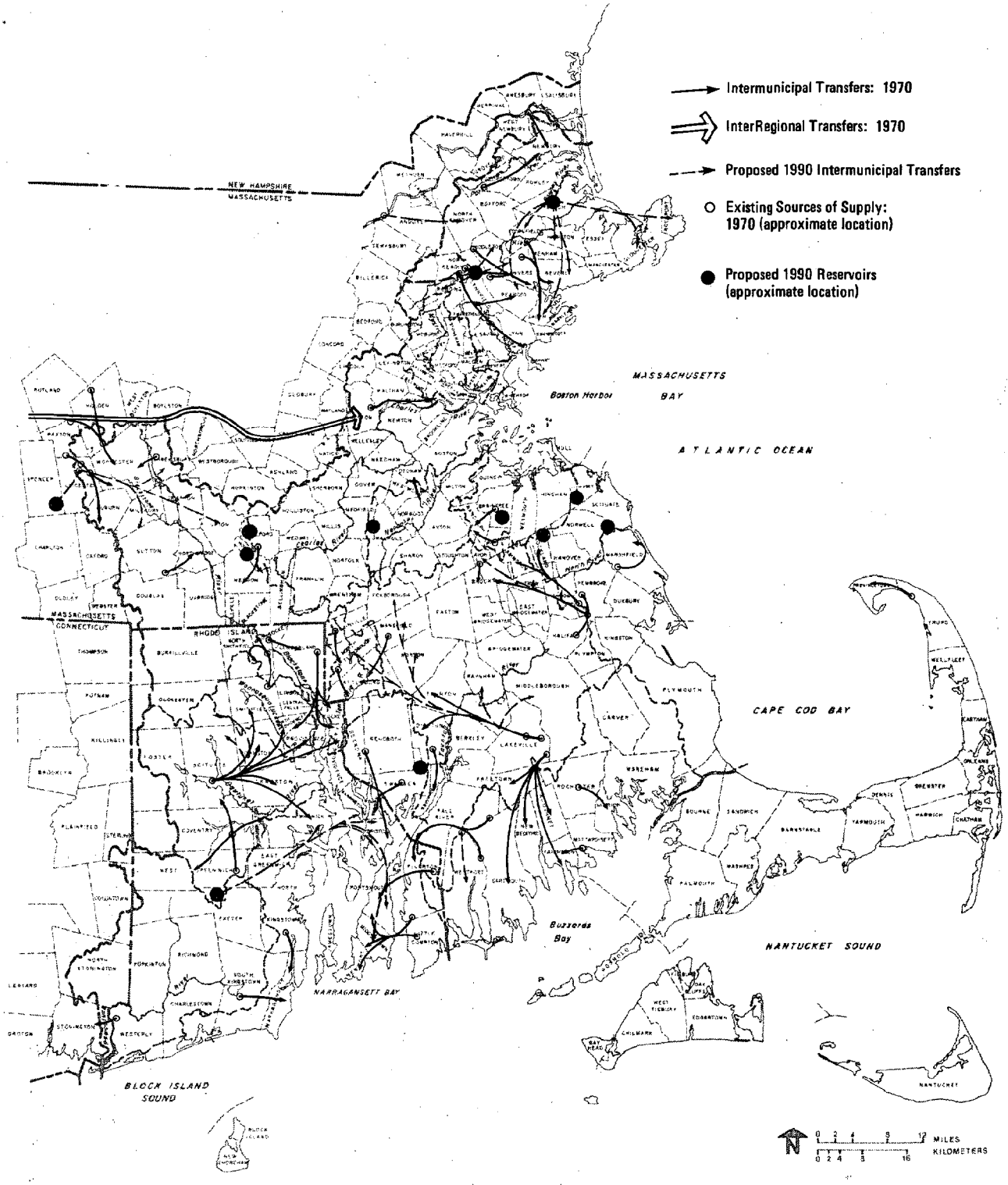


NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

EXISTING AND PROPOSED
WATER SUPPLY SERVICE AREAS

FIG. NO. 4.3



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	EXISTING & PROPOSED WATER SUPPLY TRANSFERS	FIG. NO. 4.4

However, there are not enough examples of this type of technology to recommend it for general use without qualification. Furthermore, the cost cited in the quotation does not appear to include transmission and distribution, both of which are the major components of total water supply costs.

Drinking water is only one of the many products of recycling, however, and some industries are already recycling wastewater for use in their manufacturing processes. If water quality standards are met, industrial water supplies may become pure enough to make recycling even more economically feasible for many high volume water users. Again quoting from the Engineering News Record centennial edition:

> "By 1974 or 1975 [Denver] will reclaim 10 million gallons daily of wastewater for industrial use; by 1986 about 100 mgd, and by 2000, reclaimed water will supply 25% of the city's total needs."

Thus, while it will probably be many years before recycled wastewater is used for drinking water, it could be feasible to use it in some industrial processes in SENE in the near future, thereby making additional water supplies available for municipal use.

Although the current energy crisis and a continuing shortage of fossil fuels may have adverse effects on the economic feasibility of energy-intensive desalination in conjunction with conventional power plants, the use of waste heat from nuclear power plants for desalination is a topic which should be carefully researched. In addition to providing a lower cost energy source for the desalination process, this method would help to reduce the thermal pollution presently caused by nuclear power plants. If further research on this method of desalination – and on methods of disposing of the brine it would generate – were successful, municipalities on the South Shore might be able to jointly develop an economically feasible desalination facility for public water supply with the Pilgrim nuclear power plant in Plymouth. Some distribution facilities already exist for such a source, a fact which increases its economic viability.

Spray irrigation, *discussed in the ground water section of this chapter* could indirectly provide the SENE region with a new "source" of water. Spray irrigation of treated wastewater provides a way of returning water to the water table from which it was originally drawn. Additional study of the economic feasibility, environmental impacts, and health aspects of this procedure in SENE must be undertaken.

Advanced technologies may, in the long-run, alleviate some of the future water supply problems which the SENE region faces. Although they may relieve many of the environmental stresses which we are currently placing on our water resources, we should ensure through intensive research, that they do not place additional burdens on the environment.

Improving Water Supply and Water Quality. Water supply and water quality are intimately related. For example, removing wastewater from a watershed by sewering can lower the level of ground water and deplete streamflow there, creating a problem for municipalities which rely upon ground water resources for their supplies. On the other hand, the amount of water consumed in a municipality directly affects the size and efficiency of its treatment plants. An effort must be made to coordinate the management practices at both ends of the water pipe.

Water supply systems are generally not institutionally linked with wastewater disposal. The Metropolitan District Commission is probably the only exception to this general situation in the SENE region. Greater coordination between water supply and wastewater disposal systems, however, could result in economic and environmental benefits for the region, as well as in more efficient water management policies for both water supply and water quality interests.

One method of coordinating water resource management would be to establish regional authorities to deal with wastewater treatment and disposal as well as with the development, maintenance, and distribution of water supplies. These authorities would have regulatory, operational, and management powers in areas of water supply and wastewater disposal. However, conflicts might arise between proposed water management authorities and existing water supply and wastewater disposal systems. If the geographical boundaries of the last two interests were not coterminous, a great deal of institutional reshuffling and political confusion could result. In addition, the interests of local municipalities and local water supply and wastewater disposal systems in "home rule" are in many cases too entrenched to accept a regional authority which could dictate water supply and disposal policies. Much careful research and consideration would have to go into recommending the immediate adoption of specific water management authorities. The background information available to the SENE Study was not sufficient to provide such a recommendation. However, over the long-term, conditions for the establishment of regional water management authorities may become more favorable. Two institutional approaches for a more integrated approach to water management are described in *Chapter 10, Strengthening the Management System for Natural Resources.* In addition, *Chapter 5, Water Quality,* discusses areawide waste management in the context of recent water pollution legislation.

A modification of the regional authority alternative has been suggested for the *Cape Cod planning area and is more fully discussed in that planning area report.* However, in general, the recommendation states that a regional water agency, while not responsible for delivery of water supplies, will have the authority to manage uses of the Cape's supplies for protection of their water quality. The economic and environmental value of ground water to the area as a whole is too great to allow the inconsistency and duplication of effort involved in local water management. Other areas of the SENE region where such agencies may be appropriate for both ground and surface water management are: municipalities in the Ipswich River basin (Ipswich-North Shore planning area); and the Pawtuxet planning area *(see those planning area reports for details).*

Making Interbasin Transfer: The MDC. Because the major supplier of water in SENE, the Metropolitan District Commission (MDC), is truly regional – indeed interregional – in scope, it is appropriate to include a discussion of its future options in this report. The MDC manages the water supply, wastewater treatment, and outdoor recreation facilities of many of its member communities. It is the largest regional water supply system in New England. Currently, the MDC supplies the water needs of 41 Massachusetts municipalities* (32 within the SENE region) from three major reservoirs: Quabbin, Wachusett, and Sudbury. These reservoirs impound water diverted from tributaries of the Connecticut and Merrimack River basins. Table 4.2 lists the municipalities served by the MDC as of 1970.

As in the case of other regional developments, the importation of water to municipalities in the Boston Metropolitan and Ipswich-North Shore planning areas has been primarily due to necessity. Where ground water of sufficient quality and quantity is present, it should be developed. However, local development of ground and surface supplies in MDC towns is generally less satisfactory than importation of water, because of the lack of high quality supplies or the preemption of well sites, recharge areas, and watershed lands by urban and suburban development.

TABLE 4.2 COMMUNITIES SERVED BY THE MDC in 1970

FULLY SUPPLIED MEMBERS:		
Arlington	Marblehead	Revere
Belmont	Medford	Saugus
Boston	Melrose	Somerville
Brookline	Milton	Stoneham
Chelsea	Nahant	Swampscott
Everett	Newton	Waltham
Lexington	Norwood	Watertown
Malden	Quincy	Winthrop
PARTIALLY SUPPLIED MEMBERS:		
Cambridge	Peabody	
Canton	Wakefield	
Lynnfield	Weston	
Needham	Winchester	
NON-MEMBERS SUPPLIED:		
Clinton	Leominster	Southborough
Chicopee	Marlborough	South Hadley, F.D. #1
Framingham	Northborough	Wilbraham
		*Worcester

* On an emergency basis only.

* Worcester also receives emergency supplies from the MDC. Lancaster has an agreement with the MDC to receive water, but has not made use of this agreement since 1963.

The existing dependable yield of the MDC system is estimated to be 300 mgd. However, the average daily amount of water furnished by the system in 1970 was 307 mgd. Above average rates of precipitation since 1971 have enabled the MDC to supply more water than its theoretical safe yield.*

The existing deficit in the MDC's water supply must be corrected in the near future. In addition, the system will require new sources of supply as its member communities increase their consumption and as additional towns gain membership. In 1974, the *Northeastern United States Water Supply (NEWS) Study* by the U. S. Army Corps of Engineers estimated that by 1990, 24 additional municipalities (18 of them within the SENE region) will have no option for water supply other than the MDC. These municipalities are listed on Table 4.3.** The Corps estimated that these communities and the 41 presently served communities will place an additional demand of 141 mgd (over its present 300 mgd yield) on the MDC by 1990. The Metropolitan Area Planning Council, in its report on *Alternative Regional Water Supply Systems for the Boston Metropolitan Area* (Camp, Dresser and McKee, February, 1971), came to a similar conclusion, estimating that the MDC would require 196 mgd over its 300 mgd yield by 1990.

In order to meet its projected demands, the NEWS Study recommended Northfield Mountain and Millers River basin projects would divert an average of 72 and 76 mgd, respectively, from the Connecticut River basin during periods of high flow. The Northfield Mountain project would use a high flow skimming technique, principally during spring runoff periods, diverting water from the main stem of the Connecticut through Northeast Utilities' pumped storage hydroelectric facility in Northfield and Erving, Massachusetts. In order to provide water for the diversion, Northeast Utilities would pump an additional 375 million gallons into its upper storage reservoir each day that flows in the Connecticut are above a control flow of 17,000 cubic feet per second (cfs) at the Montague City U.S. Geological Survey gaging station. The diverted water would then be piped to Quabbin Reservoir through a 9.8 mile long aqueduct. Although high flow skimming of 375 mgd could yield an annual average of 84 mgd to the MDC system, the NEWS Study estimates that, because of "operational considerations," the average daily yield to Quabbin would be about 72 mgd.

Like the Northfield Mountain diversion, the Millers River basin project would use high flow skimming techniques to divert water from the East Branch of the Tully River, about four miles above Athol, Massachusetts, and from the main stem of the Millers River, about three miles above Athol. Both diversions in the Millers River basin would require not only the control flow of 17,000 cfs on the Connecticut at Montague City (see above), but would also require minimum flows on their respective rivers. Diversions might occur simultaneously or possibly only at one site, depending on the control flows and the water quality of the two rivers. Because of the low quality of the Millers River, treatment at the project's intake, or advanced treatment at the point pollution sources along the river, would be required. The combined diversion from the Tully and Millers Rivers would be carried to Quabbin through a seven mile long aqueduct and would provide the MDC with an average annual supply of 76 mgd. This amount, combined with the 72 mgd from the Northfield Mountain diversion, would provide 148 mgd to meet the NEWS Study's projected needs for MDC communities in 1990.

TABLE 4.3 COMPARISON OF NEWS AND SENE FINDINGS: COMMUNITIES WITH NO REPORTED OPTION OTHER THAN THE MDC

*Ashland	Holbrook	Millis	Stow
Avon	Holliston	*Natick	Sudbury
Bolton	*Hudson	Norfolk	*Wellesley
Braintree	Lincoln	Randolph	*Westwood
*Dedham	*Maynard	Sherborn	Weymouth
Dover	Medfield	*Stoughton	*Woburn

* Communities which the SENE Study finds have no reported option other than the MDC. All communities listed here have been identified by the NEWS Study as having no reported option other than the MDC for meeting projected water supply needs.

*Average daily amount of water supplied by the MDC in:

1971 = 322 mgd
1972 = 318 mgd
1973 = 316 mgd

**The MDC is now negotiating with two other municipalities not considered by the NEWS or SENE studies. However, both studies found that these municipalities have alternative sources other than the MDC.

Findings in the SENE Study, however, indicate that reliance of the 65 towns on MDC supplies may not be as great as suggested by NEWS. Table 4.4 presents results of the NEWS and SENE studies for comparison. The SENE Study findings are based on two factors which differ from those of the NEWS analysis: lower population projections and a different interpretation of existing and potential local resources available to meet water needs.

Both the NEWS and SENE studies estimate a reasonably close rate of increase in domestic per capita water consumption between 1970 and 1990. However, while the NEWS Study uses the OBERS "Series C" figures as the basis for its projections, the SENE Study has used a more recent set of figures, the OBERS "Series E" projections. The latter projections assume a continuation of the zero population birth rate level which the nation is now experiencing, rather than the higher 1960–70 national growth rate on which the "Series C" projections are based.* Although the disaggregated figures may not be totally accurate for individual towns and cities, it is felt that, over the total number of municipalities considered in this comparison, the Series E figures are reasonable projections.

The second major difference between the SENE Study and NEWS figures is the evaluation of sources other than the MDC. Based on its policy of maximum use of local resources, the SENE Study has investigated the existing or potential local surface and ground water sources for the same 65 municipalities evaluated by the NEWS Study. Detailed accounts of the SENE Study's findings for the communities within the SENE region may be found in the

TABLE 4.4 COMPARISON OF NEWS AND SENE STUDY ESTIMATES FOR WATER SUPPLIES IN METROPOLITAN BOSTON THROUGH 1990 WITHOUT NORTHFIELD MOUNTAIN AND MILLERS RIVER DIVERSIONS. a/

Assumptions – DEMAND	NEWS	SENE
Rate of growth, per capita use	1.1 gpcd/yr b/	1.1% pc/yr c/
Total projected population 1990	2,845,000	2,773,000
Total projected demand 1990	524 mgd d	493 mgd
Assumptions – SUPPLY (in mgd)		
Existing MDC supply	300	300
Existing local supply	74 e/	104 f/
Potential local supply	9	12
Total projected supply – 1990 without additional diversions	383	416
Net deficit – 1990	141	77

a/ Service area: Current MDC towns (fully and partially supplied, 32), current non-member towns supplied (9), and towns identified by NEWS as having no reported options other than MDC service by 1990 (24).

b/ gallons per capita per day/year graphical; domestic rate (industrial rate not available)

c/ per capita/year compounded; domestic and industrial rate

d/ total NEWS demand based on domestic and industrial projections

e/ 1970 yield of ground water systems reduced to allow for 1970 maximum day demands

f/ 1970 yield of ground water systems applied to 1990 average day demands
Additional supplies available to meet 1990 maximum day demands.

*In fact, the OBERS Series E figures closely approximate the "Dispersed" estimates (or the lower limit of county population totals listed in the NEWS study [Millers River Basin Water Supply Project, Volume II, Appendix B, pp. B-13 to B-14]).

Boston Metropolitan and Ipswich North Shore Planning Area Reports.

Although the SENE Study was able to identify 12 mgd in potential additional local resources in the 65 communities, this figure is not significantly different from the 9 mgd which the NEWS Study identified as additional supplies. Thus, the major difference in the two studies' water supply figures is 30 mgd in the estimated yield of *existing* local supplies. This difference may be explained by the fact that the NEWS Study significantly reduced its estimate of the amount of existing ground water supplies if these supplies were insufficient to meet maximum day demands. In contrast, the SENE Study included all ground water supplies which satisfied communities' average day demands,* provided that these communities also had storage of additional supplies sufficient to meet their maximum day demands.

Therefore, of the 24 additional communities which the NEWS Study assigned to the MDC service area by 1990, the SENE Study has found that only 9 would have to join the MDC at that time (see Table 4.3). The remaining 15 municipalities appear to have a sufficient amount of water from existing or potential local sources to postpone their membership in the MDC system. If more detailed investigations of local resource potential reveal that additional supplies are not available or suitable for use, the affected municipalities will require connection to the MDC.

The last row of figures on Table 4.4 compares the NEWS and SENE Study estimates of MDC communities' need for water by 1990 if no additional sources of water supply were developed (i.e., if neither the Northfield Mountain nor the Millers River basin diversions were constructed). While the NEWS Study estimates that 141 mgd would be required by 1990, the SENE Study figures indicate that, based on lower demand projections and on maximum use of local resources, only 77 mgd would be necessary to meet the MDC communities' needs. The question faced by the MDC is how these short-range needs will be met.

The SENE Study has investigated short-range water supply alternatives to the Northfield and Millers River diversions, but to date has been unable to suggest any alternatives which, either separately or in combination, are demonstrably superior to these projects. However, work is in progress by others on several studies, and additional investigation needs to be carried out in order to determine their feasibility.

The Merrimack River presently serves as a source of water supply for Lawrence, Lowell, and Methuen, and could, with treatment, serve communities in the Ipswich and Merrimack basins which now are members of the MDC or which might have to join the MDC in the future. The NEWS Study is presently considering the advisability of providing supplies to several Merrimack Valley communities from the Merrimack by 1990. However, the NEWS Study is not considering diversions from the Merrimack to serve out-of-basin needs, including those of the MDC, until after 1990. Presently, the water quality of the Merrimack River necessitates a high degree of treatment before it can be used as a water supply source. The cost of treatment and distribution, which could result in a total project cost as high as $79.1 million for in-basin use alone,** precludes this alternative as a practical short-term solution for MDC needs. State and local interests in New Hampshire are also concerned about the potential Massachusetts diversions of the Merrimack. Nevertheless, it appears that a clean Merrimack River will hold the greatest potential as a long-term solution for the MDC's water supply problems, and continuing study of this alternative is extremely important.

The MDC is currently sponsoring a study on the feasibility of using the Upper Sudbury River as a source of additional water supplies. A draft report has been prepared and is undergoing review by the MDC, but no conclusive information has been developed as yet. However, there is a possibility that if technical matters are resolved, the Upper Sudbury could provide the MDC with additional supplies of between 30 and 40 mgd by the mid-1980's. These supplies would be in addition to the 15 mgd presently being withdrawn from the Sudbury River for MDC use. Until more definitive information is developed, neither the MDC nor the SENE Study can evaluate the feasibility of the Upper Sudbury project, but it appears to be a potentially valuable source of supply, and the Study endorses the MDC's continued investigations.

The apparently substantial reserves of ground water in Plymouth County, Massachusetts, have been suggested as an alternative source to the Northfield Mountain and the Millers River diversions. However, as discussed in the South Shore Planning Area Report, the South Shore is one of the fastest growing areas in the Southeastern New England region. Based on discussions with consultants who are conducting a water supply study in the area, the SENE Study's conclusion is that Plymouth County ground water will be needed

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* Average day demands represent a community's yearly average of daily water demands. Maximum day demands represent the amount of water required by a community on the peak day in any given year. Because ground water supplies generally have no storage facilities, communities which rely entirely on ground water must develop enough supplies to meet their maximum day demands even though these peak demands may occur infrequently. However, the SENE Study finds that communities which use both surface and ground water supplies can rely on the storage capacity of their reservoirs to provide the additional water needed to meet maximum day demands. Thus, these communities only need to develop ground water supplies to meet their average day demands.

** MERRIMACK RIVER WATER SUPPLY STUDY. Information Packet for Public Meeting, July, 1975.

to meet local, in-basin water supply needs. This source may be a short-term solution, helping to keep several South Shore communities from having to join the MDC, but, in the long-run, it will probably not be possible to supply the MDC area with enough Plymouth County ground water to reduce the need for additional sources.

Desalination has been proposed as a source of additional MDC water supplies. However, as mentioned earlier in this chapter, present desalination techniques are not economically feasible for large-scale use, and environmental problems, such as brine disposal, still remain to be solved. Desalination will certainly not be economically feasible in time to preclude the need for the Northfield Mountain diversion, and it is doubtful that it could be developed in time, and at a large enough scale, to replace the Millers River diversion. It is important to note, however, that desalination has a great deal of potential as a long-term source of water supply, and studies on the development of economically feasible, environmentally safe methods of desalination should be vigorously pursued.

The reuse of wastewater has also been discussed in a previous section of this chapter. The SENE Study has concluded that while recycling of wastewater for industrial use can be economically sound, it will probably be many years before recycled wastewater is an economically viable alternative to other sources of drinking water supply. Industrial recycling of water would not result in large enough savings to negate the short-term needs for new MDC sources. However, for the long-term, wastewater reuse for drinking water and for industrial use could result in substantial water supply savings in the future, and research in this field must be continued.

Another alternative which should be explored is the reactivation of presently unused local water supplies in communities now served by the MDC. Although the SENE Study staff is aware of no previous work on this matter, it is possible that if local supplies were reactivated, pressures on the MDC sources would be lessened. This proposal is consistent with the Study's theme of making maximum use of local resources. Unfortunately, reactivation may not be an economically acceptable solution for many of the communities involved, which joined the MDC because of the high costs of treating their local supplies. However, communities such as Canton, which joined the MDC because of demands on local wells during the summer months, can maintain local sources to meet most of their needs, while relying on the MDC for augmenting their water supplies during times of peak demand. Other communities which have discontinued the use of previously significant supplies should look into the option of their reactivation to lessen the burden placed on MDC sources. Additional research would have to be carried out to determine the technical feasibility and the costs and benefits of reactivating these local supplies.

Continuing the theme of maximizing the use of in-basin water supplies, the SENE Study strongly endorses the MDC's present policy of requiring maintenance and development of its member communities' local resources. The Study encourages the MDC to continue this policy, even as additional sources become available. Communities which, in the past, were required to purchase a certain percentage of their water from the MDC in order to be served should consider revising their agreements with the MDC if they can make greater use of their local resources and place fewer demands on the MDC. The maintenance and protection of existing in-basin water supplies, as well as the protection of potential local sources, remains the major recommendation of the SENE Study.

Water conservation must also be stressed in the MDC communities. Water saving appliances and fixtures discussed earlier in the chapter could result in stabilized or reduced water demands if they were used on a large enough scale. Unfortunately, it does not appear that this approach can be regarded as a short-term solution to the MDC's water supply problems, as it should require a significant period of time to replace older appliances. In terms of future savings, however, a greater emphasis on water saving devices could increase public awareness of their benefits. The Study has also suggested, above, that these fixtures could be required in new buildings when their cost is less than the price of the water they would save. Certainly, a program of public education on the advantages of water conservation would be a first step towards voluntary "demand management."

Along the same lines, the MDC must act to prevent water losses from system leakage. A recent study * prepared for the MDC by the Water Resources Research Center at the University of Massachusetts and Curran Associates, Inc., has identified a large amount of "unmetered" water usage in MDC communities, particularly in Boston. "Unmetered usage" includes distribution system leaks, unavoidable leakage, meter slippage, "blow-offs" (devices to prevent freezing water pipes or poor water quality), main flushing, sewer flushing, street cleaning, fire fighting, unmetered public usage, and other unmetered usage. Because the unmetered usage in Boston accounts for over half of the total unmetered usage in all MDC communities, the Water Resources Research Center report recommends that the city undertake a study to investigate the causes of this situation. The report also states that leaks and breaks in many water distribution systems are generally regarded as the major components of unmetered usage (p. 57). Even though some leakage in a distribution system is unavoidable,

* Water Usage Study in Communities Served by the Metropolitan District Commission. June, 1975.

the report suggests that, "based on the price of water in the MDC communities, location and repair of leakage in excess of 3,000 gallons per mile of main per day may be considered justifiable" (p. 58). If a large portion of the MDC's unmetered water use is, in fact, leakage and if all communities served by the MDC could eliminate leakage in excess of 3,000 gallons/mile of main/day, the report estimates that approximately 47 mgd of the communities' total 1972 demand of 376 mgd could be saved. Since a large proportion of this water is supplied by the MDC, (about 318 mgd in 1972), the 47 mgd reduction could result in substantial water savings for the system. It is therefore in the best interests of the MDC and the City of Boston to pursue the Water Resources Research Center's investigations further and, if their findings are confirmed, to act immediately to reduce water loss from system leakage.

In light of the foregoing discussions, it appears that while several water supply alternatives may be potentially important to the MDC's future supplies, and while water conservation measures can result in significant savings, neither the above individual alternatives, nor combination of them, has the potential to fully meet the MDC's projected short-range water supply needs of 77 mgd. In contrast, the proposed Northfield Mountain project would supply the MDC's water needs through the late 1980's.

It appears that the water supplies from the Northfield Mountain diversion will be required to meet the needs of MDC communities almost immediately. The diversion, which has been approved by the Massachusetts legislature, would provide the MDC with 72 mgd from the Connecticut main stem. Subject to pending negotiations, the project would use the existing Northfield pumped storage facility operated by Northeast Utilities. The 1980 Connecticut River Basin Plan, prepared by the New England River Basins Commission in 1972, investigated the diversion from the "donor" area's point of view. Recognizing the need for environmental safeguards and the potential political problems which could arise, that Plan recommended the Northfield Mountain diversion, *with the following qualifications:*

1. "The Commission recommends continued evaluation for adverse environmental effects throughout project planning, development, and operation, with mitigation of environmental damage or repair by removal of the cause.

2. "The Commission recommends that all proposed diversions of Connecticut River water below the newly constructed nuclear power plant at Vernon, Vermont, including Northfield Mountain, be conditioned on satisfactory completion of environmental impact evaluations of the power plant. It is recommended that these evaluations include careful investigations of the possibility of radioactive contamination of Connecticut River water into Quabbin Reservoir. It is further recommended that proposed diversions be conditioned on adequate measures to prevent radioactive contamination of diverted water, including water quality monitoring.

3. "Diversion of surplus water from the Basin is recommended subject to recognition of riparian rights, specifically the right of return of these waters when needed for water supply or flow augmentation within the Basin.

4. "The Commission recommends [that] . . . approval of diversions [in addition to that already authorized at Northfield Mountain] be conditioned on:

   a. Creation of a regional mechanism for allocating water in which downstream states have a voice. In the event that the creation of such a mechanism proves unfeasible, it is recommended that its functions be performed by existing institutions with appropriate regional management capabilities;

   b. Prior measurement of the impacts – environmental, social, public health, economic, and other – used in determining "excess flows" [that is to say: prior determination of the impacts the diversion(s) would have]; and,

   c. Prior determination of the location and available yield of ground water sources in the [Connecticut] Basin and on development of adequate measures for their protection, in coordination with environmental and flood management studies conducted as part of the supplemental study program."

The first condition, that of continued evaluation for adverse environmental effects, has been addressed in part by the Corps of Engineers in their environmental studies of the Northfield Mountain and Millers River basin diversions. The Corps has also stated that during post-authorization studies, environmental analysis will continue until action on the projects is complete. Moreover, departments in the Massachusetts Executive Office of Environmental Affairs and the Office of State Planning will have the opportunity to review the environmental effects of the projects during the state's evaluation of their Environmental Impact reports. It should be noted that completion of the Northfield project is subject to compliance with both the Massachusetts Environmental Policy Act and the National Environmental Policy Act. In addition, it is also important that environmental impact be considered after the diversions are in operation and that any adverse effects of the projects be remedied.

Steps are being taken to satisfy the second condition, that of water quality monitoring below the Vernon, Vermont nuclear power plant. The completion of the Atomic Energy Commission's Environmental Impact Statement on the Vermont Yankee plant indicates that public health agencies and detailed monitoring specifications should effectively guard against water quality problems. In addition, the U. S. Environmental Protection Agency (EPA) has advanced the opinion that this diversion would not cause degraded water quality in MDC supplies, provided that the EPA-proposed program of watershed management to maintain Class B water in the vicinity of the water intake at Northfield is carried out.* However, final authority to approve or disapprove of the Northfield project on water quality criteria is the responsibility of the Commonwealth of Massachusetts.

The third condition, recognition of riparian rights, has not yet been resolved by the parties involved, primarily the states of Connecticut and Massachusetts. It may be appropriate to deal with this issue in the context of developing a regional mechanism for the equitable allocation of the Connecticut River basin's water supplies.

The 1980 Basin Plan's final condition, which includes the above-mentioned regional mechanism, deals with diversions beyond the Northfield Mountain project and will be discussed in detail with respect to the Millers River diversion, below.

Whereas the 1980 Connecticut River Basin Plan has documented the issues of environmental safeguards and political equity required by the "donor" region before the Northfield Mountain diversion can be constructed, the SENE Study's figures have substantiated the need for the diversion from the "recipient" area's perspective. Therefore, while observing the qualifications listed above, it is the SENE Study's position that the Northfield Mountain diversion should have first priority for the MDC.

According to the SENE Study's estimates, the completion of the Northfield Mountain project would leave the MDC communities with a 1990 deficit of 5 mgd. Although this amount of water would have to be provided, the figure does not carry the urgency of the 69 mgd deficit projected by the NEWS Study for this same date. In other words, the findings of the SENE Study suggest that although the Northfield Mountain diversion will be needed as soon as possible to meet the MDC's water supply demands, the need for additional supplies will not occur until the late 1980's. However, at that time, several municipalities which will have been able to rely on local sources may have to look to the MDC for supplementary supplies, even if they protect and conserve their existing and potential supplies.

In addition, the rate of water consumption in the 50 municipalities which will require MDC service will continue to increase, though probably at a lower rate than at present.

If the rate of increase of per capita water use remains at about one percent (1%) per year, MDC municipalities would require an additional 196 mgd over the MDC's current safe yield of 300 mgd by 2020 – far more than the two proposed diversions could supply. For reasons given earlier in this chapter, however, it appears more likely that the rate of increase in water use will slow down in the future. If this rate is assumed to be a 0.5 percent increase per capita per year after 1990, the SENE Study estimates that the 50 municipalities which it recommends be assigned to the MDC will require an additional 117 mgd by 2020, rather than 196 mgd.

As the previous discussion of short-term alternatives has shown, the Millers River diversion currently represents the most reliable source of the additional supplies which will be required in the late 1980's. However, water supply alternatives such as the Upper Sudbury River and conservation measures may lessen the pressure which the MDC communities will place on their water resources. With the Millers River basin project in place, and based on the lower 0.5 percent increase in per capita usage per year, the SENE Study estimates that the 76 mgd which the project would supply could meet the MDC's additional water needs through 2020.

In fact, if the lower rate of growth in water use discussed above were to occur, about 31 mgd would be available to meet the additional water requirements of the municipalities which would have to join the MDC between 1990 and 2020.

However, before the Millers River diversion can be constructed, it is extremely important that the final set of conditions, listed above under the 1980 Connecticut River Basin Plan's fourth recommendation, be observed.

The development of a regional mechanism, if feasible, or other appropriate arrangement, between Connecticut and Massachusetts in order to allow downstream interests a voice in water supply allocation is a recommended condition for development of the Millers River diversion as indicated on page 4–20. Unfortunately, despite meetings held between the two states in 1974, the two states have been unable to reach an agreement on the form this mechanism should take. The New England Division of the Army Corps of Engineers recommended that federal loans for both the Northfield Mountain and Millers River basin projects be conditioned upon prior agreements between Massachusetts and Connecticut on the diversion issues. However, reports of the Corps of Engineers' Board of

* Correspondence from Regional Administrator, EPA Region I to Division Engineer, New England Division, Corps of Engineers, February 28, 1975.

Engineers for Rivers and Harbors have stated that, while it will be in the best interests of both Connecticut and Massachusetts to "enter an agreement regarding the management and allocation of waters of the lower Connecticut River,*" it is not necessary to make this agreement a condition for federal loans in the case of the Northfield Mountain or Millers River basin projects.

The Water Resources Research Center has recently been funded to study the question of an interstate water allocation mechanism for the Connecticut River. It is hoped that the recommendations of that study will encourage Connecticut and Massachusetts to reach a mutually acceptable agreement and will provide the states with the tools to do so.

The second prerequisite (page 4–20) before a diversion such as the Millers River basin project could be recommended is that there be prior measurement of the diversion's environmental impacts on the "donor" area. The NEWS Study has included detailed environmental reports on the impacts of the Millers River diversion. The Board of Engineers for Rivers and Harbors found that these reports were of sufficient scope and depth to support the project recommendations. It also concluded that the positive effects of the diversion would outweigh its minor adverse environmental effects. However, respondents in the Connecticut River basin have felt that it is necessary to have more detailed information than has been currently produced, in order to fully evaluate the environmental effects of the project. In addition, Connecticut River basin interests have requested reevaluation of the present control flow requirement of 17,000 cubic feet per second (cfs) at Montague City to determine the appropriateness of that figure.

Water quality monitoring, a prerequisite for the Northfield Mountain diversion under the 1980 Connecticut River Basin Plan, should also be a major consideration for the Millers River diversion. EPA has stated that its approval of the diversion of water from the Millers River is not possible until the point sources of pollution on the river have been treated and good quality water is consistently available.** The Corps of Engineers' Board of Engineers for River and Harbors has also expressed the opinion that in addition to monitoring the water supplies, additional studies should be conducted to more precisely define the scope of the Millers River diversion's water quality problems and ecological effects. Two years ago, the Massachusetts Water Resources Commission indicated a willingness to prepare a mathematical water quality model of the Millers River as a part of the development of a complete plan for that basin. Information from such a model would provide data useful for impact assessment of the diversion of Millers River water to the Quabbin Reservoir.

Currently, the Federal Power Commission, under a separate study, is preparing an environmental impact statement on the relationships among hydroelectric facilities, the electric power generation and transmission systems, and water use in the Connecticut River basin, with extensive use of mathematical models. This material should prove useful in further determining the environmental effects of diversions in the basin.

The findings of the SENE Study indicate that there is time for additional research on the above issues before the Millers River basin project is needed. While the option to divert water from the Millers River basin should be protected by beginning the initial project planning and acquiring the necessary land, this additional time can be used to provide more definitive information on alternatives to the diversion and its environmental consequences. In addition, the Corps of Engineers has stated that its environmental analysis will continue during post-authorization studies.

A third condition (page 4–20) which must be met before the Millers River diversion can be implemented is the prior determination of the adequacy of water resources in the Connecticut River basin. The in-basin water supply needs have been considered both within the earlier Connecticut River Coordinating Committee report*** and also by the Corps of Engineers during the NEWS survey. Water supply needs were considered beyond 2020, and both groups found that the size of the in-basin need was extremely small in comparison with the amount of water that would be left within the river after diversion. Further, during the environmental and ecological investigations of the basin conducted for the NEWS Study, and during the continuing ecological studies of the Connecticut River Supplemental Study, no in-basin needs which would be adversely affected by the diversion were determined.

However, members of the 1980 Connecticut River Basin Plan's Citizens Review Committee were concerned about the adequacy of Connecticut basin ground water resources to meet future needs. It was felt that the future water requirements of the basin, including the needs of munici-

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* DEAN–BR (21 March 1975) (25 Oct. 74), 2nd Ind., Subject: Northfield Mt. Water Supply Project Survey; Millers River Water Supply Project, Survey.

** Correspondence from Regional Administrator, EPA Region I to Chief Engineer, New England Division, Corps of Engineers, December 24, 1974.

*** Connecticut River Basin Coordinating Committee, Comprehensive Water and Related Land Resources Investigation Connecticut River Basin, Volume III, June 1970.

palities, industries, and agriculture along the Connecticut River and its tributaries, must be considered in establishing a policy on out-of-basin transfers. The group's objective, given the current data base, would be to obtain a reasonable understanding of in-basin needs before allocations of water could be made.

Based upon the foregoing discussions, the SENE Study has determined that the Millers River diversion can be recommended assuming that the conditions of the 1980 Basin Plan are observed. If they are not satisfied, other alternatives may have to be selected, despite their present environmental or economic implications.

In conclusion, the SENE Study has confirmed the MDC's need for the Northfield Mountain diversion. Moreover, it appears that the Millers River basin project will be required by 1990 because no currently proven short-range alternatives will fully meet the MDC's water supply needs. The supplies provided by the Millers River basin diversion can be expected to meet the MDC's additional water requirements through 2020. This is a significant finding. Based on its assumptions of population growth and water use, the SENE Study has indicated that the supplies of the Millers River project will be adequate for a longer period than previously believed.

Of course, population and consumption projections are always open to question, especially when they are long-range estimates. The growth of water supply demands in the MDC service area should be monitored so that the MDC can update its projections of future water demands and can plan for serving them. However, assuming the accuracy of the SENE Study's water consumption projections, this more optimistic picture means that the conditions affecting the environmental and political consequences of the Millers River basin diversion can be clarified before construction of the project begins.

The Secretary of Environmental Affairs for Massachusetts has stated that the timing and economics of water supply alternatives to diversions must be addressed before it is assumed that further diversions are necessary and wise.* As discussed above, the SENE Study indicates that there is additional time for consideration of these alternatives, at least as they apply to the Millers River diversion. At the same time, however, the option to build the Millers River project must be kept open. This can be accomplished by initiating planning and design of the project and by acquiring the land necessary for its construction. In the meantime, work must continue on the long-range water supply solutions which do not involve further diversions of the Connecticut River. The longer the MDC can rely on the Northfield and Millers River basin projects for its additional needs, the more time is allowed for the development of advanced technologies and new resources in Southeastern New England. The Millers River basin project can be expected to meet the MDC's needs through 2020. In the interim, it is likely that alternatives such as diversions from the Upper Sudbury or Merrimack Rivers, recycling, and desalination will become technically, economically, and environmentally feasible as major sources of supply, and that they will be developed when new sources are needed. Constructive use must be made of the years before 2020, ensuring that all long-range solutions are thoroughly investigated from economic, environmental, and social perspectives.

Expanding or Forming Regional Systems. The Study has investigated a number of additional existing and proposed regional water supply systems. Specific recommendations for development of these regional systems have been made and are discussed in detail in the *ten planning area reports.* However, a brief summary of some of the major regional systems is appropriate in this report as well.

Ipswich River System. The Ipswich-North Shore planning area is one of the only areas in SENE where topographic conditions and water availability favor surface water reservoir construction. Existing resources are inadequate to meet projected 1990 needs. Water consumption from the planning area's municipal sources in 1970 averaged 71 mgd. There is an existing safe yield of 79 mgd within the basin, with the MDC supplying an additional 17 mgd. The 1990 maximum-day demand is expected to reach 127 mgd.

The SENE Study recommends that a large regional reservoir, Reservoir 30-B, proposed by the Water Resources Commission, be constructed to serve eight municipalities in the planning area by 1990. After 1990, the reservoir could be expanded to serve additional municipalities. Maintenance of the reservoir and the distribution of supplies could best be handled by the establishment of an Ipswich River regional water supply system.

Despite some local opposition to the reservoir, this source has significant advantages over other alternatives and is strongly endorsed by the Study. Reservoir 30-B would be capable of supplying water at roughly

* Correspondence from Secretary of Environmental Affairs, Commonwealth of Massachusetts, to Chairman, New England River Basins Commission, September, 1975.

the same cost to consumers as expansion of the Metropolitan District Commission. Some of the required land has already been purchased, and many municipalities are involved. A number of these communities will need additional water supplies soon and will have no alternative resources. Further discussion of the situation and the full text of the recommendations may be found in the *Ipswich-North Shore Planning Area Report.*

Taunton and New Bedford Water Departments. The Lakeville Ponds complex, located in the Taunton planning area, has been developed to provide an estimated yield of 31 mgd to the Taunton, Fall River, and New Bedford water departments. Fall River has several alternative sources available, such as expanding the Copicut Reservoir, further developing and treating water from Noquochoke Lake, and exercising unused stream rights of up to 6 mgd. Therefore, this municipality is not expected to use its rights to 11.5 mgd from the Lakeville Ponds until well after 1990. Furthermore, if these rights were exercised, and if Taunton and New Bedford maintained their present levels of withdrawal, the safe yield of the ponds would be exceeded. Taunton and New Bedford will soon need more water and have few alternative sources. Therefore, the SENE Study recommends that these two municipalities acquire Fall River's rights to the Lakeville Ponds.

Should Taunton acquire some of these rights, the city would be assured of 9.4 mgd by 1990, a sufficient yield to supply its own needs through 1990. Dighton already purchases a large portion of its water supply from Taunton. Attleboro will need additional supplies in 1975. Moreover, six other communities will need to supplement their local resources sometime before 1990 in order to meet their peak water demands. Therefore, the SENE Study recommends that all these municipalities form a regional water system using rights to the Lakeville Ponds acquired from Taunton and a diversion of Fall Brook to the Ponds to supplement existing public water supplies.

New Bedford should also purchase a share of Fall River's rights to the Lakeville Ponds. However, this action alone will be insufficient to meet the 1990 needs (over 25 mgd) of New Bedford and the four other municipalities served by the New Bedford Water Department. Therefore, the SENE Study recommends that New Bedford develop potential ground water supplies in New Bedford and Acushnet to supplement its existing safe yield. The *Taunton Planning Area Report* contains a discussion of the Taunton system and the full texts of the corresponding recommendations. The *Buzzards Bay Planning Area Report* contains the discussion and recommendations for the New Bedford System.

Brockton Water Commission. The Brockton Water Commission, with a supply of 13.4 mgd, presently satisfies the total demand of Brockton and Whitman and most of Hanson's demand. It also supplies a small amount of water to Abington, Avon, and Pembroke. Silver Lake, located in both the Taunton and South Shore planning areas, serves as the source of supply for the Brockton system. Because the neighboring town of Avon, will need additional water supplies before 1990, the SENE Study recommends that Brockton extend its service area to include Avon. Flood skimming of Howard and Pine Brooks and the Jones River in Kingston should be explored to augment the existing Silver Lake supply. Additional consideration of the Brockton system may be found in the *Taunton Planning Area Report.*

Providence Water Supply Board. The Providence Water Supply Board (PWSB) is the second largest regional system in SENE. At present, this system supplies, either wholly or partially, the needs of seven municipalities in Rhode Island. Existing dependable yield of the system is estimated to be 72 mgd. In 1970, the PWSB served a total amount of about 55 mgd to its municipalities.

It appears that four more municipalities may be supplementing their present sources with connections to the PWSB by 1990. However, the SENE Study's demand projections indicate that the capacity of the system need only be expanded by 8 mgd through 1990. The SENE Study therefore suggests that the 26 mgd from the proposed Big River Reservoir would be sufficient to supply PWSB municipalities well through 1990. The administration of this reservoir, either by the Providence Water Supply Board or by the state Water Resources Board, should assure the multi-purpose uses of the proposed diversion sites on the Wood River. In addition, either the PWSB or the Water Resources Board should encourage full development of local ground water resources in the Wood River Valley to minimize costs of water supply and to preclude or postpone the need for any surface water impoundments on the Wood River.

This recommendation would expand the amount of water available to the Providence water system to supply future needs in its present service area. It would also allow the system to expand service to several municipalities, such as four communities in lower Narragansett Bay, which may require additional sources of supply after 1990. Further discussion of the recommendation and its full text may be found in

the *Blackstone and Vicinity Planning Area Report.* The recommendation is also discussed in the *Narragansett Bay Planning Area Report.*

Pawtucket Water Supply Board and Woonsocket Water Department. The Rhode Island section of the Blackstone River basin is served primarily by the Pawtucket and Woonsocket water supply systems. Both systems use a combination of ground and surface sources, providing a total yield of about 28 mgd to the six municipalities which they wholly or partially serve. This supply appears to be enough to meet the municipalities' 1990 demands, which are estimated at about 22 mgd. However, in preparation for meeting long-range water needs, the municipalities will have to consider alternative sources of supply. The Tarkiln and Nipmuc reservoir sites are the most suitable areas for development in the northern part of Rhode Island. Projected additional demands on the Pawtucket and Woonsocket systems could be met from the Tarkiln's 5.4 mgd yield alone, well beyond 1990. The SENE Study recommends that the Rhode Island Water Resources Board petition the General Assembly to approve the Tarkiln and Nipmuc projects and provide for the acquisition of these sites in the near future. By acquiring the Tarkiln and Nipmuc sites now, long-range options for the Pawtucket and Woonsocket systems would be assured at considerable savings. This topic will receive further consideration in the *Blackstone and Vicinity Planning Area Report.* The full text of the recommendation may also be found in that report.

Other Regional Systems. In addition to the water supply systems described above, a few other systems are discussed in the planning area reports. A Worcester regional system and a South Shore water district are considered in the *Blackstone and Vicinity and South Shore Planning Area Reports,* respectively. The last district could be developed more for investigation of water supply alternatives than for actual distribution of resources.

Improving Institutional Arrangements. In order to implement many of the alternatives suggested in this chapter, some legislation must be enacted. This section briefly suggests some of the inadequacies of existing legislation and discusses how several of the water supply alternatives may be implemented by legal means. The discussion of ground water management will be followed by alternatives for establishing regional water supply systems.

Ground water management. The maintenance and protection of ground water quality and quantity will not be achieved unless measures for the implementation of some of the alternatives suggested in the ground water section of this report are undertaken. At present, there are few local and no state regulations governing the right to acquire and use ground water resources in Massachusetts and Rhode Island. The courts have recognized however, that rights to percolating water, as opposed to ground water flowing in a definite underground stream, are inherent in the rights of ownership of the overlying land. Thus, the landowner may use the ground water percolating through his land even though his use interferes with the flow of percolating waters in his neighbor's land and diminishes the water in his neighbor's well. However, the landowner may not purposefully or negligently interfere with his neighbor's use of the ground water.

In Rhode Island, an overlying landowner has the same obligation to protect the quality of a subterranean stream as he does with regard to surface streams, but is not liable for the pollution of percolating ground waters unless the person claiming injury can demonstrate that the pollution was the result of negligence on the part of the person controlling the polluting substance.

In Massachusetts, under Chapter 546 of the Acts of 1973 (Chapter 21, section 26A), discharges of polluting matter into ground water from point or major non-point sources is subject to civil and criminal penalties unless a permit, based on effluent limitations set by the Massachusetts Division of Water Pollution Control, has been obtained from the Division. *(See Chapter 5, Water Quality).*

State administrative regulations are limited to registering well drillers and requiring the submission of a report upon completion of a well. However, the Massachusetts Department of Environmental Quality Engineering exercises ultimate authority as to the quality of public underground water supply. Approval of public health officials is required for designation of water sources and for acquisition of watershed land for public water supply.

Local governments in both states are empowered to enact land use controls to further the public health, safety, and welfare. These controls cover public water supply and ground water. Municipalities have the authority, with public health department approval, to acquire watershed lands by purchase or eminent domain to protect both the water quality and safe yield of the water supply. Thus, the acquisition process itself can amount to effective protec-

tion of the resource. Courts have not yet recognized, however, the authority for land use regulations protecting aquifers and recharge areas because of the difficulty of precisely specifying the location of such resources.

Since the most productive aquifers often cross municipal boundary lines, local authorities could be encouraged to provide for their joint management. However, history indicates that municipalities are unlikely to voluntarily undertake such cooperative or complementary efforts. It is unlikely that they will forfeit controls to the region or the state for the purposes of establishing protection zones and regulating the extent of pumping from the aquifer.

Ground water quality should be upgraded or maintained when ground water is a source of supply. Provisions should be made to ensure that ground water used for supply is protected from the contamination associated with septic tanks and other underground pollution. Agencies which decide the location of ground water supplies must often seek cooperation from those that review the location of potentially polluting sources such as highways and drainage systems. Although policies exist to prohibit the improper use of land within several feet of municipal wells, problems of ground water pollution are much too complex to be governed by simple distance regulations.

Because of the specialized nature of knowledge about ground water, and to acquire the expertise needed to make ground water decisions, it has been suggested that legislation ought to be enacted to create a state body of expert ground water hydrologists and other professionals. This body would have the responsibility to study and report on ground water matters and to advise municipalities on resource management. Public health representatives on the board should determine health policy in matters of ground water quality. The board could have the power to close off the water supply or to order the cessation of polluting activity where it found a clear danger from activities such as storage or use of highway deicing salts or pesticide application near ground water sources.

If more effective regulation of ground water recharge areas is to occur, and is desired, the state could play an active role in assuring their protection. State intervention to regulate these areas could be incorporated in a program to manage significant recharge lands. The state could, through a variety of institutional mechanisms, ensure that these areas are developed compatibly with water supply goals. Some alternative approaches to this kind of institutional program are discussed in *Chapter 10, Strengthening the Management System for Natural Resources.*

Regional Supply Systems. In order to establish regional water supply systems, discussed earlier, municipalities will require legal and institutional authorization. A number of alternative arrangements for such systems have been suggested. First, a state controlled regional authority might be established for a given area similar to the MDC model. Second, a system composed of representative municipalities could be created as an independent special district with approval by the state. Third, private water companies could be encouraged to expand to include multi-community service, similar to the existing Dedham Water Company and the Hingham Water Company. A final option might include establishing federal field offices with responsibility for at least the planning and development of supply sources. However, this alternative is probably unacceptable because it would remove responsibility for a local function to a higher level of government than necessary. An optimal arrangement would seek solutions at a local or sub-state regional level, then move reluctantly to the state level only if circumstances so require. The extensive participation and the democratic machinery in the process of developing supply is legally necessary and popularly demanded. For that reason the private water company alternative would prove untenable.

The first suggestion, based on a commission such as the MDC, would also prove disadvantageous for implementing this recommendation. Historically, in the case of the MDC, the creation of a regional agency of state government has set the tone for later decisions to expand in anticipation of regional need. The expansion of supply in advance of need and the provision of services to areas in advance of their growth has led to inefficiencies in the trade-off between cost and dependability of supply. Because of its control by a state representative legislative body, such an agency would not only have diminished efficiency but also a reduced ability to be fair. A "board of directors" of several hundred legislators is, at best, a cumbersome management scheme.

The most efficient and politically expedient way in which to establish a regional system would be on the basis of intermunicipal negotiation and contract. While the impetus for such regionalization should come from member communities, its authority would be subject to approval by state legislatures and public health departments and should be consistent with state water resource planning.

Alternative Plans

In order to meet the 1990 and 2020 water needs in Southeastern New England, the SENE Study considered two alternative plans. First, an environmentally oriented plan emphasized the maximum use of conservation and demand management, along with the maintenance and development of local ground water supplies. In addition, the plan attempted to make each basin in the region as self-sufficient as possible. Second, an economically oriented plan stressed the goal of providing all of the region's required supply at the lowest possible cost.

Recognizing that economic and environmental goals are not necessarily incompatible, as described in *Chapter 1,* the recommended program has attempted to combine the two alternative approaches. It has, however, placed slightly more emphasis on the environmental approach. It has also stressed the social objective of local self-sufficiency wherever possible. The recommendations in the next section accordingly emphasize the development of water supplies at the lowest reasonable environmental cost.

Recommendations

The recommendations for water supply in the SENE region can be divided into three groups. The first group consists of general recommendations which should apply throughout the region. The second group applies to municipalities relying wholly or partially on ground water sources, while the third group of recommendations refers to municipalities whose needs are met by surface sources.

Recommendations applicable throughout the region. Recommendations which apply throughout the region, *listed in their general order of priority,* are as follows:

1. **Maintain existing water resources. The Department of Environmental Management and the Water Resources Commission in Massachusetts and the Water Resources Board in Rhode Island should establish a program which encourages municipalities to maintain the quality and yield of their existing sources of supply to ensure their continued use as long as technically, economically, and environmentally feasible.**

2. **Prefer local ground water to intermunicipal surface water to interbasin transfers. In order to maximize local self-sufficiency, the Water Resources Commission and the Executive Office of Environmental Affairs in Massachusetts and the Water Resources Board in Rhode Island should encourage SENE municipalities to meet future water demands by judiciously using in-basin ground water and regional in-basin surface water resources to their maximum extent before they consider interbasin transfers of water.**

3. **Limit water consumption through education and water saving technology. The Executive Office of Environmental Affairs in Massachusetts and the Water Resources Board in Rhode Island should develop and extend water demand management through pricing for high volume users and through education for residential consumers. They should encourage the use of water saving devices for both domestic and industrial uses to increase the efficiency of water use and to help stabilize or reduce per capita water demand.**

4. **Acquire key watersheds and potential well sites. The Department of Environmental Management in Massachusetts and the Water Resources Board in Rhode Island should establish a program to help their municipalities preserve future options for development of in-basin water supply resources. The agencies should encourage municipalities to acquire and manage key watersheds and potential well sites.**

5. **Establish regional water management agencies. In order to achieve total water resource management for an area, the Executive Office of Environmental Affairs in Massachusetts and the Water Resources Board in Rhode Island should encourage municipalities to join together in regional agencies. These agencies would manage activities which have an impact on water supplies to protect their quantity and quality.**

6. **Study advanced technologies leading to new sources of water. The U. S. Department of the Interior, in cooperation with the Environmental Protection Agency, should greatly increase activities in the investigation of the techniques to desalination in conjunction with nuclear power plants. The Department of Environmental Quality Engineering**

in Massachusetts and the Water Resources Board in Rhode Island should increase research in wastewater re-use (recycling, spray irrigation). In addition, the economic environmental, and public health impacts of the above projects should be carefully researched by the above agencies and by the Department of Public Health in Massachusetts and the Department of Health in Rhode Island. Such activities could make these technologies as viable as other water supply options currently being considered for the period after 1990.

Recommendations for the communities relying wholly or partially on ground water. The SENE Study has formulated recommendations for communities which rely either wholly or partially on ground water. For these municipalities, the recommendations, *listed in their general order of priority*, are as follows:

7. **Survey ground water location, quality, and availability.** The SENE Study endorses the general recommendation from the Central Massachusetts Water Study, summarized as follows: The Massachusetts Water Resources Commission (and the Rhode Island Water Resources Board), in cooperation with the U. S. Geological Survey, should make a survey of ground water location, quantity, and availability in SENE to provide information:

   - To assist municipalities in designing their exploration programs for well sites
   - To assist regional agencies in evaluating future needs to supplement ground water
   - To assist municipalities in regulating, protecting, and preserving their ground water resources.

8. **Restrict activities shown to be hazardous to ground water quality.** The states' departments of health, the Department of Environmental Quality Engineering in Massachusetts, and the Water Resources Board in Rhode Island should encourage municipalities and water management agencies to restrict sanitary landfills, storage and usage of highway deicing salt, industrial waste disposal, fertilizers and other activities hazardous to ground water quality from recharge areas of existing wells and potential sites for high capacity wells.

9. **Limit ground water withdrawal to maintain stream levels.** The Department of Environmental Quality Engineering in Massachusetts and the Water Resources Board in Rhode Island should guide municipalities or regional water management agencies in requiring ground water withdrawal permits to prevent undue streamflow depletion and pond level lowering. Depletion limits should be based on the values of water for all uses, including supply, recreation, navigation, waste assimilation, and aesthetic needs.

10. **Monitor salt water encroachment in coastal aquifers.** The Department of Environmental Quality Engineering in Massachusetts and the Water Resources Board in Rhode Island should guide coastal municipalities, in defining acceptable limits for salt water encroachment and in establishing a legal and institutional framework for the regulation of ground water development.

11. **Provide recharge basins to capture storm runoff.** The Department of Environmental Quality Engineering in Massachusetts and the Water Resources Board in Rhode Island should encourage municipalities to construct (or to have developers construct) new recharge basins in areas where development has covered major recharge lands.

12. **Establish state ground water boards.** The Massachusetts General Court and the Rhode Island General Assembly should establish a state board of qualified ground water hydrologists and public health officials within the respective state Water Resources Commission and Water Resources Board which should be charged with the responsibility for:

    - Coordinating activities such as ground water exploration, salt water monitoring, and limitation of ground water withdrawal.
    - Developing state land use standards for protecting intermunicipal and municipal aquifers and recharge zones.
    - Encouraging the adoption of local land use regulations implementing the state land use standards.

Recommendations for municipalities relying on surface water. The SENE Study has proposed additional recommendations for municipalities relying on surface water systems for their supplies. Recommendations in this third group include:

13. **Expand MDC sources by constructing the Northfield Mountain Facility. Carry out conservation measures. Plan the Millers River Facility.** To meet immediate needs, the Metropolitan District Commission should promptly construct the Northfield Mountain diversion facility. The MDC should actively carry out conservation measures and should encourage investigation of unmetered water use problems. The Millers River basin project does not have to be in operation until the late 1980's, but to protect the opportunity for timely implementation of this option, design and land acquisition should be initiated now. In addition, the MDC should continue to examine the technical, economic, and environmental feasibility and timing of other alternatives for meeting its long-range needs.

    In carrying out this recommendation, the affected states and, specifically, the Massachusetts Executive Office of Environmental Affairs and the Corps of Engineers can continue to implement the provisions of the NERBC 1980 Connecticut River Basin Plan, which recommends continual evaluation for adverse environmental effects throughout project planning, development and operation, with mitigation of environmental damage or repair by removal of the cause. In addition:

    For the Northfield Mountain facility as well as subsequent diversions, the 1980 Basin Plan recommends that:

    - based on satisfactory completion of environmental impact evaluation, proposed diversions be conditioned on adequate measures to prevent radioactive contamination of diverted water, including water quality monitoring; and,
    - diversion of surplus water from the Connecticut basin be subject to recognition of riparian rights, specifically the right of return of these waters when needed for water supply or for flow augmentation within the basin.

    Before any diversions in addition to that already authorized at Northfield Mountain are made (i.e. the Millers River diversion), the Basin Plan recommends that:

    - an appropriate mechanism be established for allocating water in which downstream states have a voice. In the event that the creation of such a mechanism proves unfeasible, it is recommended that its functions be performed by existing institutions with appropriate regional management capabilities.
    - prior evaluation of environmental, social, public health, economic, and other impacts on in-basin needs be made;
    - monitoring the quality of water continue; and,
    - Connecticut River Valley in-basin ground water resources be determined and adequate measures for their protection be developed.

    In five years, the MDC should also re-examine population growth and consumption needs to verify trends and determine the necessary timing of needed solutions; and should:

    - continue to require maintenance and development of member community local resources;
    - actively promote water conservation measures, including use of water-saving devices and demand management; and,
    - take steps to prevent economically avoidable water losses from distribution system.

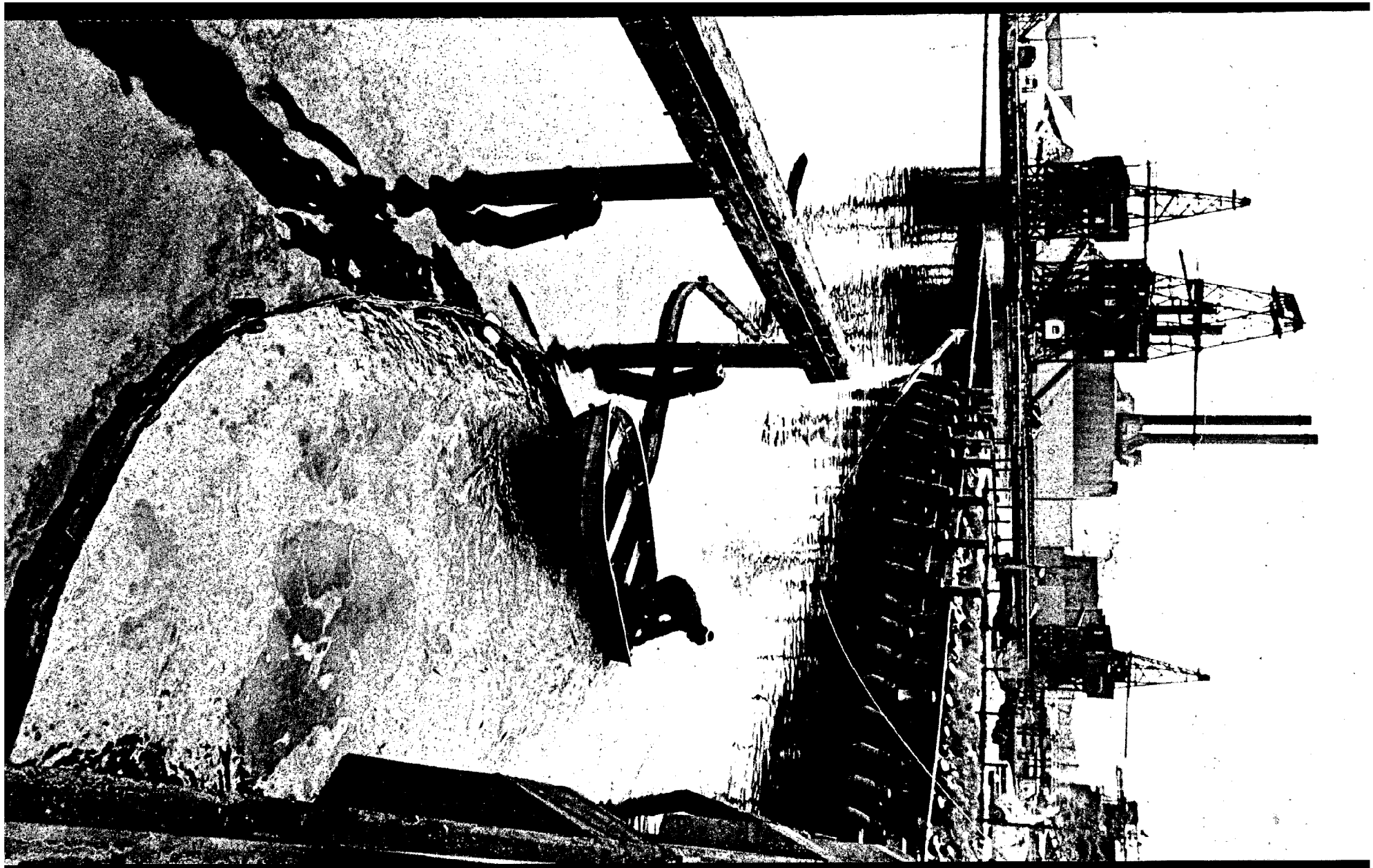
    If the provisions of the 1980 Connecticut River Basin Plan, summarized above, are not satisfied, other alternatives may have to be selected. At the present time, alternatives being studied include:

    - the feasibility of diversion of treated Merrimack River and/or Upper Sudbury River waters to the MDC system as additional sources; and,
    - new technologies including wastewater recycling and desalination.

14. **Encourage regionalization of water supply systems.** The Executive Office of Environmental Affairs and Water Resources Commission in Massachusetts and the Water Resources Board in Rhode Island should encourage regionalization of water supply systems among municipalities wherever it is technically, economically, and environmentally feasible.

Implications

As described in *Chapters 1 and 3*, once overall land use goals have been developed, water supply policy can be used as a tool to bring about greater economic efficiency and environmental quality in the SENE region. Patterns of land use which protect recharge areas and which use existing infrastructure, such as water supply systems, enhance the environmental and economic aspects of life in this region. Furthermore, coordinated water supply and water quality planning can provide more efficient methods of water management and environmental protection. The efficient use and protection of existing sources of water, coupled with careful planning and development of additional sources, should provide the residents and industries of the SENE region with an adequate supply of reasonably economical, high quality water over the next 50 years. Where regionalization is selected, benefits include cost sharing, operational efficiency, and quality control. Maximum use of in-basin resources will maintain local and regional autonomy and will preserve flexibility in water supply policies. In addition, advanced technology may allow the region to develop new sources of water without placing increased stress on its natural resources.



Water Quality

5

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CHAPTER 5 WATER QUALITY

The Setting

The people of the SENE region yearn for clean water – clean streams and ponds, clear harbors, clean shellfish beds, clean salt water beaches. They have said so in unmistakable ways – in their support of strong state water pollution control programs, in support (with occasional exceptions) of local bonding proposals for pollution abatement, in unrelenting pressure on public officials and industry to restore the quality of their waters and keep them that way, and in public meetings held by the SENE Study.

Current Program Levels

The pace of pollution abatement depends heavily on federal grant levels for collection systems and treatment plants. From the start of the federal grant program in 1956 to the end of Fiscal Year 1974, 245 municipal projects, at a cost of $288.6 million, were approved in Massachusetts. During this same period, 65 projects were approved in Rhode Island, at a cost of $44.3 million. Fiscal Year 1976 funds for federal aid to municipal construction projects amount to $295 million in Massachusetts and $45.6 million in Rhode Island. However, the states estimate a total of $812 million per year in Massachusetts and $180 million per year in Rhode Island would be required for the next six years in order to meet their 1983 construction goals. This is three to four times the level of current federal assistance. Thus, a high priority must be placed on the preservation of existing high quality streams in these states rather than on costly after-the-fact restoration.

Present Patterns and Future Trends

Two thirds of major stream miles in the SENE region are presently below state standards, as are most waters in urban harbors – where access to clean water is most urgently needed and is in shortest supply. By 1977, most of these waters – except those bearing the heaviest pollution burdens – will be fishable, and many will be swimmable. Most presently closed shellfish beds will remain closed because of stringent requirements, but the spread of "closed" areas should be slowed. The attractiveness of the SENE region as a place to live and work will be enhanced.

About 70 percent of the SENE region's population is served by municipal wastewater systems. The remaining 30 percent rely on individual septic systems. Twenty-two of 78 major industrial sources are, or will be, treated in municipal plants, by subsurface disposal, by process changes, or by the closing or moving of a business. The remaining 56 industries will be required to provide best practicable treatment (BPT) by July 1, 1977.

But much remains to be done. The most stubborn pollution problems will exist where the value of clean water to the most people is highest – in and near urbanized areas – particularly in cities with substantial industrial concentrations and with combined sanitary storm sewers. Boston Harbor and the Boston area rivers, extreme upper Narragansett Bay and its tributaries, and several stretches of the Blackstone River are key examples.

How can the remaining problems be solved? The answer to that question is the burden of this chapter. To answer it, it is necessary to take a closer look at how the national effort to protect and restore water quality works in the SENE area, to define more carefully the nature of pollution problems and assess priorities for solving them, and to outline a strategy developed on these bases.

How the Water Pollution Control Program Works.

The current pollution control program concentrates heavily on completing construction of secondary treatment plants in 1970's. National goals have been set for 'fishable-swimmable" waters by 1983, and "zero discharge" by 1985.

The federal government, through the Environmental Protection Agency, sets broad goals and grants money to strengthen state water pollution control agencies, and to help construct treatment facilities. The federal government also brings enforcement actions in certain circumstances. The National Pollutant Discharge Elimination System is also administered by the Environmental Protection Agency. This system is more fully discussed in the "Industrial Discharges" section of this chapter.

The states have the primary responsibility for water quality, through the Division of Water Pollution Control, Department of Environmental Quality Engineering (in Massachusetts) and the Division of Water Supply and Pollution Control, Department of Health (in Rhode Island). Both states plan abatement programs, set schedules and requirements for municipal and industrial abatement, allocate federal (and state) grant support for treatment plant construction, and set and enforce water quality standards.

Water Quality and the Regional Report

As was stated in *Chapter 4*, it is necessary to read each chapter in the context of the entire SENE Regional Report. Elements of each chapter have direct bearing on the water quality discussion. The relationship between water quality and water supply is the most clear-cut.

In *Chapter 4, Water Supply,* the interrelationships between water quality and water supply were discussed in some detail. Again, these interrelationships must be stressed when water quality is considered. The SENE Study's recommendations have been developed with existing institutions in mind. Therefore, because most water supply and water quality institutions in the SENE region serve separate functions, the *Water Supply* and *Water Quality* chapters were written to recommend policies or actions which could be implemented by these distinct institutions. However, throughout each chapter, cross-references serve to emphasize the interdependent nature of water supply and quality.

The sections entitled *Improving Water Supply and Water Quality Management* and *Areawide Management* in *Chapters 4 and 5,* respectively, present methods by which water quality and water supply institutions may achieve a higher degree of coordination and integration. In addition, long-range alternatives for the integrated management of water supply and water quality are presented in *Chapter 10, Strengthening the Management System for Natural Resources.*

There are other chapters of the Regional Report which also have a direct or indirect relationship to the contents of *Chapter 5. Chapters 1 and 2* provide an overall setting in which to assess water quality issues. *Chapter 3, Guiding Growth,* deals with the impact that provision or withholding of sewer service has on growth and with the limitations imposed on waste disposal by soil type and other factors. Furthermore, water quality issues also relate to issues in the *Outdoor Recreation, Marine Management,* and *Locating Key Facilities Chapters (Chapters 6, 7, and 9* respectively.) These relationships are summarized in *Chapter 11, Tying the Recommendations Together.*

The Situation

About two-thirds of the total length of major streams in Southeastern New England are currently below the water quality standards set for them by the Massachusetts and Rhode Island water pollution control agencies. In contrast, the coastal waters are generally of high quality and support a variety of uses such as shellfishing, bathing and boating. Coastal water quality problem areas are limited to harbors receiving combined sewer overflows and municipal and industrial wastewater discharges. Figure 5.1 summarizes existing water quality for the major streams and coastal waters in SENE.

Table 5.1 shows the principal types of pollution that determine the quality of surface water and ground water in each of the ten SENE planning areas. The determinants are listed across the top in descending order of regionwide significance. The table also shows that, among the ten planning areas, water quality is the worst in four – Boston Metropolitan, Taunton, Blackstone and Vicinity, and Pawtuxet. The two planning areas with the best overall water quality are Cape Cod and the Islands, and Pawcatuck.

Why Cleanup is Desirable

The widespread deterioration of water quality in SENE and in the nation has led to the recognition by the people and the Congress of the United States that prompt attention must be given to this problem. It is clear that water pollution significantly affects the public health and the environmental and economic well-being of the Nation.

The Federal Water Pollution Control Act Amendments of 1972 is an expression of these concerns and states:

> The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. . . . [Sec. 101(a)]

The Act goes on to state:

> It is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of states to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources. . . . [Sec. 101(b)]

The three major themes of the SENE Study are either directly or implicitly contained in this quote. Enhancing the SENE environment through water quality programs should improve the region's attractiveness for enticing and holding the skills it needs for its services-oriented economic future. Conversely, that future, which includes an evolutionary movement away from the heavily polluting manufacturing sectors, should also make it easier to improve the quality of SENE waters. In short, improved water quality improves the future economy, which further improves water quality.

The second theme is also double-edged as it applies to water quality programs. Guiding growth eases water quality problems, particularly those related to land use. Conversely, early provision of sewering and adequate treatment tends to concentrate growth, while its deferment or denial tends to disperse growth. In brief, water quality programs can be both a major beneficiary and a major tool for implementing a policy for guiding growth.

Existing Organizations and Programs

The third study theme – of using existing knowledge, programs and institutions – also fits water quality rather well. Recommendations for filling some major knowledge gaps for non-point pollution sources will be given later, but in general the SENE Study recommendations are based upon proceeding with existing knowledge. The existing programs, authorities, and institutions are considered good enough. The basic need is for better use of these tools, not more tools.

The responsibility for water quality restoration and preservation is shared by federal, state and local governments, private industries, and concerned citizens. Each sector must maintain a firm, positive commitment to environmental enhancement, if the goal of clean water is to be realized. At the federal level, where the overall program is principally coordinated, the key organization is the Environmental Protection Agency (EPA). At the state level, where the major responsibility for planning and administering the program takes place, the key agencies in Massachusetts are: The Divisions of Water Pollution Control, and Environmental Health within the Department of Environmental Quality Engineering; in Rhode Island, the key agency is the Division of Water Supply and Pollution Control of the Department of Health (DOH). In Connecticut the Department of Environmental Protection is responsible for state water quality programs. The above Massachusetts and Rhode Island agencies will be cited frequently throughout the chapter, especially in the recommendations. The Connecticut agency should be *inferred* where appropriate; but for brevity it will not be mentioned, as

TABLE 5.1 KEY DETERMINANTS OF WATER QUALITY BY PLANNING AREA

	Determinants of Water Quality									Overall Severity
					Land Use Discharges					
PLANNING AREA	Combined Sewers/Urban Runoff	Municipal Discharges	Industrial Discharges	Low Streamflow	Septic Systems	Agricultural Runoff	Landfill Leachate	Oil Pollution	Watercraft Wastes	Relevative Severity of Water Quality Problem / All discharges, combined for the Planning Area as a whole.
Ipswich - North Shore	•	○	•	○	●		○	•	•	○
Boston Metropolitan	●	●	●	•			○	●	•	●
South Shore		○	•	○	○	•			•	○
Cape Cod & Islands		○			●	•			○	•
Buzzards Bay	●	●	○		•	○			•	○
Taunton	○	●	●	○	○	○		•		●
Blackstone & Vicinity	●	●	●	•	•		○	○		●
Pawtuxet		●	●	●	•					●
Narragansett Bay	●	○	•					○	○	○
Pawcatuck		○	○		○				•	•
SENE as a whole	●	●	●	○	○	•	•	•	•	●

● = Major determinant ○ = Intermediate determinant • = Minor determinant

only three municipalities in Connecticut (North Stonington, Stonington, and Voluntown) are within the SENE boundaries. In all three states, local government and industry are particularly important in achieving water quality goals because they have the major responsibility for building, operating, and maintaining pollution control facilities. These facilities will serve as the framework for regional water quality management systems. Local government also plays a key role in regulating land use and subsurface disposal systems. Both types of control will contribute to the effectiveness of efforts to preserve waters which are currently of high quality.

The Water Quality Goals

The ambitious goals of EPA's water quality program, as enunciated in the 1972 Amendments cited above, are: (1) to attain swimmable-fishable waters, where possible, by 1983; and (2) to achieve zero discharge everywhere by 1985. Figure 5.2 presents the water quality standards (1977 goals) for SENE waters as determined by the states and approved by EPA. A comparison of this map with the earlier map in Figure 5.1 (existing water quality) points out the specific locations where present water quality is substandard. The most severely degraded waters are found in portions of the Charles River, the Taunton River, and New Bedford Harbor. For municipal and industrial sources of pollution, two dates, July 1977 and July 1983, are to serve as targets for a base level of technological control. The period 1973-1977 is referred to as Phase I, 1978-1983 as Phase II.

Phase I is characterized by the issuance of permits and the award of construction grants. It provides the beginning steps for meeting a goal of swimmable-fishable waters. For some pollution sources, achieving the 1977 treatment objectives will be all that is necessary to meet 1983 objectives. Most of the pollution problems being addressed in this phase are well identified, and have been addressed by local, state, and federal governments in past years.

Phase II will be a period in which solutions become more subtle, the alternatives for abatement more challenging, and for which a better understanding of the causal and cost-benefit relationships of alternatives will be required. It will be a period for implementing plans for controlling non-point sources and the most formidable point sources of pollution. A solid start toward addressing these problems must be made, however, during Phase I. In addition, while Phase II will emphasize treatment techniques for combined sewer overflows, it is recognized that the best solutions will evolve as the results of case-by-case studies because treatment may not be necessary in all areas requiring swimmable-fishable water quality.

State water quality planning efforts are also based on the Federal Water Pollution Control Act Amendments of 1972. The permit process, whether administered by the state in Massachusetts, or by EPA, as is the case in Rhode Island, must be coordinated with the overall water quality standards and planning program. It is their responsibility to ensure that water quality standards are met. The states gather basic information and categorize all stream stretches as either:

- Effluent limited – in which water quality will meet all applicable water quality standards after the application of minimum national effluent limitations established by the EPA for point-source discharges and municipal treatment works.
- Water quality limited – in which water quality will meet applicable water standards only after application of more stringent effluent limitations.

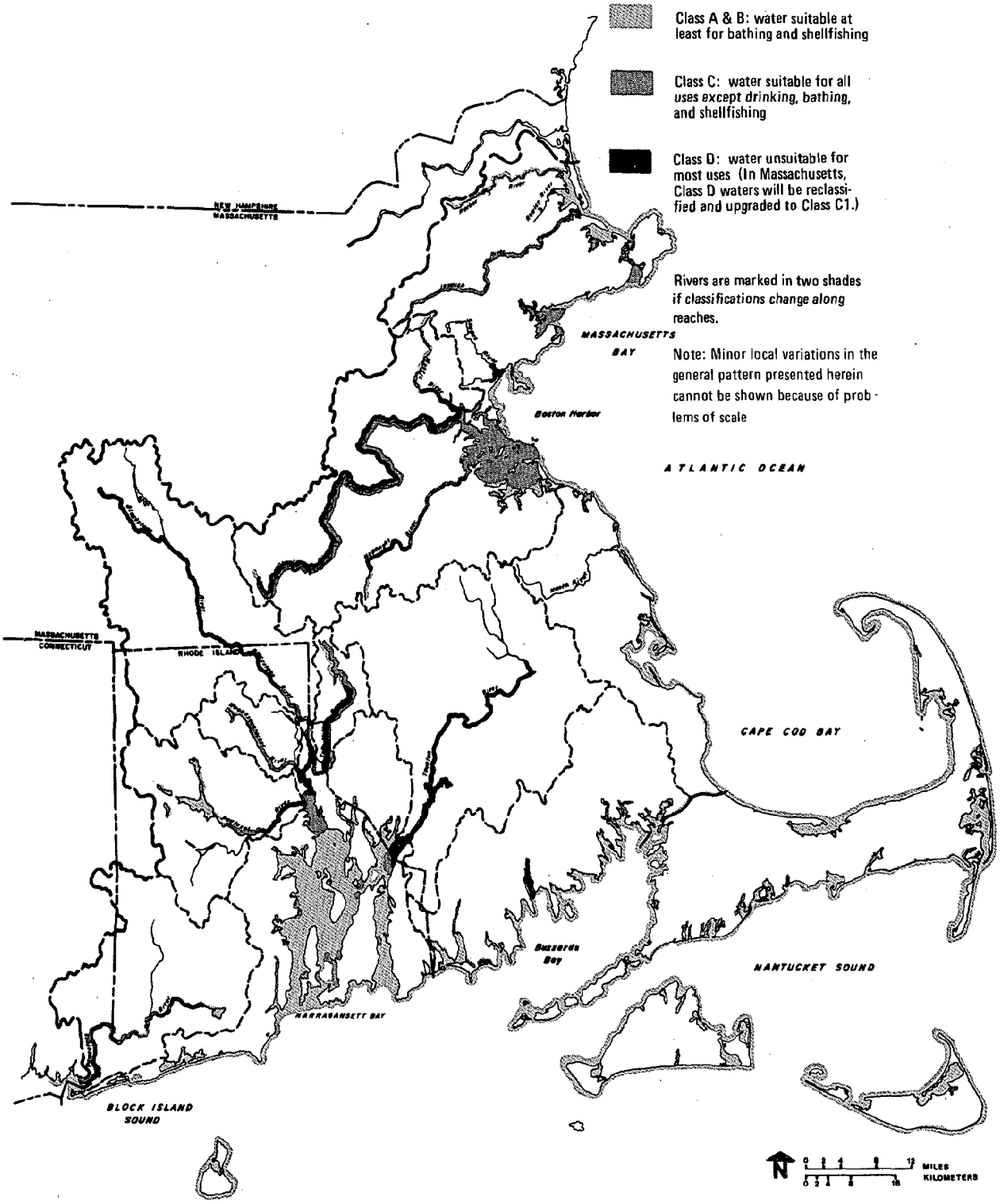
Both states have so categorized their streams, as illustrated in Figure 5.3.

For segments classified as "effluent limited", the state must develop an overall management plan to maintain water quality. For segments classified as "water quality limited," the state must assign maximum daily load limits. In Massachusetts, the Division of Water Pollution Control has the in-house capability to determine these maximum allowable loadings. The Rhode Island Division of Water Supply and Pollution Control carries out such functions by contracting with private firms. The Statewide Planning Program has completed the Woonasquatucket interim basin plan and the Blackstone preliminary and final Moshassuck draft basin plans. In addition, preliminary management plans for the Taunton River, and the Massachusetts portion of the Blackstone and Ten-Mile Rivers have been developed by the Massachusetts Division of Water Pollution Control. These plans were the basis for most of the recommendations included in those planning area reports.

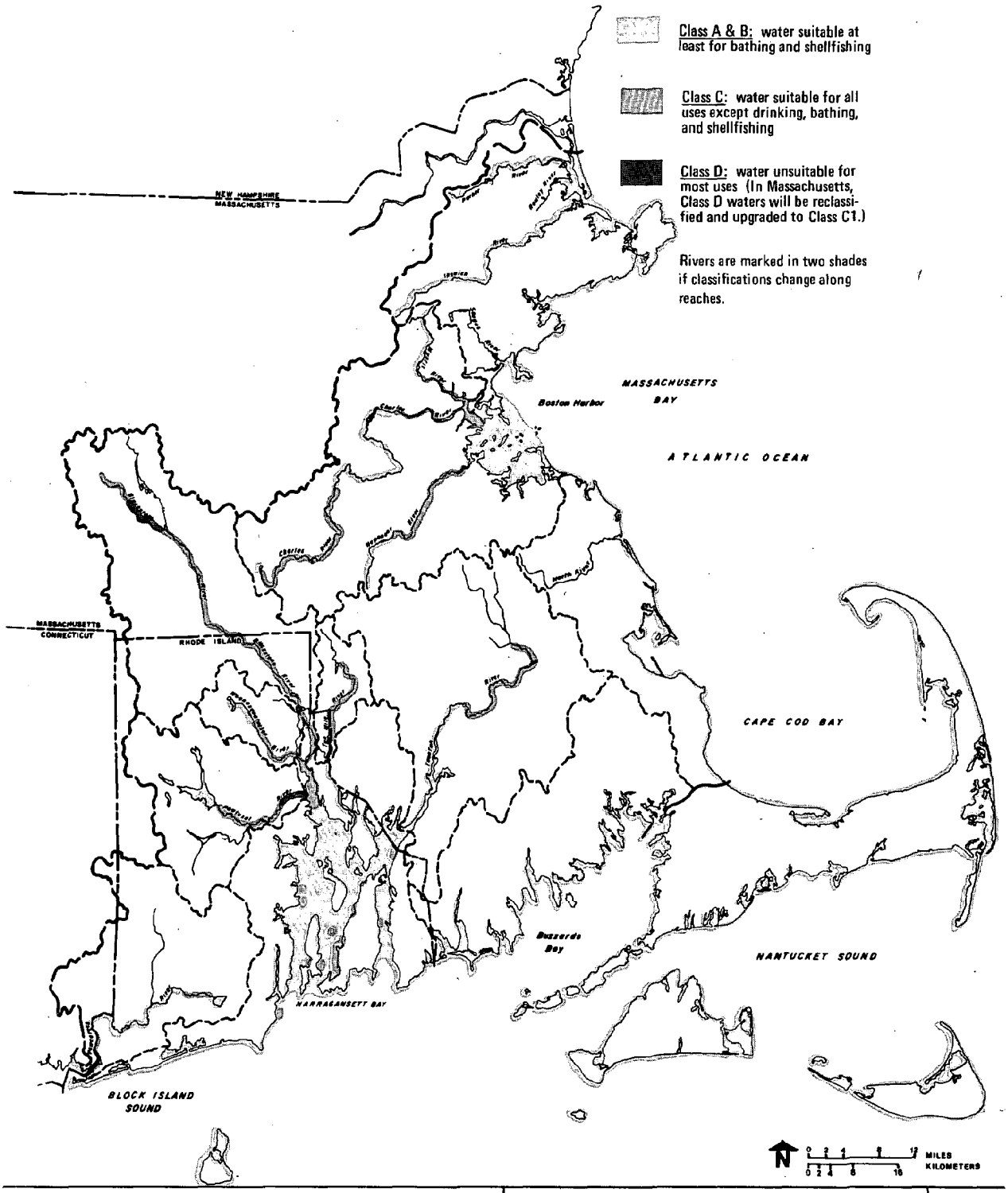
Other plans examined included the *Boston Harbor-Eastern Massachusetts Metropolitan Area Wastewater Management Study* and *studies done for and by regional planning agencies. Town engineering reports* were also investigated if available. Elements of each are included later in the recommended program and *more specific information can be found in the individual planning area reports.*

Scope of the Chapter

The remainder of this chapter considers each of six major sources of water pollution in order of decreasing region-wide significance – combined sewer overflows and urban stormwater runoff, municipal discharges, industrial discharges, non-point pollution sources, oil pollution, and watercraft wastes. For each source, the general situation is described and alternative solutions are examined. Following is



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	EXISTING WATER QUALITY	FIG. NO. 5.1

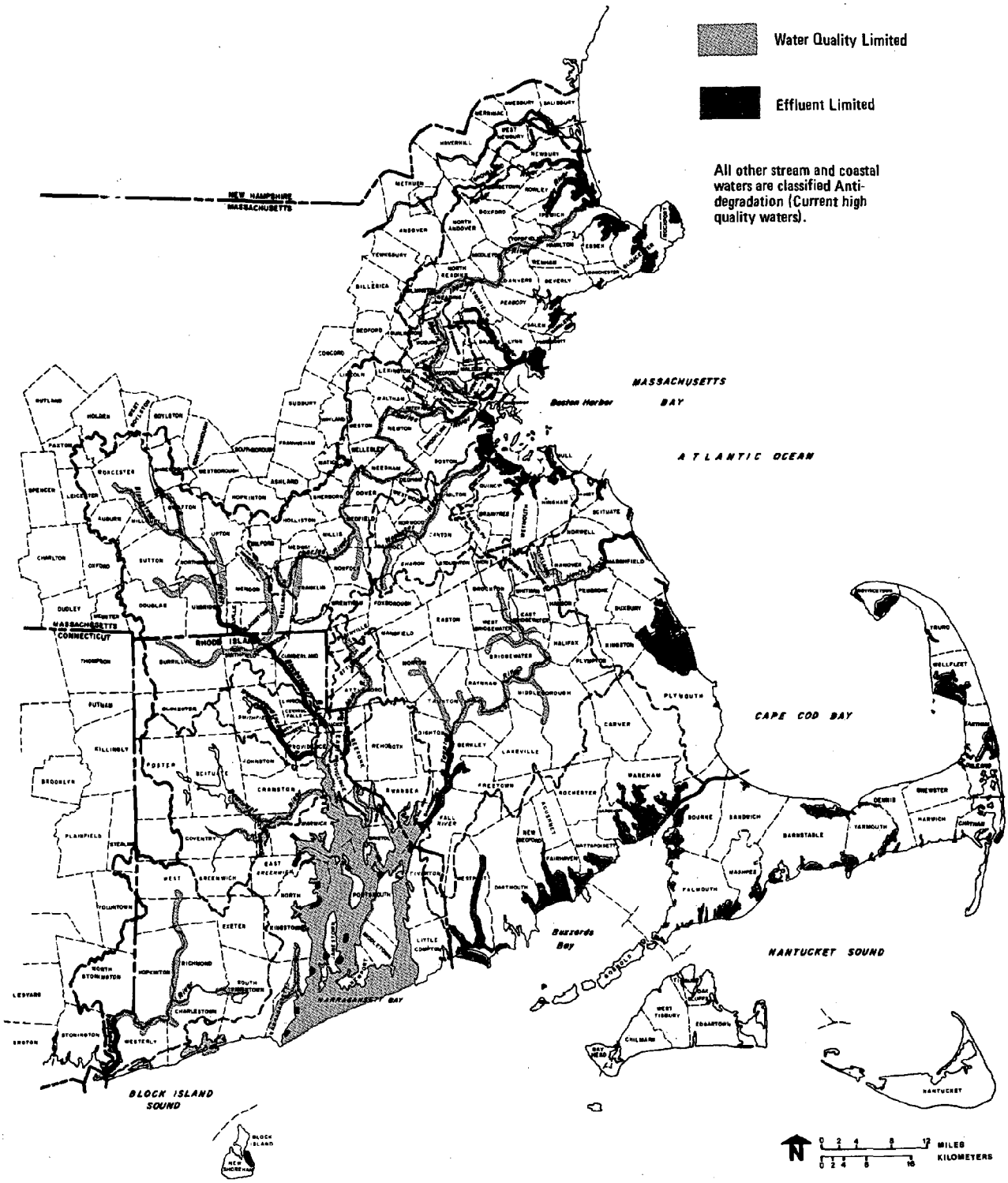


NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

PROPOSED WATER QUALITY (1977 goals)

FIG. NO. 5.2



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

SEGMENT CLASSIFICATION
WATER QUALITY

FIG. NO. 5.3

a brief discussion of areawide water quality management, alternative plans are outlined, and a recommended program is described by arraying recommendations under the headings of preservation, restoration, and planning area priorities. Lastly, the total cost of the program is broadly estimated and the major environmental, economic, and social implications of carrying out the program are highlighted.

URBAN STORMWATER RUNOFF/ COMBINED SEWER OVERFLOWS

The Situation

A good hard rain is an extremely efficient city street cleaner. It washes suspended pollutants out of the air and off exposed surfaces where they have settled; dirt, animal wastes, and debris are flushed from the streets. What disappears down the drains, gutters, and sewers is called "urban stormwater runoff". Unfortunately, the problems associated with such pollutants do not disappear down the drains as well. They reappear along the riverfront or in the harbor, becoming perhaps the most serious water pollution problem in SENE. Although many excellent studies throughout the nation have stressed the seriousness of this problem for at least a decade, its importance is only now being widely accepted. Recent EPA studies indicate that stormwater runoff in many modern cities is heavily laden with zinc and lead and that it probably contributes a greater pollution load than the city's treated waste outfalls. In some cities the oxygen demand of urban stormwater runoff is three to five times greater than that of treated wastewater.

In Brockton, the Massachusetts Division of Water Pollution Control sampled streamflows and found that violations of bacterial standards for swimmable waters occur regularly during wet weather. Other indicators of water quality showed similar increases. Such substantive investigation has been lacking in most other areas of the region and extensive "wet weather" stream surveys are needed.

When storm sewers also carry sanitary wastes, the problem is further aggravated. These combined sewers must then carry (1) urban stormwater runoff, (2) sanitary wastes produced during the period of high runoff, and (3) resuspended material from sediments and solid sanitary wastes which had accumulated on the sewer bottoms during the previous period of dry weather flow.

The effects of combined systems are twofold. First, since they convey both municipal and industrial wastewater as well as stormwater, treatment facilities can become hydraulically overloaded during times of excessive stormwater runoff, thus lowering the operating efficiency of the treatment plant. Second, combined systems are equipped with overflow points to prevent the "backing up" of sewers. This results in the discharge of untreated mixed wastewater and stormwater directly to streams or coastal waters during certain storms.

There are several major combined sewer systems in the Study area. Their overflows degrade the quality of portions of Boston Harbor, the Mystic, Charles, and Neponset Rivers. Approximately 19,000 acres are served by combined sewers in portions of Boston, Cambridge, Chelsea, Somerville, and Brookline. In the sewer system tributary to Boston's Deer Island treatment facility, 125 overflow points have been located. The second largest combined sewer system serves Providence, Rhode Island, and overflows occur to the Providence, Seekonk, Woonasquatucket, and Moshassuck Rivers. Fifty-six overflow points have been located in Providence, while New Bedford has identified 27 overflow points to the Acushnet River and New Bedford Harbor. Fall River has 14 to the lower Taunton River and Mount Hope Bay. Other areas which exhibit combined sewer problems are Taunton and Worcester in Massachusetts, and Newport (10 overflow points), Central Falls and Pawtucket in Rhode Island.

These systems serve the most heavily populated areas in the SENE region. About 3.4 million people are currently served by municipal sewer systems. About 60 percent of these people are connected to combined sewers either directly or through separate systems which eventually discharge to combined sewers.

Significant concentrations of bacteria, oxygen demanding wastes, and suspended solids are discharged to the receiving waters when overflows occur. In many of the areas described above, it is difficult to determine the contribution combined sewer overflows make to water quality degradation, since inadequately treated municipal and industrial discharges are also present. However, it is known that combined sewer overflows have resulted in periodic closings of Tenean Beach in Dorchester, several shellfish areas in Winthrop Bay, Dorchester Bay, the tidal portions of the Neponset River, and shellfish areas in upper Narragansett Bay.

The Rhode Island Department of Health has determined that when one-half inch of rain is recorded in Providence in a 24-hour period, the shellfish areas in the Providence River must be closed for 7 days. For a rainfall of one inch, the closure is in effect for ten days. The total number of days that the shellfish areas have been closed in one year has exceeded 200 in the past. In other areas affected by combined sewer overflows, water quality classifications always preclude water contact recreation.

The Solutions

Alternatives

Measures for addressing urban stormwater problems include: (a) stormwater sampling; (b) attenuation of runoff; (c) better street cleaning; (d) separation of combined sewers; (e) in-stream controls; (f) off-system storage; and (g) treatment of combined sewer overflow. A combination of methods will usually provide the best solution. The optimum combination depends upon topography, erodibility, and other characteristics of the soils of the service area, land use patterns, sewer system design parameters, capabilities of wastewater treatment facilities, location of overflow points, desired uses of the receiving waters, and availability of construction sites.

Stormwater sampling. One of the first measures to be undertaken in dealing with this aspect of non-point pollution is to determine the extent and the severity of the problem. Somewhat different water quality sampling techniques will be required than those customarily used on stream surveys. For the most part, current water quality sampling is geared only towards determining allowable loadings for discrete discharges of wastewater. Pollution from runoff enters the subsequent model as an estimated background effect or not at all.

Attenuation of Runoff. Subdivision controls can attenuate runoff in new developments by increasing open space, by providing safe and attractive stormwater detention ponds, and by making maximum use of permeable drainage ditches. These measures could also improve ground water recharge.

Runoff can also be attenuated by providing buffer strips along streambanks, particularly in suburban and rural areas. The buffer strips should be heavily vegetated and attractive. They should be able to fit gracefully into programs to manage category B lands *(Chapter 3)*, to improve picnicking, fishing and extensive recreation *(Chapter 6)*, and to manage flood plains *(Chapter 8)*. Furthermore, even when exclusively under private ownership, streambank buffer strips should enhance land values.

Better Street Cleaning. Most current street cleaning programs and equipment are designed with no awareness of the significant polluting effects of stormwater runoff. Better, more frequent street cleaning might help considerably, but more information is needed on its cost-effectiveness compared to treatment and other measures described in this section.

Separation. For years physical separation of stormwater and wastewater collection systems was considered the only method of abating combined sewer problems. In the older cities – Boston, Fall River, New Bedford, and Providence – complete separation of combined sewers would be a massive undertaking resulting in massive social disruption. Now, with the growing realization that the stormwater portion of combined sewer overflows can be as detrimental to water quality as the sanitary wastewater portion, alternatives which will manage the entire problem are being considered and implemented.

In-System Controls. These measures include maintenance of overflow regulators and tide gates, use of improved regulators, infiltration and inflow control, and the use of computerized sewer system controls. They vary in cost. The degree to which they can be implemented depends on the nature of the specific system.

Regulators are devices which control the flow of wastewater and stormwater between the local collecting sewer, the interceptor sewer, and the outfall. During wet weather, they allow overflows to prevent back-up in the sewer. **Tidegates** prevent salt water inflow into the sewer and interceptor during periods of high tide. A malfunctioning regulator can allow untreated wastewater discharges during dry weather, and a defective or missing tide gate will force a treatment facility to accept large volumes of salt water, thus reducing overall treatment efficiency. The Metropolitan District Commission in Boston is currently conducting a program of regulator and tidegate maintenance and repair.

Infiltration and inflow of water reduce the capacity of a sewer system available for the transport of wastewater. Hence, the frequency and volume of overflows increase and treatment plant efficiency decreases if much unwanted water finds its way into the system. Poor joints and crushed pipes are usually the cause of excessive infiltration and inflow and are symptomatic of older systems. Combined sewer systems, such as those in Attleboro and North Providence, can experience excessive infiltration and inflow.

Another effective in-system control measure with possible application in larger systems is **computerization.** The systems make the most effective use of interceptor and line capacity by employing computer-linked monitoring and control devices to route and store combined sewer flows. The computer system allows an operator to divert flows to half-empty interceptors, thus using all available in-system storage and "buying time" until the wet weather passes and the combined flows can be accepted by the municipal treatment facility, thus treating the stormwater as well. An added advantage of this type of system is that individual components can be installed as funds become available and can still produce good results. Possible applications may be found in Boston and Providence.

Off-system storage. This measure refers to the use of holding tanks to collect combined sewer overflows and to return the collected wastewater to the sewers during periods of low or direct flow, thus completely eliminating the discharge and providing treatment of overflows at the municipal wastewater treatment facility. Because of the size of

the systems and the highly urbanized character of Boston and Providence, widespread use of this method is not feasible. Fall River and New Bedford should consider this measure, however.

Treatment. Perhaps the most cost-effective measure is additional treatment wherever feasible. Generally, physical or physical/chemical treatment is applied to the combined sewer flows, followed by chlorination. Also, the flow could be conveyed to an existing wastewater treatment facility. All but the small combined systems should strive to implement treatment measures for managing the entire problem.

The Cottage Farm Station on the Charles River is an existing example of combined sewer overflow treatment. When flow exceeds the capacity of existing downstream treatment plants and their interceptors, all the excess combined sewer flow is diverted to the Cottage Farm station for detention, chlorination, and release. When runoff exceeds interceptor capacity moderately, diversion and detention can be very effective. In the case of major excess runoff, however, detention is decreased and treatment is minimal. From May 1971, to December 1973, the Cottage Farm station received 769.8 million gallons of wastewater and discharged 674.5 million gallons of treated flow. The remaining 95.3 million gallons of flow were returned to the interceptor and treated at the Deer Island primary treatment facility. A second combined sewer overflow treatment facility on the Charles will be built by the Metropolitan District Commission in conjunction with a new dam at Warren Avenue.

An alternative concept should be evaluated while planning other combined sewer overflow treatment plants. The valve arrangements could allow the plant to retain and treat to high standards all of the initial very contaminated runoff and bypass all of the later relatively clean flow. Overall abatement efficiency could thus be greatly improved by concentrating on the more contaminated early portion of the total flow. However, in extensive systems, detailed sampling must be undertaken in order to determine whether or not this "first flush" treatment alternative would yield economically and environmentally justifiable results.

MUNICIPAL DISCHARGES

The Situation

About 80 municipal wastewater facilities are currently discharging to the waters and land areas of the region. They serve 3.4 million people, about 70 percent of SENE. As indicated in Table 5.1, effluent from some of these facilities contributes substantially to water quality problems in each of the 10 planning areas. The problem is particularly severe in the following five planning areas, which are listed from north to south: Boston Metropolitan, Buzzards Bay, Taunton, Blackstone and Vicinity, and Pawtuxet.

EPA provides 75 percent of the funding for the planning, design, and construction of publicly owned wastewater treatment facilities. The states contribute an additional 15 percent and communities usually bear the remaining 10 percent. Massachusetts also administers a 90 percent grant program for certain projects not federally funded. The Gloucester Treatment Facility is one such project.

The grant requests for Fiscal Year 1975 are listed in Table 5.2. They are arranged by state according to state-established priorities.

The low level of funding slows construction progress. While EPA continues to attempt to meet the goals of the Act, it is generally felt, both in and out of government, that the deadlines in the Act will not be met for all publicly owned treatment facilities unless substantial funding increases occur. Even if fully funded, engineering and construction could probably not be completed in time.

Fiscal Year 1976 funds for federal aid to municipal construction projects amount to $150 million statewide in Massachusetts and $19.5 million in Rhode Island. Total needs estimated by each state amount to $6.5 billion in Massachusetts and $1.4 billion in Rhode Island. At 75 percent, the federal share would be $4.9 billion and $1.1 billion, respectively. If the last projects funded take two years to construct in order to meet the 1983 goals, about $812 million in Massachusetts to $180 million in Rhode Island will be needed annually for the next six years. This is five to nine times the current level of federal assistance. For these and other reasons EPA has developed a policy of strict preservation of streams closest to standards in order to reach the goals of the Act in as many areas of the region as possible.

The Solutions

Alternatives

General approaches for solving municipal wastewater problems include (a) additional sewering, (b) higher degree of treatment, (c) better effluent disposal methods, (d) better sludge disposal methods and (e) greater regionalization. A combination of several methods will usually be required.

Additional Sewering. It should be clear from the land use discussion in *Chapter 3* that the provision or withholding of sewer service can be a powerful means of determining growth patterns. Sewers allow high density development in some areas and thus help to preserve open space in others. At the same time, however, a large treatment facility with a large wastewater volume to be assimilated at the disposal site necessitates a higher degree of treatment. In addition, the runoff associated with the higher densities generally contribute more to the degradation of water quality than the runoff from areas of lower density on individual subsurface systems.

The 1990 design capacity for presently existing treatment facilities and new facilities proposed by the SENE Study would serve 5.2 million people. Figure 5.4 locates the existing and potential sewer service areas in SENE. Wastewater from the potential service areas would be treated by the proposed facilities, shown in Figure 5.5. In general, the

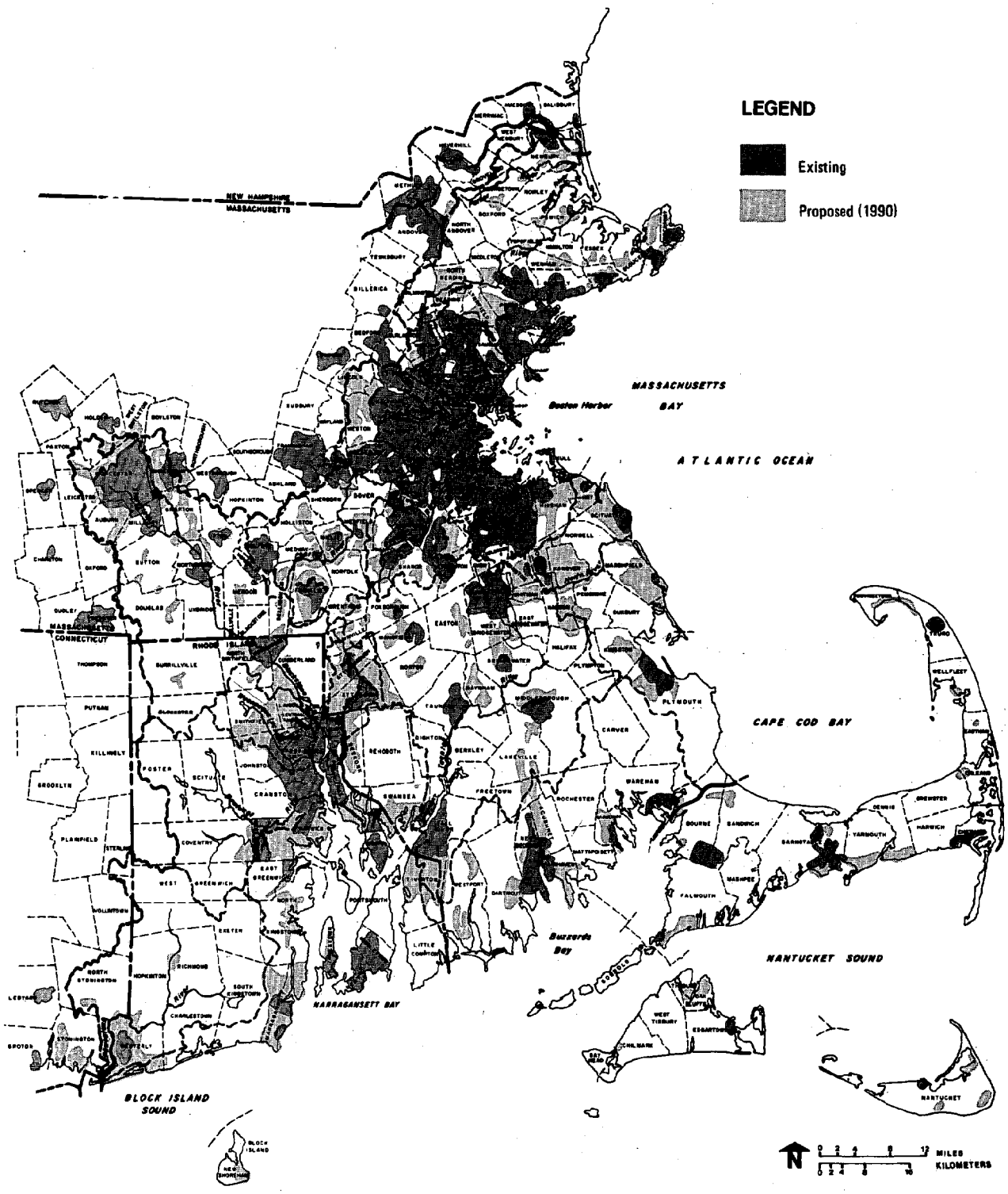
TABLE 5.2: CONSTRUCTION GRANTS PROJECTS LIST - FISCAL YEAR 1975

Applicant Name by Priority	Planning Area	Type of Grant 1/	Project Description 2/
In Massachusetts:			
Hull	BM	PDC	I, PS, FM, outfall
Lynn	INS	PD	I, PS, S
Nahant	INS	PD	PS & FM to Lynn
Mattapoisett	BB	PD	I, PS & FM to Fairhaven
Hopedale	BL	PDC	A
Charles R. P. C. District	BM	PD	I, PS, A
Metro. District Commission	BM	PDC	Stormwater detention
Newburyport	INS	PD	PS, S
Metro. District Commission	BM	PDC	Incinerators
Attleboro	BL	PD	I, PS, A
North Attleboro	BL	PD	I, PS, A
Groveland	INS	PDC	I & PS to Haverhill
South Essex Sewer District	INS	PD	S
Fairhaven	BB	PD	I
Taunton	TA	PDC	I, PS, FM, A
Brockton	TA	PD	A
Milford	BM	PD	A
Uxbridge	BL	PD	I, PS, S
South Essex Sewer District	INS	PDC	PS & FM from Marblehead
Middleboro	TA	PDC	A
Falmouth	CC	PDC	PS, FM, S
Weston	BM	PDC	PS, FM to MDC
Sutton	BL	PDC	I, PS to Millbury
Essex	INS	PDC	I, PS, A
Blackstone	BL	PDC	I, PS to Woonsocket
Millbury	BL	PDC	I
Raynham	TA	PDC	I, PS & FM to Taunton
In Rhode Island:			
Providence	BL	P 3/	S, combined sewers
Woonsocket	BL	C 3/	I, S
Quonset Point	NB	P 3/	II, S, sewers
Newport 1 & 2	NB	C 3/	I, PS, FM, sewer separation
Barrington	NB	C	I, PS, FM
Burrillville	BL	C	I, S
Westerly	PTCK	C	I, PS, FM, S
New Shoreham (Block I.)	NB	C 3/	I, PS, FM, S
Lincoln	BL	C 3/	I

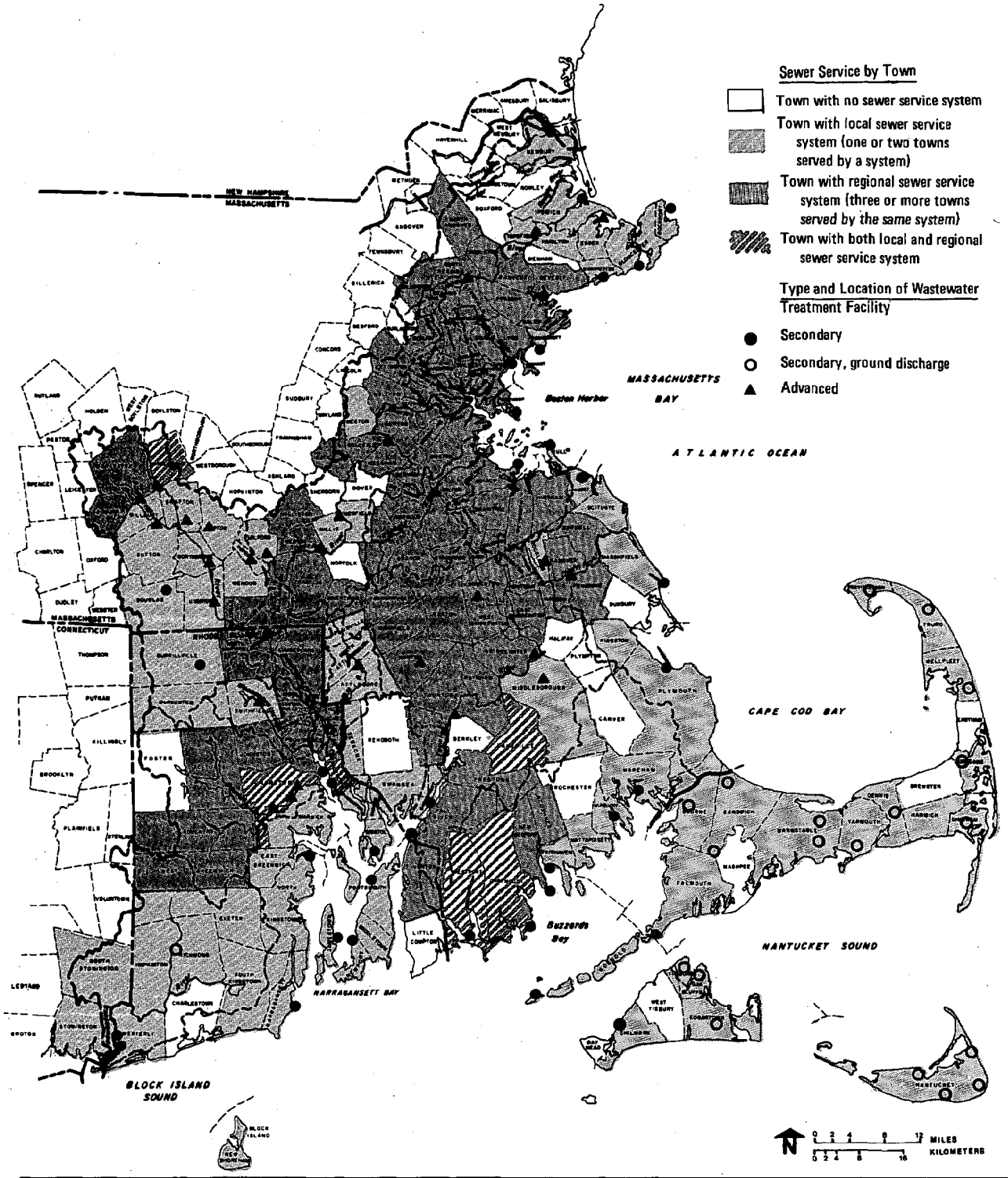
1/ P = Planning, D = Design, C = Construction

2/ I = Interceptor, II = Infiltration/inflow, PS = Pumping Station, FM = Force Main, S = Secondary Treatment Plant, A = Advanced Treatment Plant

3/ Awarded before November 5, 1974



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	EXISTING & PROPOSED SEWER SERVICE AREAS	FIG. NO. 5.4



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

PROPOSED
WASTEWATER TREATMENT
SYSTEMS AND FACILITIES – 1990

FIG. NO. 5.5

proposals for these facilities follow state and regional planning agency recommendations.

Higher Degree of Treatment. Three general degrees of treatment are provided in the region: primary, secondary, and advanced (tertiary). All should be followed by disinfection. Primary treatment is provided by most of the communities along the coast with sewer systems. Of the 3.4 million people served by sewer systems in the region, 73 percent are connected to primary facilities, 23 percent are connected to secondary treatment plants, and 4 percent are connected to systems which receive no treatment. Because of the inefficiencies of primary treatment, and since the 1972 Act requires secondary treatment, this condition should change. Advanced treatment is currently proposed for all but two stream discharges in order to meet the 1983 swimmable-fishable goal.

Better Effluent Disposal Methods. There are three basic methods of disposing of effluent from treatment plants: stream disposal, ocean disposal, and land disposal. Of the three, the most widely used in the SENE area are **stream and ocean disposal.** The largest discharges are to the coastal waters of the region since most of the cities are on the coast. However, the most severe water quality problems result from municipal wastewater discharges into the streams of the region. The Worcester treatment facility on the Blackstone River, the Brockton facility on the headwaters of the Taunton, the Milford facility on the Charles River, and the Cranston, West Warwick, and Warwick facilities on the Pawtuxet are prime examples of the above situation.

Land Disposal, most commonly by spray irrigation on agricultural or forest land, is not currently used to any great extent in the region. Several communities have used filter beds, a type of land disposal, but not in significant amounts. Several areas, including the Taunton, Pawcatuck, Upper Charles, Blackstone, Buzzards Bay, South Shore, and Cape Cod, have lands which meet the physical requirements for land disposal – good drainage and depth of soil; depth, quality, and use of ground water; topography; climate and public access. Because of the contribution this method makes to recharging ground water, it will be particularly applicable on Cape Cod if problems of safety, high cost, and extensive land requirements can be overcome. Several planning areas such as the Taunton have some suitable acreage close to urban areas. Therefore, they may be appropriate for small scale land disposal operation.

Better Sludge Disposal Methods. As higher and higher degrees of treatment are required to meet water quality goals, sludge disposal problem will increase. Although no fully reliable data are available on the quantity of sludge handled in Massachusetts and Rhode Island, Table 5.3 provides an estimate of the quantity of sludge that will be generated in SENE in 1990.

Sludge handling and disposal can cost as much as 25 to 50 percent of the total wastewater treatment plant capital and operating costs. Assuming that the average cost of disposal is in the neighborhood of $25 per ton of dry solids, the total annual cost at present for sludge treatment and disposal in Massachusetts and Rhode Island is $11 million per year.

Sludge disposal alternatives include ocean dumping, incineration, land spreading, and landfilling.

Ocean dumping is prohibited in Rhode Island. Although it is not prohibited by state statute in Massachusetts, it is regulated under the federal permit and license systems. At present, ocean dumping is allowed at only one site in Massachusetts, in Boston Harbor at the Deer Island wastewater treatment plant. Since state and federal policies discourage ocean dumping as a means of disposal, it does not appear to be a viable alternative for the future.

Incineration of sludge containing organic matter reduces the amount of solids to be disposed. The resulting ash will vary from 15 to 45 percent of the original weight of solids. However, the disposal of this ash is an associated cost of the incineration process. Incineration, moreover, can cause air pollution, and siting an incinerator is perhaps as controversial as siting a solid waste disposal facility. For example, a proposed incinerator for the MDC's Metropolitan Sewer District in the Boston area has drawn considerable criticism because of possible airborne nuisances and health hazards.

TABLE 5.3 ESTIMATED SLUDGE VOLUMES FOR 1990 BY STATE AND PLANNING AREA*

State	Volume
Massachusetts Part of SENE	120.3
Rhode Island Part of SENE	22.9
SENE Total	143.2
Planning Area	**Volume**
Ipswich-North Shore	12.3
Boston Metropolitan	70.2
South Shore	4.9
Cape Cod & Islands	1.1
Buzzards Bay	5.0
Taunton	12.6
Blackstone & Vicinity	28.0
Pawtuxet	5.9
Narragansett Bay	2.1
Pawcatuck	1.1
SENE Total	143.2

*/ In thousands of cubic feet per day, treated and dewatered

Land spreading is the only disposal option which takes advantage of the potential of sludge as a soil building material. Furthermore, it furnishes an alternative to more concentrated inorganic fertilizers which have recently diminished in supply and increased in cost because of the petroleum shortage. Applied to land in either a liquid or dried state, the water, nutrients, and organic matter in sludge increase the humus content, fertility, and water-retention capacity of the soil. Both Attleboro and North Attleborough are presently investigating the possibility of using dried sludge as a soil conditioner. It has also been suggested that the Metropolitan Sewer District convert its sludge to fertilizer, rather than incinerate it (see above). The principal problems of land application appear to be the potential long-term effects of toxic metals in the sludge and the product's marketability.

Landfilling is used by most industries and municipalities in Massachusetts and Rhode Island. After the sludge has been treated and dewatered, it is brought to the landfill site and buried in accordance with sanitary landfill guidelines.

Greater Regionalization. This last alternative measure involves communities joining together to provide wastewater treatment and disposal at one site. Because of economies of scale, regional treatment facilities are generally cheaper to build and operate. Because personnel are generally better trained at larger facilities, they are usually more effectively operated. Of major importance is the fact that fewer water bodies are exposed to potential degradation since fewer discharges result. The recommended programs in each planning area have favored this approach over individual municipal treatment facilities wherever possible. Regional approaches can also help to achieve preservation goals by limiting discharges above the most upstream municipal plant.

Major regional treatment facilities exist in the Boston Metropolitan planning area (Metropolitan District Commission), in the Ipswich-North Shore planning area (South Essex Sewer District), and in the Blackstone and Vicinity planning area (Upper Blackstone Pollution Abatement District and Blackstone Valley Sewer District). These regional districts serve two-thirds of the total sewered population of SENE.

Later, a closely related concept will be discussed under the heading of *"Areawide Management."* Unlike the regionalization described immediately above, areawide management will not be confined primarily to municipal discharges.

INDUSTRIAL DISCHARGES

The Situation

According to Table 5.1 industrial discharges have a major effect upon the region's water quality, particularly in the following four planning areas: Boston Metropolitan, Taunton, Blackstone and Vicinity, and Pawtuxet.

In terms of flow, electric power production is the largest industrial discharge category. In terms of water quality degradation, other industries in the region are also important. Textile dyeing and finishing is the largest contributor of biochemical oxygen demanding material (BOD) to the region's waters, and the jewelry and metal finishing industries discharge significant quantities of metals in plating wastes.

The abatement of waterborne industrial wastes is managed by the industrial permits program. Administered by the U. S. Army Corps of Engineers for the first three years of its existence, the program was modified, renamed the National Pollutant Discharge Elimination System (NPDES), and transferred to EPA by the Federal Water Pollution Control Act Amendments of 1972.

In general, the program is working well and on schedule in SENE. Based upon permits which have been written or drafted thus far, of the 78 major existing industrial discharges into surface water bodies in the region, 22 will be eliminated by connection to municipal systems, by subsurface disposal methods, by process changes, or by the closing or moving of a firm. The remaining 56 will be required to provide best practicable treatment (BPT) by July 1, 1977. Currently, engineering is proceeding on schedule, and no delays are foreseen which will cause an industry to miss the 1977 deadline. However, the industries whose discharges will be eliminated through connection to a planned municipal system may not be able to meet the deadline because of lack of federal funds for municipal treatment facility construction and other delays. Pretreatment, which is usually less than BPT should occur on time, however. Smaller flows have resulted through water conservation, recycling and reuse in order to lower user charges levied by the municipal plant. This trend is encouraged and applauded by the SENE Study.

A special aspect of industrial wastes is hazardous wastes – pesticides, radioactive wastes, industrial chemicals and biochemicals. The management of hazardous wastes is generally inadequate in SENE. The uncontrolled discharge of such waste materials into the environment unnecessarily threatens the public health and welfare.

In Massachusetts, the Department of Environmental Quality Engineering is charged with the authority and responsibility for hazardous and toxic waste disposal. State regulations cover handling and disposal methods involving the transport

of hazardous wastes by truck, rail, and vessel. In addition, the Department licenses the disposal of hazardous wastes by any person.

Rhode Island does not have specific laws regulating the use and disposal of hazardous wastes. Only the use and application of pesticides are regulated by statute; disposal is uncontrolled. In many cases, pesticides are disposed of in municipal sewers, and in other cases, they are disposed of at municipal landfill sites. The other hazardous wastes are controlled by the state's air and water pollution control laws.

Pesticides are used only on a small scale in Massachusetts because agriculture is not a significant economic activity. There is a storage facility in Hingham for pesticides disposed of by businesses and farmers in the state. It is estimated that between eight and ten tons of pesticides are stored there annually.

The major sources of radioactive waste in Massachusetts are the Boston Edison nuclear power plant in Plymouth and New England Nuclear of Boston, a firm which manufactures fuel rods for use in hospitals, research laboratories, and schools. These hospitals, laboratories, and schools, most of which are located in the Boston area, are the other sources of radioactive wastes.

The University of Rhode Island at Kingston, which operates a small reactor, and the United Nuclear Company of Charlestown, which operates a uranium recovery plant, are the primary sources of radioactive waste in Rhode Island.

Radioactive waste in both Massachusetts and Rhode Island is packaged according to federal regulations and transported to designated disposal sites outside of the SENE region.

Most of the industrial chemical wastes in Massachusetts and Rhode Island are generated by the metal plating and finishing industries. These wastes are treated on-site at the larger plants. Dewatering and landfilling at the plant usually follows. On occasion, leachate from these on-site landfills has polluted water sources. Cases of pollution have been noted most frequently at plants in the metal plating industry. The smaller companies usually look to disposal firms to handle their wastes.

Although hospital wastes are similar to those generated by other types of public institutions, they require special consideration due to the possibility that pathological materials may be present. In most cases, the disposal of pathological wastes is accomplished by incineration (which may affect air quality). Where they are disposed through sewers, however, pathenogenic wastes may contaminate the receiving waters.

The disposal of biochemical wastes is a potentially dangerous problem in the Boston and Providence areas. The larger laboratories hire disposal firms to take care of their wastes, but many of the smaller laboratories either store these wastes or flush their wastes without pretreatment into municipal wastewater treatment plants.

The Solutions

Alternatives

For industrial wastes, there is no need to change the industrial permits program. It seems to be working well.

The burden of disposing of hazardous wastes is best placed upon industry or the farmer who uses them. Determination of the proper disposal method for these wastes must be made on an industry-by-industry basis. Geological, air quality, and cost studies must be made for each industrial plant. The states could locate, approve, and monitor discharges from every significant source of hazardous wastes in their state.

Commonly used alternatives include land burial, deep-well injection and ocean dumping. Incineration is used for disposal of some organic chemicals, and biological and flammable wastes.

Sanitary landfills are preferable to dumps for the disposal of hazardous materials. Unless designed properly, however, sanitary landfills have potential for surface and ground water pollution as well as air pollution from gas venting.

Land burial is a suitable method for those hazardous materials that require complete containment and permanent disposal, including radioactive and highly toxic chemical wastes. The material is deposited either directly into the ground, or is deposited in stainless steel tanks or concrete-lined pits beneath the ground.

The geology of the SENE region does not provide suitable deep underground reservoirs to accept wastes by means of deep-well injection. Unless all other alternatives have been found less satisfactory for environmental protection, and unless extensive hydraulic and geologic studies are made, EPA opposes deep-well injection.

Since state and federal policies discourage ocean dumping, and the environmental problems associated with it have long been recognized, ocean dumping is not considered a viable alternative. Incineration and open burning can result in air pollution unless adequate controls are employed.

SOME NON-POINT POLLUTION SOURCES

In marked contrast to most of the point sources considered above, most non-point sources of water pollution are difficult to measure and control. Prominent non-point sources include: (1) stormwater runoff; (2) precipitates from airborne pollution; (3) sediment; (4) septic systems; (5) in-stream pollution sources; (6) agricultural runoff; and (7) leachate from landfills. The first source was considered earlier where it is most significant, as urban stormwater runoff. The second will not be discussed directly in this report. Its principal manifestation, however, is the form of dust often containing lead and zinc. The dust coats cities and factories near its points of origin. It affects water quality primarily when it is washed into water bodies in the form of urban storm runoff, which was covered earlier. Sediment is considered below.

Although non-point sources are currently difficult to measure and their effects are even more difficult to access, they must be fully integrated into any comprehensive plan that attempts to improve the quality of water bodies in an economically efficient way. Increasingly numerous studies have documented their importance. As treatment efficiency of point sources rises, the key question becomes increasingly more pertinent: might the effort to abate non-point sources be just as effective as other efforts to improve water quality? In the future, concurrent efforts should be made to deal with both point and non-point sources of pollution.

Septic Systems

The Situation

Cesspools and septic tanks service 26 percent of the population in the SENE part of Massachusetts and 36 percent of the population in Rhode Island. From a quantitative point of view, properly operated septic systems help replenish ground water supplies and maintain streamflow. Qualitatively however, seepage from improperly designed, constructed, and operated systems is probably a major source of water pollution. According to Table 5.1, this problem appears almost everywhere, but it is most severe in two planning areas – Ipswich-North Shore, and Cape Cod and the Islands. The problem is especially apparent where seepage from septic systems for homes and cottages hastens eutrophication in the lakes they border. Other symptoms include surface wetness and accompanying odors, overland runoff to streams in wet weather, and contamination of ground water supplies.

Rhode Island has recently reviewed and updated regulations regarding individual disposal problems and believes them to be adequate. Massachusetts has contemplated this step.

There is strong public support for the Department of Environmental Quality Engineering to take the step of reviewing existing regulations with particular attention to the allowable depth of subsurface systems to ground water and the maximum rate of percolation, a function of porosity and slope. The latter is of concern because septic wastewater which is flowing too rapidly to have a chance for purification in the natural system can contaminate water supplies.

With proper enforcement, it is estimated that more than 40 percent of the current population now dependent on septic systems can remain on such onlot facilities without serious problems. The other 60 percent of the 1970 septic tank users will probably require connection to sewers because of undersized lots, poor soil conditions, or other reasons. For new development, limiting septic systems to those lands shown on SENE's development capability maps (Plates 1, 2 and 3) as suitable for such purposes will ensure that individual disposal systems can continue to be useful for an important portion of future residential development. In most cases, however, where detailed soils surveys are available they should be used to locate individual disposal systems. Without such precautions, the cumulative failure of individual systems will intensify pressure for even more sewer extensions and new treatment works. The result will be new concentrations of effluent in high quality streams, loss of in-basin ground water, and increased municipal service costs. Towns already facing this problem include sections of Wilmington and North Reading along the Ipswich River in Massachusetts; and the villages of Wakefield and Peacedale along the Saugatucket River in Rhode Island.

Disposal of the solids collected in subsurface disposal systems is a related problem. Most of the existing treatment and disposal methods are inadequate to ensure the protection of public health and environmental quality.

In Massachusetts, the Department of Environmental Quality Engineering has delegated the authority for overseeing septic tank and cesspool waste disposal operations to the local boards of health. But the lack of community-provided disposal sites has led to violations of the law and potential pollution problems. Private pumpers have dumped septic tank and cesspool wastes into isolated swamps and streams, down the embankments of rivers, and even on road sides in wooded areas.

The disposal of this pumped waste presents a problem to the private contractor. Although some pumpers maintain private land disposal sites, many feel it is a community obligation to provide such an area. Since many communities do not provide disposal areas, contractors discard the waste in the quickest, easiest way possible.

Some municipalities, however, do provide disposal facilities. Brockton accepts waste pumpings from as many as 30 surrounding communities at its wastewater treatment facility.

In Rhode Island, the state Department of Health regulates septic tank and cesspool waste disposal. The state requires pumping contractors to be licensed yearly. It also has the power to establish regulations concerning methods of disposal and pumping equipment. However, no laws currently cover disposal methods, although some laws prohibit contamination of drinking water.

The lack of waste treatment and disposal sites is as serious a problem in Rhode Island as it is in Massachusetts. Many communities do not have treatment and disposal facilities, and some pumpers are discharging wastes in an unsafe and environmentally damaging manner. Cranston is one of the towns in Rhode Island that does provide an adequate treatment and disposal facility for the community.

There are no federal regulations specifically regulating the disposal of septic tank and cesspool waste. Federal funding is available for construction of handling facilities at wastewater treatment plants, and the only condition is that the plant meet applicable treatment standards.

The Solutions

Alternatives

The principal **alternative measures** for minimizing seepage problems are: (a) establishing and enforcing criteria and compliance procedures; and (b) increasing use of dry disposal systems. The principal alternatives for disposal of septic pumpings are: (c) disposal at existing wastewater treatment plants; (d) land spreading; (e) drying beds; (f) lagoons; and (g) land filling.

Establishing and Enforcing Effective Criteria and Compliance Procedures. This is easily the most important alternative. An in-depth look at the criteria for locating, siting, and designing individual subsurface disposal systems might disclose some aspects of existing regulations that still allow problems to develop. For example, high percolation rates coupled with the minimum allowable depth to ground water may result in bacterial contamination, nitrate build-up or even phosphate build-up in the ground water. Allowing systems to be placed in fill material might invite clogging conditions at the "fill-old ground" interface. Site inspections could be limited to the wet months of the year in order to spot potential water table problems. Deeds for property might be required to state specifically whether tests have, or have not, been conducted, and where the reports may be examined. For more general planning, the subregional multi-colored land capability maps (Plates 1, 2, and 3) in the rear pocket of this report could be used. Four land classifications are particularly relevant to planning and siting septic systems – aquifers, ledge soils and/or steep slopes, moderate to no septic system limitations, and severe septic system limitations. Septic systems should be discouraged on ledge soils and/or on steep slopes and soils with severe septic system limitations.

Whatever the criteria, to be effective, they must be enforced. Therefore, emphasis is focused on institutional and legal arrangements for compliance through state and local regulatory authorities. This is a major task; the states have difficulty in regulating installation of the multitude of widely dispersed systems – not to mention regulating their performance and maintenance.

The two states have been doing most of the things suggested above, but continued more intensive effort is justified.

Increasing Use of Dry Disposal Systems. If they ever come into widespread use, new, non-water-using home waste disposal systems may, in the future, alleviate some of the problems with septic systems. The only residue is claimed to be a small quantity of compost removed about once a year. Wastewater from kitchen and bathroom sinks, showers and tubs must still receive treatment, however.

Disposal at Existing Wastewater Treatment Plants. Probably the best method of disposing of septic pumpings is to truck them to the nearest secondary or higher wastewater treatment plant for treatment along with sewage. The user, of course, would pay his fair share of the treatment costs.

Since this alternative is not always available, however, other methods must be considered below. Whatever method is chosen, town government must play a key role. It should provide the disposal sites and carefully monitor their use.

Land Spreading. In the ordinary land spreading method, septic pumpings are spread above the soil and allowed to dry. Since the waste is spread in the open, animals and people may easily come in contact with disease-causing bacteria and viruses. Other possible problems are contamination of drinking and recreation waters, attraction of disease-carrying insects, and objectionable odors.

The plow-furrow-cover, terreator, and sub-sod-injection methods are other techniques of land spreading which require further research to determine whether treated soil may be useful for agriculture. All three methods involve placement of the wastes under the soil. Possible problems include concentration of heavy metals, plant absorption of the metals, and persistence of viruses in the treated soil and related ground water.

Drying beds. Drying beds treat the septic pumping in a shallow, uncovered pit which is underlined primarily with sand and gravel. Since the pit is open, it is subject to the

inflow of surface water and possible overflow, and it is exposed to animal and insect contact. Some dewatering of the wastes occurs through leaching, which may have an effect on ground water. The pit apparently does not act as a stabilization pond due to its insufficient depth.

Lagoons. In lagoons, solids in the waste settle to the bottom. When the lagoon is filled and sufficiently dewatered, the stabilized sludge can be removed and buried.

Landfilling. This is a possible method for disposing of septic tank and cesspool wastes, although most experiments in landfilling have been primarily concerned with sewage sludge. In particular, close attention should be paid to controlling runoff and leachates. Besides contamination of water resources, other possible problems include insects, rodents, and odors.

Low Streamflows

The Situation

Generally, water law in the Northeast conforms to the riparian doctrine as interpreted by the courts through specific case litigation. The riparian doctrine gives to the owner of the land adjacent to a stream the right to use water from that stream. If downstream users object, the upstream rights may be limited to a "reasonable use," as decided by the court.

If the upstream riparian owner is a municipality which diverts a significant quantity of water for its water supply system, users will receive a reduced flow until the water is returned – less evaporative, seepage, and other consumptive losses – to the system in the form of treated effluent. Unless the stream is very small, these flow reductions are usually inconsequential. Sometimes, however, the water is diverted to another basin or to the ocean through sewers. As a result, the water near the mouth of the stream from which the diversion was taken will be a few parts per thousand saltier and somewhat cleaner. Near salt water outfalls, however, the water will become a few parts per thousand fresher and also somewhat dirtier. These changes can have a slight, but not critical, effect on the region's ecological system. The most likely harmful possibility might be the closing of an area to shellfish harvest near the outfall. This is a consequence of every wastewater discharge and has little to do with the small salinity changes produced by the diversion.

If the stream is very small, so that the diversion or intermittent water use is a large proportion of its total flow, the consequences can then become biologically and hydrologically devastating. Downstream use might have to be restricted because of the irregular flow. Recreational uses such as boating and fishing might be impaired. Fish and biota are not always permitted sufficient water cover to be able to thrive in such streams. Findings from water quality studies on intermittent streams suggest that the dissolved oxygen and temperature levels often fluctuate to such an extent that water quality standards may be violated. Aesthetically, the streams suffer most. Odor from algae and river bed biota which die from lack of water cover, and are not swept away by the flow, may constitute serious pollution problems. Moreover, dry river bed bottoms will never compare to the visual beauty of free flowing streams.

The South Branch of the Pawtuxet River has extremely erratic flows and wastewater discharges. The Nemasket River often has low flows incompatible with a municipal treatment facility discharge downstream. Both of these rivers are regulated for water supply purposes, industrial and municipal, respectively.

The Solutions

To minimize in-stream problems, particularly in heavily used streams having little flow, low flow augmentation should be considered. Wherever a stream happens to have an upstream reservoir, additional water should generally be released during periods of low streamflow. Since these releases will often conflict with other reservoir purposes – such as water supply and recreation – hard negotiation and carefully considered trade-offs will be necessary between upstream and downstream communities. Low flow augmentation with highly treated wastewater is also being attempted. Safeguards must be instituted to avoid stream pollution in the event of treatment plant failure, however.

Agricultural Runoff

Agricultural runoff includes the runoff of fertilizers and and animal wastes. Pesticides and herbicides were considered earlier in this chapter as hazardous wastes. Sediment is considered in *Chapter 8.*

According to Table 5.1, agricultural runoff is a minor water quality problem in SENE, which is a non-agricultural region. The problem is moderate in only two planning areas – Buzzards Bay and Taunton. It is minor or inconsequential elsewhere. The *planning area reports* for the two cited areas contain further detail.

Farming practices can significantly reduce problems of agricultural runoff. Chemical fertilizers can be applied so as to minimize adverse water quality effects. Manure can be spread during periods when soil moisture is low and the

ground is unfrozen. Well-vegetated streambank buffer strips – advocated earlier under urban stormwater runoff – can attenuate agricultural runoff particularly near locations where animal wastes are produced or spread in quantity.

Leachate from Landfills

According to Table 5.1, leachate from landfills is a fairly minor regional problem. It is of moderate importance in three planning areas, however – Ipswich-North Shore, Boston Metropolitan, and Blackstone and Vicinity.

If not properly controlled, landfill leachate can cause ground water and surface water bodies to be degraded in the same manner as any other improperly treated wastewater. Two of the worst problems exist in the Charles River at Milford and in the Saugus-Pines estuary. The first causes eutrophication and water quality degradation; the second causes water quality problems that contribute to the closing of shellfish beds.

The degree to which most of the other landfills affect water quality is poorly documented. Sampling programs are needed before abatement techniques can be properly chosen. The most effective measure is careful site selection and preparation. The concept is to isolate the leachate from important aquifers or surface water channels.

In-stream Pollution

The Situation

In some streams, the use of previously cited solutions to deal with point and non-point discharges may not result in desired water quality improvements. The chief sources of in-stream pollution are: (1) toxic and/or oxygen demanding benthic deposits; and (2) a high volume of pollutants relative to the volume of streamflow, even if the pollutants have received treatment.

The Solutions

Alternatives

In order to deal with these problems described above, three alternative measures should be considered: (a) dredging of benthic deposits; (b) aeration; and (c) treatment.

Dredging of Benthic Deposits. Several lakes have been restored by dredging polluted material that covered their bottom. Sometimes, however, dredging for water quality improvement can create more problems than it solves by resuspending polluted material. If benthic deposits cannot be removed by natural stream mechanisms, covering of the problem material with clean sand is an alternative.

In-stream Aeration. Although sometimes technically difficult to accomplish, aeration can help a stream to handle a heavy organic load, especially if the stream is sluggish and deep, and has a slow natural reaeration rate. Aeration can be accomplished in the stream by mechanical mixers or diffusers. It can often also be accomplished at the treatment plant out-fall site by a series of simple weirs over which the effluent cascades. Municipal discharges to the upper Charles and the Taunton Rivers will require such post aeration.

In-stream Treatment. This method is being used experimentally at the Storrow Lagoon, in the Charles River Basin. Some of the lagoon's water is diverted through a physical/chemical treatment facility and returned after treatment. If water quality in the lagoon improves sufficiently, a full scale plant would be the likely next step. Treatment systems like this are applicable where non-point sources or the volume of effluent preclude significant water quality improvement, regardless of the degree of upstream treatment. Another example is the lower Pawtuxet where the volume of effluent now precludes any classification higher than Class D. The operational costs of such systems, however, could be prohibitive.

OIL POLLUTION

Oil pollutants threaten the goal of achieving swimmable-fishable water, especially in the Boston area. These pollutants reach the water through inadequately treated industrial and municipal wastewater, overflows from combined sewers, accidental spills, runoff from land areas, discharge exhaust from two-cycle engines used on recreational boats, air pollutants, and drainage entering from outside the SENE Study area.

The Study area has no major refineries, but Massachusetts and Rhode Island rely on oil tankers to provide the great volume of oil required to service the densely populated and industrialized areas in eastern Massachusetts and Rhode Island. Many oil unloading and storage facilities are located in the Study area with the two major concentrations located in Boston Harbor, and in the Providence River and Harbor.

Of 189 oil spills recorded in SENE during 1973, 86 occurred in Boston Harbor and 10 in the Providence Area. Woods Hole and Beverly-Salem Harbors showed more spills than Newport, Fall River and New Bedford Harbors. Continued vigilance by the Coast Guard, EPA, and the state water pollution control agencies can help to control

this potential threat to water quality and marine life. However, prevention by all persons handling oil is the key to fewer spills.

Chapter 9 considers related problems associated with the exploitation of oil and gas reserves off the SENE coast.

WATERCRAFT WASTES

From a regionwide point of view, pollution from recreational watercraft is relatively less significant than many of the other sources of pollution described in this chapter. However, locally – and particularly to the individual swimmer – the presence of watercraft wastes near beaches and popular harbors is particularly serious. As might be expected, the key problem areas are Cape Cod and the Islands and Narragansett Bay.

The region's recreational boating fleet discharges about 22 million gallons of wastewater to the SENE coastal waters each boating season. This is equivalent to the year round untreated wastes from a population of about 600 people. If spread evenly along SENE's 1540-mile coastline, and evenly throughout the year, wastes from watercraft would clearly not be noticed. However, the wastes are concentrated into a few months and into a few crowded harbors. If these harbors are adjacent to waters desired for swimming and shellfishing, problems occur. Furthermore, the wastes are very noticeable from the shore and docks.

There are two distinct alternatives for handling the domestic wastes generated on watercraft. They are: (a) flow-through devices providing primary treatment and disinfection; and (b) holding tanks, devices which result in no discharge. Both pose problems.

Flow-through devices will not always operate at designed levels of treatment if improperly maintained, and there is no practical way for enforcement personnel to ensure that proper maintenance will be performed. Moreover, the treatment provided by an on-board, flow-through device could be considered inadequate in the only areas where treatment of any sort might be really needed – over shellfish areas and near bathing beaches.

The second alternative, the holding tank, also poses problems. It requires that pump-out facilities be available, which is not now the case at most docks and marinas. In addition, the level of treatment provided by on-shore facilities where they do exist, is often inadequate. Also, for certain types of vessels, on-board retention or complete disposal is not feasible.

A third alternative is restricted usage. Areas with concentrations of recreational boating could be closed to swimming and shellfish harvesting. Conversely, all areas near those dedicated to swimming and shellfish harvesting could be closed to boating. As a further refinement, boats could be allowed near shellfish harvest areas and near bathing areas, if the owner voluntarily agreed to comply with holding tank requirements. However, enforcement of this alternative could be more difficult than those required under the first two alternatives considered in this section.

New EPA and Coast Guard regulations have tried to mesh the first two alternatives. "Proposed Certification Procedures and Design and Construction Requirements," written by the Coast Guard for marine sanitation devices (MSD), allows certain certified flow-through devices for specified time periods. No new vessel constructed two years after promulgation of the regulation will be permitted to discharge wastes. Thus, it appears that "no discharge" is the ultimate goal. If pump-out facilities and adequate on-shore treatment facilities are developed, the "no discharge" concept will ensure maximum possible pollution abatement.

Pollution from outboard motors (discharge of unburned hydro-carbons) is another cause of concern with respect to watercraft. How much concern is open to considerable debate. A large quantity of unburned fuel is known to be discharged through the exhaust of two-cycle outboard engines on recreational boats. The effect of this fuel on the water quality and aquatic life is uncertain. Since the resultant oil concentrations are low, adverse environmental effects may be minimal. However, toxic constituents in the fuel, such as lead, may be increasing, expecially in lakes and ponds. Nevertheless, one effect of these discharges is certain: a large quantity of oil and gasoline is being wasted. Devices which eliminate these discharges and recycle unburned fuel are presently available. These devices are inexpensive to purchase and they lower fuel bills. Consequently, their use is recommended not only from an environmental standpoint, but also from an economic one.

AREAWIDE MANAGEMENT

Past experience has indicated that individual municipal efforts to improve water quality can be costly and complex to manage. It is often the case that a coordinated water quality management program linking several communities will have a greater chance to meet state water quality goals than strictly local action. Moreover, such an areawide approach facilitates simultaneous management of the effects of water supply development on water quality and, conversely, the effects of sewering and disposal methods on water supply. However achieved, this integration is essential in several parts of SENE where a decision regarding one function will preclude, or open up, opportunities in the other. Primary consideration should be focused on the Ipswich River watershed in the Ipswich-North Shore planning area, the upper Charles watershed in the Boston Metropolitan planning area, the North River watershed in the South Shore planning area, the Cape Cod and Islands planning area and the Pawtuxet planning area.

Within the SENE boundaries are portions of as many as ten proposed *"208 planning areas"*. Designation of these areawide waste treatment management areas is required under Section 208 of the Federal Water Pollution Control ActAmendments of 1972 and subsequent regulations. Nine of the 208 areas are in Massachusetts. The agencies designated to carry out the development of these areawide waste treatment management areas will not have authority to implement waste water management or water supply plans. They could, however, provide for the necessary coordination between proposed water supply developments and water quality management plans, because the 208 areas coincide with, or include many of, the previously mentioned watersheds. The coordination could be ensured by having water supply experts provide technical assistance to the 208 agencies. Water supply aspects are covered more fully in *Chapter 4, Water Supply.*

ALTERNATIVE PLANS

The primary goal of the Federal Water Pollution Control Act Amendments of 1972 is the elimination of all discharges of pollutants to navigable waters by 1985. However, it seems clear that in SENE, as in many other parts of the nation, that ultimate goal cannot be reached without massive increases in federal funding – if at all. At the same time, the steady, if somewhat slower than anticipated, progress in municipal treatment plant construction, and the strides being made in industrial wastewater recycling and recovery, indicate that we have a good chance of at least approaching that goal.

Within the context of these political and scientific realities, then, several alternative plans were developed, with varying degrees of economic or environmental emphasis.

The environmental plan sought the lower, but still ambitious, goal of swimmable-fishable waters everywhere by 1983. The plan gives equal priority to point and non-point sources of pollution. Treatment, rather than separation would be the only alternative to solving the combined sewer overflow problem. Moreover, some kind of breakthrough in understanding the significance, distribution, and means of abating non-point source pollution would be needed. If such a breakthrough could be made, a major abatement program would have to be developed, accepted, funded and executed. Clearly, the social and environmental benefits would be very high. But so would the costs. Until a better idea of the nature and scope of the non-point source problem can be developed, exactly how costly the program might become cannot be estimated.

The economic plan emphasized least-cost alternatives consistent with the achievement of water quality standards set by the states and approved by the U. S. Environmental Protection Agency. These standards include classification of water quality lower than Class B ("swimmable-fishable"). Highest priority went to industrial and municipal point sources of pollution, then combined sewer problems, and finally non-point sources. Least-cost alternatives were chosen, resulting in the minimum allowable water quality in keeping with the standards. Therefore, achievement of Class B waters under this plan would be delayed well into the future.

RECOMMENDATIONS

General Strategy

The recommended program strikes a balance between economic and environmental objectives. It also includes certain political and technical constraints not considered in either of the alternative plans described in the previous section.

The *objective* of the recommended SENE program for water quality is to achieve swimmable-fishable waters by 1983 wherever realistically attainable economically, socially, and technically.

"Realistically attainable" means that some areas should not use limited financial resources to achieve water quality goals of questionable worth. The recommended program recognizes the political-institutional reality that the municipal and industrial abatement programs are already well underway. Therefore, it generally follows current state plans, especially in the planning area reports. Second, the recommended program recognizes the technological reality that non-point sources are still not well understood, while at the same time recognizing our rapidly increasing respect for their significance.

The philosophy behind the recommended program can best be brought out by several examples. Achieving water of suitable quality for swimming in the Upper Blackstone River would be an unwise use of current financial resources since the river is often too shallow for swimming, regardless of quality. Boston's Inner Harbor is another example of an area where swimmable quality is not "achievable" as a short-term goal because of the diverse sources of its pollution. Socially, it may also be of low priority because of the general shoreline character and lack of significant access. Furthermore, the economic importance of the harbor and its waterfront activities other than swimming would currently take priority. The lower Pawtuxet River is another example where structural solutions at prohibitive cost could be misused in the short-run to attain swimmable quality. As a result of such situations, the recommended program for water quality suggests that while swimmable-fishable waters everywhere should be a long-term goal, the limited financial resources now available should be invested in abatement efforts that will provide significant short-term environmental improvement, protection of the public health, restoration of public uses, and clean-up of entire riverine or estuarine systems.

The recommended program therefore has two thrusts – preservation and restoration where most attainable. The individual policy and action recommendations that comprise the recommended program are presented below.

Preservation

The SENE program gives immediate priority to ensuring that no additional water quality degradation be allowed in areas of high quality water. Five recommendations are listed below in what is perceived to be their *general order of importance* in meeting the above-stated objective of the recommended program.

(1) Stress non-degradation in areas now swimmable-fishable.
(2) Carry out current state antidegradation policies.
(3) Attenuate runoff from new urban developments.
(4) Negotiate acceptable low-flow regimes with upstream communities.
(5) Provide streambank buffer strips.

The first is the general policy. The others are policies or actions supporting it. Environmentally, all five recommendations are attractive. All appear relatively inexpensive, when compared to their potential benefits, although there may be some localized difficulties with numbers 2 and 3. Technologically, all are easy, but number 3 and number 5 will require some imaginative but rewarding landscaping. Politically, most are attractive, but number 2 may encounter localized problems and number 4 may become difficult – but the difficulties would be worse if it were ignored.

The full text of each recommendation, including who is responsible and qualifying details, is given below:

1. **Stress non-degradation in areas now swimmable-fishable. All federal, state, municipal, town, and private water quality programs should ensure that water bodies currently swimmable-fishable are kept that way.**

2. **Carry out current state non-degradation policies. In Massachusetts, the Department of Environmental Quality Engineering should ensure that no new discharges will deteriorate the quality of stream water above the most upstream municipal discharges and Class SA and SB waters (shellfish harvest and swimmable-fishable salt water), with conditioned exceptions:**

   (1) to allow new cooling water discharges if standards are met; (2) to allow new municipal discharges if part of a comprehensive plan; and (3) to require existing discharges to cease and either connect to a municipal system or provide high degrees of treatment consistent with maintaining high quality waters.

   In Rhode Island, the Department of Health should ensure that no new discharges will deteriorate the quality of Class A, B (drinkable, swimmable), SA, and SB waters.

3. **Attenuate runoff from new urban developments. The Massachusetts Department of Community Affairs and the Rhode Island Department of Community Affairs should encourage each of their municipalities to adopt subdivision controls which emphasize open areas and the use of permeable**

drainage ditches, and provide attractive, safe stormwater detention ponds, thereby also possibly augmenting ground water recharge.

4. Negotiate acceptable low-flow regimes with upstream communities. Wherever applicable, but particularly in the Nemasket and Pawtuxet River Basins, the Massachusetts Department of Environmental Quality Engineering and the Rhode Island Departments of Health and of Natural Resources should ensure that negotiations are conducted between upstream reservoir managers and downstream municipalities to improve low-flow regimes, at least to the extent that these regimes will be compatible with economically-achievable downstream wastewater treatment measures and water uses.

5. Provide streambank buffer strips. Everywhere, but particularly in communities expecting high development pressures, the Massachusetts Department of Environmental Management, the Rhode Island Department of Natural Resources and the Rhode Island Statewide Planning Program, in conjunction with other flood plain programs, should encourage municipalities to provide attractive streambank buffer strips to preserve vegetation and other natural systems which help keep non-point source pollutants from reaching sensitive water quality areas.

Restoration

The SENE program has a set of nine recommendations within the limitations discussed earlier, to restore existing water quality. They are listed below in what is perceived to be their *general order of importance* in meeting the objective of the recommended plan.

(6) Emphasize treatment of combined sewer overflows.
(7) Accelerate federal grants for municipal wastewater treatment.
(8) Continue current industrial permits programs.
(9) Begin regionwide stormwater and wet-weather stream sampling.
(10) Make towns responsible for scavenger waste disposal.
(11) Determine municipal sludge disposal policy on a plant-by-plant basis.
(12) Place burden on industry for disposing of hazardous wastes.
(13) Study and define the landfill leachate problem.
(14) Provide pumpout facilities and treatment for watercraft wastes.

Environmentally, all recommendations are attractive. Economically, all recommendations, except possibly numbers 7, 8 and 14, could provide considerable benefits, relative to their costs. Technologically, all are within the current state of the art, but numbers 6 and 12 should be challenging. Politically, all should be acceptable, but numbers 10 and 14 can be expected to encounter opposition.

The full text of each recommendation, including who is responsible and qualifying details, is given below:

6. Emphasize treatment of combined sewer overflows. The U. S. Environmental Protection Agency, the Massachusetts Department of Environmental Quality Engineering, and the Rhode Island Department of Health should emphasize the treatment of combined sewer overflows, particularly where the receiving waters have a high value for swimming and shellfishing. These agencies should discourage separation of combined sewers unless separation can be demonstrated to be more cost-effective than other methods.

7. Accelerate federal grants for municipal wastewater treatment. The U. S. Environmental Protection Agency should persuade the Congress and the Administration to accelerate federal grants to reenergize the slow-moving municipal wastewater treatment program.

8. Continue current industrial permits program. The U. S. Environmental Protection Agency should continue the current industrial permits program, which is part of the National Pollutant Discharge Elimination System.

9. Begin regionwide stormwater and wet-weather stream sampling. Everywhere, but particularly in areas of high urban stormwater runoff and high non-point source runoff, the Massachusetts Department of Environmental Quality Engineering and the Rhode Island Department of Health should begin a major year round stormwater and wet weather stream sampling program designed to provide a rational basis for a major, badly needed, non-point source abatement program.

10. Make towns responsible for scavenger waste disposal. The Massachusetts Department of

Environmental Quality Engineering and the Rhode Island Department of Health should enforce existing legislation requiring towns to be responsible for ensuring proper and monitored disposal of wastes taken from septic tanks and cesspools.

11. **Determine municipal sludge disposal policy on a plant-by-plant basis. The Massachusetts Department of Environmental Quality Engineering and the Rhode Island Department of Health should continue to examine and approve the sludge disposal plans of each municipal wastewater treatment plant, giving balanced consideration to ground water quality, surface water quality, air quality, and socio-economic concerns, and to opportunities for achieving regional economies of scale.**

12. **Place burden on industry for disposing of hazardous wastes. The Massachusetts Department of Environmental Quality Engineering and the Rhode Island Department of Health should place the burden upon industry and farmers for disposing of pesticides, herbicides, radioactive wastes, industrial chemicals, biochemical wastes and other hazardous wastes. The above state agencies should locate, approve and monitor discharges from every significant source in their state.**

13. **Study and define the landfill leachate problem. The Massachusetts Department of Environmental Quality Engineering and the Rhode Island Department of Health should make further field investigations and studies to better define the extent and nature of water quality problems associated with existing and abandoned solid waste disposal sites, with a view to developing adequate perspectives and rational controls.**

14. **Provide pumpout facilities and treatment for water wastes, as an interim measure. Until on-board treatment is more technically and financially attractive, holding tanks and pump-out facilities are the advised methods of treatment. The Department of Environmental Quality Engineering in Massachusetts and, in Rhode Island, the Department of Health and the Coastal Resources Management Council: (a) should have publicly owned treatment plants along the coast, provide pump-out facilities; and (b) should require all marinas in heavily congested harbors and adjacent to major harvestable shellfish beds and swimming areas to provide pump-out facilities with either adequate treatment or disposal to a municipal system.**

Planning Area Priorities

Many factors should influence the development of a priority list. Few people will weigh them the same way. The factors include: the relative severity of the pollution problem; the potential and existing uses of the water body and adjacent shoreline; the population affected; the technical complexity of abatement; the readiness to proceed as evidenced by the status of planning; the cost effectiveness of the abatement; and the total costs and availability of funds.

The two preceding sections on preservation and restoration presented the Study's perception of the relative importance of 14 recommendations. These priorities were regionwide. In application, they differ from place to place as indicated in the individual planning area reports.

In this section, the Study recommends general priorities for the planning areas by considering each from a regional viewpoint. In doing so, the Study draws attention to its conviction that preservation is more rewarding than restoration because it is a more cost-effective, politically acceptable way of maximizing SENE's future inventory of swimmable-fishable waters – which is the water quality objective of the SENE program.

To illustrate, a previously cited example bears elaboration. The Pawtuxet River in Rhode Island, through on-going programs, has been receiving smaller amounts of industrial pollutants as industries treat or tie into the three secondary municipal treatment facilities there. Despite these efforts, water quality is not expected to improve above Class D levels in the lower reach. Attempting to achieve Class B waters there would quite probably sap all the funds available to the rest of the state, thereby preventing Class B in areas where it is achievable. For this reason, the Pawtuxet should have basic aesthetic and public health values attained, but a swimmable-fishable goal should not be sought in the short-run.

The **Cape Cod and Islands planning area** deserves highest priority for planning funds. Funds expended there for construction should be relatively low. Proper planning can minimize the extent of sewer service and attendant treatment facilities. The resulting limited-service areas will further tend to protect water quality by limiting urbanization and associated runoff. Several of the factors mentioned as being important in establishing priorities are evident in this basin and result in its high ranking. First, the basin contains

uniformly excellent fresh and coastal waters. Thus, the limited construction projects will serve to maintain that excellence rather than having to restore already polluted waters Some sewer service and treatment facilities are needed, and returns from the investment – protection of ground water supply and contributions to recreation and tourism – should far exceed costs in this planning area. Since the Cape is a nationally important recreation area, a significant population is affected by water quality there. Given high priority, funds can be reserved for planning and necessary construction to ensure swimmable-fishable waters throughout this planning area well before 1983.

The next area deserving high priority is the **New Bedford Harbor portion of the Buzzards Bay planning area.** Unlike the previous area, the degree of pollution is a major consideration here. Based solely on severity and complexity of water quality problems throughout the SENE portion of Massachusetts, this area received the highest priority determined by the Massachusetts Division of Water Pollution Control. Within the area, emphasis should be placed on control and abatement of combined sewer overflows in New Bedford. Partial separation may be appropriate in limited areas. However, due to the potential problems associated with urban runoff, a treatment scheme, either at the upgraded municipal facility or at overflow areas, is the most positive approach to ensure demonstrable water quality improvements.

Next on the priority list is the **Providence area and its combined sewer problems.** Based upon severity of pollution, expected water uses, and population affected, the Rhode Island Division of Water Supply and Pollution Control has determined this to be the number one priority in the state. Water quality restoration through combined sewer separation and treatment of overflows will enable more of upper Narragansett Bay to remain open to shellfishing and improve overall aesthetics in the Providence River. Recently, Providence received an EPA planning grant to study the combined sewer problem. The SENE Study considers the key to improvements to be treatment techniques, perhaps in conjunction with partial separation, to ensure that urban stormwater runoff will not perpetuate existing problems of intermittent closures of shellfish harvesting areas in the Upper Bay.

The fourth priority is the **Boston Harbor portion of the Boston Metropolitan Planning Area.** The major problems deserving attention there are the combined sewer systems of Boston, Cambridge, Chelsea, Somerville, and Brookline. Because of the large number of untreated combined sewer overflows, these systems are more important to the determination of water quality than are the existing primary discharges at Deer and Nut Islands. Therefore, they should be addressed first. Currently, one combined sewer overflow treatment facility is operating on the lower Charles River. A second is to be built in conjunction with a new dam at Warren Avenue. The design for partial separation of combined sewers in Cambridge should produce overflows only during storms of a magnitude greater than the "five-year" storm. Sewer separation is planned for Brookline, as well. Finally, tide gate and combined sewer regulator repair is a continuing project of the MDC. Emphasis should be placed first on treatment of storm sewer and combined sewer overflows affecting bathing areas and shellfish harvesting, in keeping with the "swimmable-fishable wherever achievable" theme. Next, a solution to the sludge disposal problem of the treatment facilities must be implemented. Then, remaining combined and storm sewer flows should receive attention. Finally, secondary treatment should be achieved at the Deer Island and Nut Island treatment facilities.

The **remaining planning areas** can be adequately restored within a reasonable time by adherence to existing state priorities. As a general rule, however, treatment facility discharges which alone cause degradation of water quality in a given area, should be addressed first so that a maximum of stream miles and coastline can be restored in the shortest possible time. This approach is in keeping with the swimmable-fishable goal *wherever attainable* by 1983.

With respect to time frame, it is obvious that funding is a determinant of how quickly the waters of the region can be brought to acceptable levels of quality. It is also important to recognize that the priorities listed above need not be attempted sequentially. They can be implemented, at least in part, *concurrently* in each area and between areas. Thus, for accelerated water quality control, more funding is necessary at all levels of government. As previously emphasized, if that funding is not forthcoming, dates for achievement of water quality standards, as well as minimum treatment levels, will not be met. This is why it is necessary to have a priority list emphasizing preservation and attainment of swimmable-fishable waters where feasible and economically advantageous.

This section can be summarized in the SENE Study's last water quality recommendation:

15. **Give priority to Cape Cod, New Bedford, Providence, and Boston. The U. S. Environmental Protection Agency, the Massachusetts Department of Environmental Quality Engineering, and the Rhode Island Department of Health should give planning, design, and construction priority to the Cape Cod and Islands Planning area, New Bedford Harbor, Providence area, and Boston Harbor, in that order.**

Costs

Firm detailed cost estimates cannot be made. Unfortunately, not enough attention has been given nationally and locally to accurately estimating the total costs for carrying out existing, much less proposed, water quality programs. Total costs include not only the capital costs to all levels of government, but more importantly the full capital operating and maintenance costs to everyone – government, industry, and private consumer. Costs also include the value of opportunities denied.

Notwithstanding this lack of good information, the SENE Study attempted to derive some minimum estimates of the more visible costs to provide a *rough sense of the amounts involved.* No reader should *infer* any greater degree of accuracy than this.

According to information presented earlier for municipal discharges, the two states have estimated a total of $7.9 billion to complete those portions of their municipal programs that are eligible for EPA funding. Adding the other costs of programs which are not eligible for EPA funding, and the operations and maintenance (O and M) costs over the next ten years, the capital figure costs might double. Rounding off, the municipal total would be about $16 billion. EPA, however, estimates that a more achievable total would be about $1.5 billion for that part of the capital program eligible for EPA 75-percent funding. Adding the remaining capital costs which EPA does not fund and all O and M costs for this level of performance should bring this figure to about $3 billion. Included in the EPA estimate are some projects for urban stormwater treatment. On that basis, and retaining a very conservative cost assessment approach, this estimate will include no additional costs for urban stormwater runoff.

No one keeps consolidated records on what it costs industry to comply with the industrial water pollution abatement permits program. A detailed study of these costs, however, has been done for the Connecticut River Basin by the CEM (Center for Environment and Man) for the Chase Manhattan Bank and EPA. Including all remaining capital and O and M costs, allowing for anticipated growth rates in each industrial grouping, and adding up estimates for more than 3,000 individual plants, that study concluded that about $191 million (in 1971 dollars) would have to be spent by industry during the 1972-1980 period to meet best practicable treatment (approximately secondary) water quality standards. Adjusting for the larger population in SENE, a somewhat different industrial mix, and a different degree of previous abatement efforts, and rounding off to the nearest tenth of a billion, it would appear that carrying out the industrial permits program will cost SENE industry about $0.6 billion dollars over the next decade. Of this total, nearly $0.4 billion can be expected to be for O and M costs.

None of the other programs – on septic systems, low streamflow, agricultural runoff, landfill leachate, oil pollution, and watercraft wastes – have been costed thoroughly by anyone to the Study's knowledge. The most difficult costs to estimate here are the value of opportunities denied, as, for example, land not developed. Conservatively, total costs would probably be at least $1 billion for the next decade.

Adding the above estimates in billions of dollars – $3 for municipal discharges and urban stormwater runoff, $0.6 for industrial discharges – and only $1 for everything else – produces a minimum total of about $5 billion during the next decade.

Implications

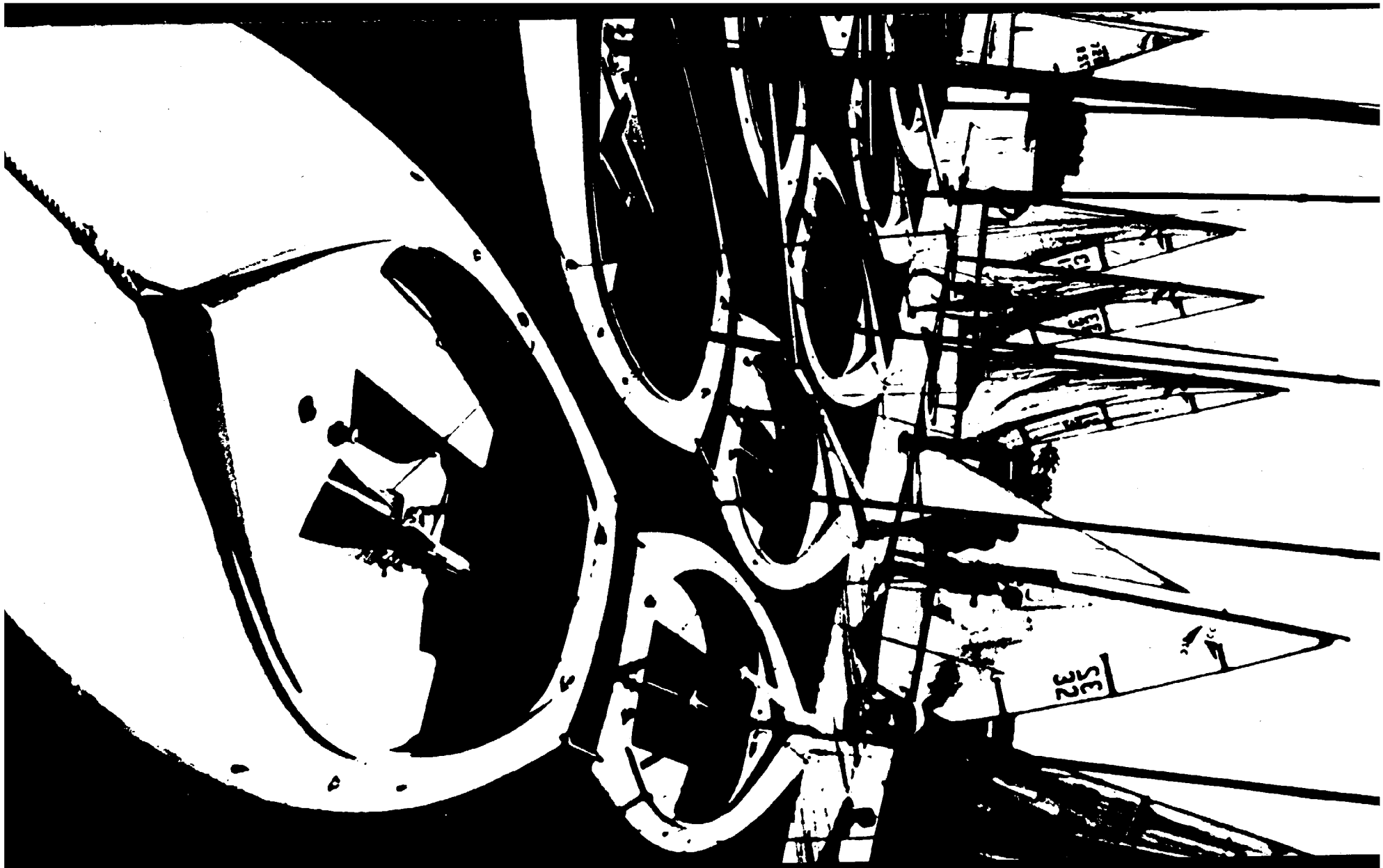
If the SENE Study's package of five preservation recommendations, nine restoration recommendations and one area priority recommendation is carried out, what difference will it all make? What will be the environmental, economic, and social implications?

Environmentally, swimmable-fishable waters will have been achieved by 1983 wherever realistically attainable, economically, socially, and technologically. To visualize the anticipated improvement, see Figures 5.1 and 5.2. They compare existing water quality with proposed water quality.

Economically, the key element of the program comes in the realization that *all* waters in the region *cannot* – and in some cases *should not* – reach swimmable as well as fishable levels in the short-run. Instead, the program emphasizes preserving existing swimmable waters and achieving the swimmable-fishable goal elsewhere, where most beneficial in relation to the costs incurred. Preservation of existing high quality waters will lower pollution control costs in the future. Total costs will be in the $5 billion range, not nearly as high as the achievement of swimmable-fishable waters *everywhere.* Economic benefits should accrue through increased recreation and tourism, improved value of waterfront locations and some increase in shellfishing. In addition, the Environmental Protection Agency has estimated that each $1 million spent on wastewater-handling facilities generates 46 jobs on and off the site. Probably the most important economic benefit is less tangible – making SENE a more appealing place for attracting and holding the professionals and highly skilled workers it will need in the future. As described in *Chapter 2, The Setting,* as a result of a trend

toward a more service oriented economy, direct demands on SENE waters, both as a medium for waste assimilation as well as for supply, may not be significantly greater in the future. Pollution problems resulting from industrial by-products may not exponentially increase as has been the trend in the past. Thus, the outlook for improvement in water quality in SENE may be somewhat better than many might perceive today.

Socially, the program adopts the popular, ongoing, long-range programs that have already won political support. Major technical problems must still be resolved, particularly in understanding and abating non-point source pollutants. Although no major institutional changes are suggested, it is evident that for the program to succeed, federal funds must be made available.



Outdoor Recreation

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CHAPTER 6 OUTDOOR RECREATION

The Setting

The SENE region's water and related land resources, described extensively in *Chapters 2 and 3,* probably mean the most to people in terms of their potential for outdoor recreation. In fact, the Study's estimates indicate that demands for various recreational opportunities are increasing so dramatically that the need for action is urgent.

The single most important program responding to this need is a **federal** program, the Land and Water Conservation Fund Program (PL 88-578). The Bureau of Outdoor Recreation (BOR in the U. S. Department of Interior) administers this program which funds federal recreational projects and up to 50 percent of state or local costs for recreational acquisition and development. Since the program's inception in 1965 to the end of 1975, Massachusetts will have obligated 100 percent of its available funds, and Rhode Island, less than 70 percent of its available funds.

Also a part of Interior, the National Park Service (NPS) plans and administers the natural, historic, and recreational sites within the National Park System, specifically for the SENE region, the Cape Cod National Seashore. Present NPS policy for managing the Seashore focuses on protecting the rich and varied resources. Demand projections for future recreation would indicate that there may be cause for reassessing this position to allow for greater recreational use. To preserve the nation's natural and cultural heritage NPS also administers the Natural and Historic Landmark Program (described fully in the Fish and Wildlife Section).

At the **state** level, the Massachusetts Department of Environmental Management (DEM) uses the funds for recreational planning, acquisition, development, and management. In Rhode Island, the Statewide Planning Program (SPP) coordinates with the Department of Natural Resources (DNR) for recreational planning, acquisition, development, and management.

At the **local** level, municipal authorities can also use Land and Water Conservation Funds for matching recreational acquisition and development. In addition, Massachusetts has a Self-Help Program to help fund up to 50 percent of local conservation acquisitions. From 1961 to the end of Fiscal Year 1974, the Commonwealth reimbursed municipalities over a $6.2 million total, about two-thirds of which (nearly $4 million) has gone to about half the Massachusetts municipalities in the SENE region. A similar program in Rhode Island, the Green Acres Fund, made $2 million available to 31 of 39 of the states municipalities, for up to 50 percent of the cost of conservation land acquisition. However, the fund has been exhausted since 1972 and the Study encourages the state to generously refund the Green Acres Program. Municipalities generally acquire and develop recreational facilities at a smaller scale than state or federal levels. However, they do have substantial powers to protect potential recreational resources, for instance, through zoning and wetlands protection legislation. The power of protection has indirect, but far-reaching implications for meeting future recreational needs, primarily in terms of keeping recreational options open.

Between the state and municipal levels of government in Massachusetts there are **substate regional** planning agencies which can advise communities about open space planning. In the greater Boston area the Metropolitan District Commission performs a planning function, but also acquires, develops, and manages recreational facilities. In both states there are myriad watershed associations and private organizations which act to acquire and develop recreational opportunities and are most effective in terms of environmental education and awareness.

There are a number of other federal programs which assist state and local governments in meeting recreational needs. The U. S. Fish and Wildlife Service (USFWS in the Department of Interior) administers the Federal Aid in Fish and Wildlife Restoration Program, which can, in some instances, cover the costs of land acquisition. The Soil Conservation Service (SCS in the U. S. Department of Agriculture) makes cost-sharing grants to local sponsors under the Small Watershed Program for land acquisition, easements, rights-of-way, and facilities needed to develop the recreational potential of watershed projects. The Department of Housing and Urban Development (HUD) administers the Housing and Community Development Act of 1974, which provides funds for any aspect of community development, including open space acquisition or urban park development. Projects related to water resources development (navigation, flood control, multi-purpose water resource projects) are legally bound by the Federal Water Project Act to consider recreational options. Further, the legislation provides funds to cover up to half the direct costs of developing recreational facilities.

While this chapter concentrates on the outdoor recreation aspects of water and related land planning, it incorporates the concepts outlined in *Chapter 1, Goals and Approach,* and *Chapter 2, The Setting,* which provide a framework. Those chapters describe, for example, the importance of

the environment to enhancing the region's economy, and that existing knowledge, programs, and institutions can provide the tools for achieving results. *Chapter 3, Guiding Growth*, outlines a rationale and policies for protecting Critical Environmental Areas, many of which could be allocated for particular kinds of recreation uses. Although references are also made to several other portions of this report, *Chapter 11, Tying the Recommendations Together,* can be consulted to determine the implications of the recommendations in this chapter or those described in other chapters of this report.

INTRODUCTION

This chapter considers many outdoor recreation activities – swimming, boating, salt water fishing, camping, picnicking, hunting, fresh water fishing, and less formal pursuits such as hiking and nature study. All are either water-related or water-enhanced. Some of the activities such as swimming may be considered as *intensive* – a large number of participants are usually accommodated in a small area. Others are *extensive* – a major part of the experience is the isolation and hence a very large area is required per participant.

The *objective* of this chapter is to develop a program for meeting anticipated recreational needs in environmentally, economically, and socially acceptable ways. To accomplish this objective, for each recreational activity there is a discussion of the demand and supply situation, alternative solutions for meeting needs, alternative plans, and recommendations. The implications of carrying out the recommended program concludes the chapter.

The best currently available consistent estimates of future recreational demand for the entire region were systematically developed in the *North Atlantic Regional (NAR) Water Resources Study* in 1971. Assuming that the people in the SENE area will want to participate in outdoor recreation at the same rate as the average New Englander did in the last decade, and after making allowances for the changing population in terms of numbers, age, education, and affluence, the average SENE citizen in 1990 can be expected to have a demand for outdoor recreation about as follows:

- 19 occasions swimming: 11 in the ocean, 4 in lakes and streams, and 4 in pools.
- 6 occasions boating; 2 requiring slips and moorings, 1 requiring boat ramps, and 3 requiring neither.
- 6 picnicking occasions: 4 requiring picnic tables and 2 not.
- 3 occasions fishing.
- 2 occasions in extensive pursuits such as hiking and nature study.
- 1 occasion camping.
- 1 occasion hunting.

To satisfy this anticipated demand, certain basic facilities will be required. Exactly how many depends upon many factors such as usage rates and spatial standards. Both will vary from place to place. Using the general factors considered representative in the NAR study and supplementary studies by the U. S. Bureau of Outdoor Recreation (Outdoor Recreation Needs – A Planning Aid Report), projected requirements and the existing supply are shown in Table 6.1. Their difference is an estimate of deficiencies ("needs").

When the percentage of requirements unmet in Table 6.1 is multiplied by the applicable participation rates summarized above, a deficit can be seen in terms of the number of occasions each person would probably be denied annually. Thus for beach swimming, 51 percent of the 15 applicable swimming occasions would be denied. This is about 8 days per capita each year. On a similar basis, the annual per capita occasions denied for the other outdoor recreation activities

TABLE 6.1 PROJECTED RECREATIONAL NEEDS *

Facility	Projected Rqmts. in 1990	Existing Supply	Deficits (Needs) in 1990	Percent 1990 Rqmts.
Acres of developed beach	4,500	2,200	2,300	51
Slips and moorings	67,000 **	47,000	20,000	30
Boat ramps - - lanes	900 **	400	500	56
Picnic tables	23,000	9,000	14,000	61
Campsites	29,000	10,000	19,000	66
Acres for extensive outdoor recreation	350,000	220,000	130,000	37

* Source: Outdoor Recreation Needs - - A Planning Aid Report. U.S. Bureau of Outdoor Recreation.
** Source: U.S. Army Corps of Engineers.

would be about one-half occasion for boating that requires slips and moorings, about one-half occasion for boating that requires boat ramps, about two occasions that require picnic tables, about one-half occasion for camping that requires camp sites, nearly one occasion that requires extensive area for hiking and nature study, and an undetermined number of occasions denied for fishing and hunting.

Table 6.1 brings out several major perspectives that must be considered in dealing with recreational needs.

(1) In terms of impact on future outdoorsmen, the occasions denied for swimming exceed the combined total of all others – about 8 of 12.

(2) Satisfying swimming needs will require intensive development of a very small area of land – less than one-tenth of one percent of the total SENE land areas. Emphasis here must be on developing selected, high-quality, favorably-located beaches for public use, and on improving access and transportation.

(3) Boating needs rank second in total quantity. Much of the boating need is met by private enterprise which, because of hard financial times, local resistance, and high maintenance and building costs, may not be able to keep pace with growing demands. Boat ramps are highly efficient in meeting small-boat demand. Existing slips and moorings, inventoried by the Corps in 1972, are now near capacity for demands of medium and large boats.

(4) There appears to be a large deficiency in picnic tables. The quantity ought to be relatively easy to provide, however, by an increase in informal (away from picnic grounds) picnicking. Abundant space is available on SENE Critical Environmental Areas (Category A and B lands on Plates 1, 2, 3) recommended for protection in *Chapter 3,* although most of this land is privately owned and not available for recreation by the public.

(5) A high proportion of camping needs appears to be unmet. Since most campsites require some roads and utilities, satisfying these needs will require coordinated planning between the public and private sectors.

(6) Area requirements for extensive outdoor recreation seem staggering – another 5 percent (130,000 acres) added to the existing 9 percent (250,000 acres) of SENE's total land area. There is, however, no lack of resources for meeting these recreational demands. The protection and management of Critical Environmental Areas through the Study's proposals for guiding growth *(see Chapter 3)* should help keep the options open for satisfying these demands. The main limitation is public access.

There are several limitations to the demand figures shown in Table 6.1. First, the numbers do not depict the fact that the major sources of demands in the region – the urban centers – are distant from the largest recreational facilities. This means that residents of the Boston, Providence, and Worcester metropolitan areas, about a third of whom do not own an automobile, find difficulty in reaching recreation resources in other parts of the SENE region. Second, despite the national nature of recreational demands in the SENE region, the Study's demands do not account for recreational demands from outside the region. Third, they do not account for the portion of the region's recreational demand satisfied in other parts of New England or the United States.

Recreation planners throughout New England and in New York have bemoaned these and other limitations, caused partly by inconsistent demand methodologies. As a result, they have proposed a Recreation Demand/Supply Study which would produce a methodology for use in the New England states. The SENE Study's experience indicates an urgent need for this effort and encourages the state legislatures to back it with funds.

Satisfaction of recreation demands can be cumulatively important for at least four strategic reasons: (1) absorbing a large portion of regional recreation demands at a local level improves local environmental quality and reduces transportation requirements; (2) allowing controlled and compatible recreation use of public Category A and B lands improves the political likelihood of keeping these lands in a protected status as proposed in *Chapter 3;* (3) maintaining the region's environmental and social amenities should become increasingly important to the region's economic future, as was pointed out in *Chapter 2;* (4) meeting recreational needs requires coordinated planning at all levels of government, particularly with regard to transportation, water supply, and wastewater treatment. In other words, care must be taken to see that tourist facilities are not expanded at the cost of spoiling the basic natural resources which attract these recreationists, as well as other forms of economic activity.

The need for aggressive action for providing outdoor recreation is clear. Most action for acquisition and development pivots around the Land and Water Conservation Fund (L&WCF) Program established by Congress in 1965 (P.L. 88-578). The program provides (1) funds for federal acquisition of land by certain federal agencies for outdoor recreation; (2) matching grants (on a 50-50 basis) for state recreation plan-

ning and state and local land acquisition or facilities development. The program is administered by the Bureau of Outdoor Recreation of the Department of the Interior. To qualify for matching grants, the Massachusetts Department of Environmental Management and the Rhode Island Statewide Planning Program have prepared and are periodically updating Statewide Comprehensive Outdoor Recreation Plans (SCORPs) which identify priorities for recreational needs, among other things.

The amounts available from the Fund for each state are determined by a formula which incorporates the state's total population, its population concentrated in standard metropolitan statistical areas, and a percentage that is prorated equally to all States.

Since inception of the L&WCF Massachusetts has been eligible for nearly $30 million which, along with over $900,000 of contingency funds, the State will have completely obligated by the end of Fiscal Year 1975. On the other hand, Rhode Island has been eligible for over $12 million over the past 10 years, of which only 70 percent has been obligated. Rhode Island, therefore, has an unobligated balance of nearly $4 million, primarily because of an inability to raise state and or local matching monies. The Rhode Island legislature has refused well over a third of the funds proposed by the Governor and the Department of Natural Resources since 1965. Among the New England states this situation is not uncommon. Excluding Massachusetts, the average portion of available Fund monies used by the five New England states since 1965 is approximately 75 percent, a figure which is much lower than other parts of the United States.

There are any number of reasons for this situation. The legislature may favor other federal programs which offer a higher federal share than the Land and Water's 50 percent matching ratio. Bonds for recreation acquisition and development may not be popular in an area with an apparent abundance of recreational opportunities. Projects which require winterizing in the cold New England climate, such as swimming pools, cannot be enclosed under the Fund and yet such facilities represent a significant recreational need.

The supply-demand data discussed earlier in this chapter suggests that there will be serious unmet needs for water related outdoor recreation opportunities, particularly in the case of Rhode Island which has been unable to generate matching monies. The situation suggests that both the state, and the national approaches should be reassessed, and, as a result, perhaps revised.

At the state level, the manner in which L&WCF program is operated could be modified. There are at least two possible funding sources which could be explored for matching Land and Water Conservation Funds. If the states qualified for, and received, funds from the New England Regional Commission under the Public Works and Economic Development Act, the state could then choose to use them in conjunction with L&WCF monies and thereby limit the state or local share up to 20 percent.

At the national level, it seems appropriate to suggest a review of the Land and Water Conservation Fund Program by Congress or the Department of the Interior. There are several options to consider. First, currently Congress is considering amendments to the L&WCF Program related to increasing the total size of the Fund, increasing the federal share for acquisition projects developing closed and sheltered facilities, and requiring annual evaluation of state grant programs. A second option set forth in the Nationwide Outdoor Recreation Plan published by BOR in 1973 proposes a revised apportionment formula which would provide more funds to states with higher population densities – at the same 50-50 matching ratio. Experience in Rhode Island – which would benefit from a density factor in apportionment – suggests that more money on the present basis is not necessarily the answer. A third option is an investigation by Congress of the cost-effectiveness of a sliding scale. Such a scale could be based on an evaluation of certain projects using such criteria as land costs, regional impact, climate, population density, degree of national significance, and degree of non-resident use.

In large measure, then, the states must revise their recreation programs so that they and the local governments take maximum advantage of assistance that is available and by getting recreation as a higher priority in the state and local budgets. On the other hand, the federal government should stand ready to assist those states and communities which are unable to come up with matching funds.

SWIMMING

The Situation

According to Table 6.1, the amount of public beach required to meet 1990 swimming demands is likely to be twice as large as the existing area. This section concentrates on ocean beaches, one of SENE's most valued resources. One problem with satisfying beach demands is that roads, public transportation, and facilities for public

beaches are often undeveloped. A second problem is that there is not enough public access to the coastline. According to the U. S. Army Corps of Engineers' National Shoreline Study, of SENE's total 1,540-mile shoreline only 225 miles are available for public recreation. A related issue concerns public rights along the shoreline. In Rhode Island, the public has access rights to the area between the mean high and mean low watermarks (the foreshore). In Massachusetts, the public has limited rights, dated to Colonial times with respect to "angling" and "fowling" and navigation uses, but these need clarification in modern terms. A third problem is the availability of funds to acquire and develop new regional beaches and local resistance to beach development. A fourth problem is that many existing public beaches are eroding due to a combination of natural forces and misuse by man. The latter is particularly retards plant growth, dune formation, and beach stabilization. Ocean waters north of Provincetown are notoriously cold, so that tourists may prefer the Cape's southern beaches or those in Rhode Island. Finally, water pollution occasionally limits swimming in some locations.

Because coastal tourists and beach users often travel long distances to SENE's beaches, there is a need for better coordination between beach developers and campground and picnicking facility planners. Efforts to develop new tourist services should be coordinated with efforts to develop additional or new beaches, although intensive development of Critical Environmental Areas (Category A and B lands) should be restricted.

The Solutions

Alternatives

The three major alternatives for satisfying future beach needs are: (a) more efficient use of existing parks and beaches; (b) securing public access to the shoreline; and (c) acquiring new beaches for state parks.

More Efficient Use of Existing Public Parks and Beaches. One method of meeting a small, but significant portion of urban swimming demands is adding facilities at the nearby beaches. Beaches in the North Shore, South Shore, Cape Cod, and Narragansett Bay planning areas have considerable potential for meeting these demands, but inadequate public transportation, facilities, and inadequate parking will hinder use to the fullest capacity. Convenient and inexpensive public transportation could provide improved beach opportunities without the adverse impacts of roads and parking lots, for thousands of residents in SENE who do not have automobiles. During the 1974 summer season, the Rhode Island DNR developed a very popular program of shuttling Providence residents to South County beaches. If additional parking facilities were provided away from the beaches and connected to the beaches by local public transport, beach use could increase and total impact on coastal lands could be lessened. Improvement of Route 146 in Massachusetts (improvements for the Rhode Island portion have been completed) would help Worcester area residents reach coastal beaches in the Narragansett Bay planning area. To improve the recreational experience and safety, bath houses, beach patrols, and lifeguards are needed at several beaches in the North Shore, South Shore, Narragansett Bay, and Pawcatuck planning areas. Details are available in *individual planning area reports.*

Beach erosion controls and nourishment are important tools for maintaining and expanding the region's existing beaches. Alternatives for controlling coastal erosion are discussed in *Chapter 8, Flooding and Erosion,* and some priorities are suggested later in this Chapter.

Management for more intensive use of existing publicly-owned beaches will often produce a greater return on investment than acquiring and developing new beaches. Disadvantages as expressed during the 90-day review period are that municipal services, roads and local environmental quality suffer because of additional beach users. In the case of state beaches, or of non-resident access to Town beaches, various forms of sharing costs for access and public use facilities and services should be explored. User fees should be considered a potential resource for these purposes. Rhode Island currently shares revenues for seasonal passes to coastal beaches with affected communities.

Securing Public Access to the Shoreline. A strategy for improving public access to the remaining 1315 miles of privately owned and inaccessible coastline would differ for Rhode Island and Massachusetts.

In Rhode Island, the public has the free right of public passage on foot along the coastline between the mean high and mean low watermarks. There remain some problems, however, including access to the intertidal strip and landowner liability for injury on private property.

A solution to that problem is legislation similar to Massachusetts Chapter 21, Section 17C, which would exempt landowners from liability for injury to the person using land for recreational access. Such legislation might encourage landowners to permit access across private lands to Rhode Island beaches.

Acquisition of public access points is more expensive, but often necessary. An active program for acquiring public access routes to the coast being conducted in Rhode Island by the Public Rights of Way Commission in cooperation with the Department of Natural Resources should be continued in cooperation with the Coastal Resources Management Council. Care must be given to coastal reaches which may be fragile or inappropriate for recreational use due to

poor water quality, conflicting land uses, or the inadequacy of roads and parking.

Unlike Rhode Island, Massachusetts residents do not have a "free" right of access along the foreshore for swimming. This was confirmed in July, 1974, when the Massachusetts Supreme Judicial Court ruled unconstitutional proposed legislation to codify a general public right to the foreshore (H.B. No. 6438). The public has limited rights, dating to Colonial times, with respect to "angling" and "fowling" and navigation uses, but these need clarification in modern terms.

A Special Legislative Commission on Availability and Accessibility of Public Beaches is continuing to consider alternative ways of opening more Massachusetts beaches to the public. A current report suggests three kinds of action: equalizing parking fees at town beaches for residents and non-residents; requiring non-profit organizations holding tax-exempt status to permit public access to beach property; and automatically opening beaches and property that remain unposted and open to the public for over five years under a right of way dedication statute. There are serious problems with each of these actions; for example, the "dedication to public use" provision might well stimulate private property owners to close beach access presently unofficially open to the public to prevent loss of the private status.

The SENE Study recommends that the Commission consider the feasibility of various forms of state financial support for access and facility development, maintenance and operation costs incurred in servicing non-resident use; and comparable forms of incentive to encourage opening of beach areas held by non-profit institutions. User fees as a source of funding for beach access and management should be fully explored.

Acquiring New Beaches for State Parks. The annual summer migration to the shore severely overtaxes beach facilities, particularly near Boston and Providence and on Cape Cod. Of the 1540 miles of shoreline in the SENE Study area of Massachusetts and Rhode Island, approximately 225 miles are accessible to the general public for coastal recreation. Even if all major stretches of beach were in public ownership, and managed for general public recreation use, the resources would be inadequate to satisfy future peak demands for public recreation.

The coastline is dotted with small stretches of beach which are not suitable for massive public use, either because of special difficulties in providing for public access, or limited capacity to sustain use. There are, however, expanses of beaches along the North and South Shore coastlines, Buzzards Bay, and Narragansett Bay which are capable of sustaining substantially increased recreation use without destruction of related ecosystems or intolerable congestion and traffic impacts on the communities involved.

Recommendations for expansion, management, and protection of specific beach areas are described in the planning area reports.

As a matter of policy, the two states should pursue the expansion of opportunities for general public use of appropriate beach areas not presently accessible to the general public, where such use can be sustained without damage to related ecosystems or intolerable burdens on associated communities. State acquisition and management should be considered one important tool for implementing this policy.

Acquisition or expansion of state-owned and managed beach areas will be expensive -- in acquisition costs; in development of access and public use facilities; and in operation and maintenance. Nevertheless, the ocean beach provides experiences of a nature so special as to demand the investment of state resources to secure these opportunities for the general public.

While the state's role is inevitable and desirable, local government and private acquisition and management of beach areas can help serve the public interest. A number of major beaches in the SENE region -- including Duxbury Beach on the South Shore and the Westport-Dartmouth reach in Buzzards Bay -- are examples of beach areas in which private institutions and local governments are providing general public access and undertaking protection programs for fragile ecosystems. Such local and private initiatives, where they are capable of serving the broader public interest, are to be commended and should be supported by state policies and programs. If the future reveals that the objectives of public access and protection of fragile resources cannot be accomplished despite the best efforts of private or local stewards, the urgency of public need for beach access will inevitably lead to renewed interest in state acquisition and management.

Alternative Plans

The alternative measures just described can be applied to varying degrees to produce three separate plans. One would stress environmental protection through such actions as the preservation of beach areas and limiting public use and access. There would be few benefits for the local or regional economies because new development (tourist or related services) would be restricted. Another plan would stress economic development through such actions as the management of beaches for intensive use and the development of numerous new state beaches and parks. While local and regional economies would prosper, environmental quality would likely decline. The recommended plan is mid-way between the two extremes: it aims to centralize management of regional facilities, but encourages continued protection of certain beach resources for public and private use.

Recommendations

To meet future demands for public beach access the recommended program, which is given in priority order below, incorporates both approaches.

1. **Expand facilities at existing state beaches and parks. The Massachusetts Department of Environmental Management and Rhode Island Department of Natural Resources and appropriate local governments, or private beach operators, should provide increased capacity at existing beaches, or expand the boundaries of existing beaches, by acquiring new parcels nearby for future swimming development and extensive recreation. Examples are Wollaston Beach in Massachusetts and Goddard State Park Beach in Rhode Island.**

   Agencies responsible for transportation and recreation planning and development in both states should consider the feasibility of increased public transportation and expansion of parking facilities away from the fragile beach environment with shuttle service to the beach on peak days. This procedure could be appropriate at locations such as Crane Beach and Wingaersheek Beach in the Ipswich-North Shore planning area, Cape Cod National Seashore beaches, and Narragansett Bay beaches such as Scarborough.

The Corps of Engineers has assessed beach erosion problems along the SENE coastline and identified several areas where erosion control could increase the public use capacity of existing beaches. The Corps has, under existing law, authority to undertake coastal erosion control projects to protect publicly-owned shore areas under specified conditions, including non-federal cost-sharing requirements. Beach erosion control projects, in some cases in combination with facilities improvement and protection from highly intensive human abuse, would characteristically include both beach nourishment (adding sand) and construction of jetties. Such a program should be considered on a case-by-case basis, following careful evaluation of impacts on "downstream" areas as well as the project areas and of compatibility with the states' coastal zone management programs. Therefore, the SENE Study recommendation is:

2. **Study beach erosion control. The Corps of Engineers, as requested by individual municipalities or together with Massachusetts and Rhode Island agencies, should control beach erosion, if justified by a preliminary feasibility study, evaluation of environmental impacts, and consistency with state coastal zone management programs, at the following beaches:**

Beach	Municipality	Planning Area
Long Point Beach	Wareham	Buzzards Bay
*Island Park	Portsmouth	Narragansett Bay
*Allen Harbor Beach	North Kingstown	Narragansett Bay
Ninigret Beach (Ninigret Conservation Area)	Charlestown	Pawcatuck
*East Matunuck State Beach	South Kingstown	Pawcatuck
Block Island Jetty Beach	New Shoreham	Narragansett Bay

Beaches marked by an *asterisk (*) should be considered for nourishment in the next 15 years.* Other beaches should be considered for erosion control in the next 15 years. Feasibility and environmental impact studies would be essential.

A second series of investigations should be conducted into opportunities for expansion of beaches – adding to the length or depth of beach area beyond the natural configuration – quite apart from erosion problems. The Corps may presently undertake nourishment and protection projects only where erosion is a major issue, and does not – even when erosion control is the present purpose – have authority to nourish or expand beaches beyond the "natural" configuration. Accordingly, the SENE Study recommends:

3. **Study beach expansion. The Corps of Engineers under new authority, working jointly with the Bureau of Outdoor Recreation, appropriate state agencies, municipalities, and private interests, should expand the following beaches by adding sand, if justified by preliminary studies of feasibility, environmental impact, and consistency with state coastal zone management programs:**

Beach	Municipality	Planning Area
Crane Beach	Ipswich	Ipswich-North Shore
Nantasket Beach expansion	Hull	Boston Metropolitan
Humarock Beach	Marshfield	South Shore
Plymouth Long Beach	Plymouth	South Shore
Ocean Grove Beach (Coles River)	Swansea	Narragansett Bay

The Corps has authority to study technical, economic, and environmental aspects of beach erosion and expansion. At the same time, it may also be appropriate for state and local governments to re-appraise the appropriate level for beach ownership and management in cases where sharply increased capacity for general public use is realized through erosion control and expansion programs.

Recommendations 1, 2, and 3 above emphasize better utilization, protection and expansion of existing beach areas. These recommendations are priority elements of a broader recommendation to:

4. **Secure public access to the shoreline.**
   The States of Rhode Island and Massachusetts should continue, as a matter of policy, efforts to expand public access to the coastal shoreline, with careful regard for the protection of fragile ecosystems and for minimizing negative impacts on affected communities and individuals.

   Beaches not under protection and capable of sustaining intensive and large scale public use should be considered for state acquisition and management. Priorities should be based on nearness to demand centers, any threat to pre-emption of public use opportunities, and prospective damage to fragile ecosystems.

   Efforts of local governments and private institutions to acquire and manage beach areas and related ecosystems for public use and protection should be recognized. Their efforts should be encouraged in appropriate ways by the states and the federal government. There are also opportunities for expansion of general public use of appropriate town owned beaches through local-state cooperation. In addition to major beach areas, opportunities for public access to the coastal shoreline generally should be expanded in both states for such valuable experiences as scenic appreciation, beachcombing, surf-casting, wildlife observation, etc.

   In Rhode Island, where public use of the foreshore is secured under State Law, the Rights of Way Commission and Department of Natural Resources should continue their public access programs, acquiring access points at frequent – roughly five-mile – intervals along Narragansett Bay and the "South County" coast.

   In Massachusetts, where public rights of access along the foreshore are severely limited, the Commonwealth should pursue an implementable clarification of the angling-fowling-navigation rights granted in Colonial times. The Commonwealth should also consider possibilities of various means of state sharing of costs of access, traffic control, facility development, and maintenance and operation in return for general public access to town beaches. User fees should be carefully addressed as a means of direct beneficiaries bearing a portion of costs, without excluding use on the basis of such fees. The Commonwealth should also continue to explore other alternatives for legislation and programs to improve public access to the foreshore generally.

RECREATIONAL BOATING

The Situation

SENE's 1,540 miles of coastline are jagged and irregular. They offer tremendous opportunities for the recreational boater, whether he is a weekend fisherman or a blue-water cruising sailor. The difficulty, however, is that the region's 50,000 permanently moored recreational boats are concentrated in a few of the more popular harbors. When the weekend trailer-boat enthusiast descends, major boat jams develop. According to Table 6.1, about 20,000 more slips or moorings and 500 more lanes of boat ramps will have to be developed to meet anticipated demands in 1990. The 500 boat ramps needed for smaller craft will provide about as many boating days as the 20,000 slips and moorings needed for larger craft.

This section focuses on slips and moorings. Boat ramps will be considered in the next section on salt water fishing. Water quality aspects associated with boating are pursued in *Chapter 5.*

Analysis of the SENE coastline established that as many as 16,000 additional boat slips and moorings could be developed at existing or potential marinas, yacht clubs, town docks or mooring areas. Accommodating this number would require only minor dredging at marina areas and no additional channel improvements.

New information is emerging which tends to dispel some fairly negative notions about marinas. Research at the University of Rhode Island has indicated that the impact of marina development on marshes and the environment is not necessarily destructive. There has been research in North Carolina into techniques for building coastal marshes

using dredged materials. Federal water quality legislation and the states' coastal zone management programs are helping to guide thinking about suitable locations for, and management of, marinas. These are important considerations in planning for methods of meeting the rapidly increasing needs for new boating facilities.

The Solutions

Alternatives

The previous discussion has shown that SENE's coastline potentially can accommodate future recreational boating demands. The main questions focus on the roles of public and private sectors and the extent of the development. The latter question involves certain value judgments – some boaters prefer the amenities of electricity, running water, and shoreline commercial development; others prefer less crowded conditions. The former can strain utilities and stimulate unsightly commercial development, while the latter may not help to meet a large portion of the demands. Both kinds of needs must be met, by means of (a) expansion of existing facilities (public and private); and (b) development of new facilities (public and private).

Expansion of Existing Facilities (Public and Private). Existing marinas can accommodate a larger volume and variety of boats, by means of: enlarging the existing area for boats and constructing additional slips and moorings; channel improvements; more efficient use of the existing land and water space through techniques such as dry-stack storage and fore-and-aft mooring. The two main problems related to this alternative are funding and regulating expansion to minimize economic and environmental impacts. Public efforts would be supported through agency budgets or through bonds.

However, private efforts are hindered by a number of problems – high capital construction and annual maintenance costs, resistance from the state and municipalities, wetland laws, popular misconceptions that marinas are environmental destroyers, susceptibility to storm damage, high costs of shore lands, high cost of credit, the seasonal nature of recreational use, inadequate business management and training, and competition.

On the other hand, in the public eye, marinas are a kind of unwelcome facility. They attract people and traffic which strain municipal services and, in the eyes of some, detract from coastal environmental quality. A popular solution is prohibiting new marina development, The problem boils down to how to satisfy increasing boating demands without sacrificing Critical Environmental Areas.

To help solve the dilema, coordinated planning is needed. A statewide boating advisory committee could encourage marina developers and managers to adopt more efficient design of existing areas through such practices as dry-stack storage and multiple moorings. They could sponsor a cove-by-cove, harbor-by-harbor study to determine how expansion of existing marinas would be possible with minimal impact on the environment and surrounding infrastructure. The results would help local decision-makers decide whether or not to approve new marina developments. In addition the committee could help marina developers by providing technical assistance in business aspects and working toward more equitable tax rates.

The Rhode Island Department of Economic Development and the Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles are appropriate agencies to sponsor the committees. Membership would include marine trade associations, natural resource managers, coastal zone planners, and municipal authorities; but over half the membership should consist of those who are most affected by marinas – boaters, salt water fishermen, local residents, and conservationists. Some of these interests are represented in the volunteer Marine Recreational Advisory Board to the Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles. The advantages of this kind of state guidance are: (1) new developments in the most suitable locations in economic, social, and environmental terms; (2) assurance that a variety of conditions are provided; (3) stimulation of private enterprise; and (4) less strain on public funds for marina development. The major disadvantage revolves around the success of coordinating disparate interests.

Investigate Development of New Facilities. Parts of the Massachusetts and Rhode Island coastline may be suitable for new marinas large enough to absorb regional demands. Using criteria such as the degree of or potential for protection, the size and ability to absorb demands, and the presence of Critical Environmental Areas, the SENE Study has identified several possible locations: Collins Cove in Salem; North Plymouth Harbor; the Seekonk River; Warwick-East Greenwich Bay; Coggeshall Cove, Portsmouth; Allen's Harbor and Davisville, North Kingstown; and Coddington Cove, Middletown. These areas should be investigated further to decide which would be most suitable, keeping in mind other factors such as accessibility and proximity to demand. The boating advisory committee suggested earlier could encourage private development of these areas. Or public agencies could lease them for private management. The latter has the advantage of enlarging the local tax base.

Alternative Plans

An environmental approach for increasing slips and moorings would involve guidance about suitable locations for development of new areas and expansion or existing marinas. It would meet a smaller portion of the boating demand than the economic approach, but it would main-

tain a higher regard for environmental quality. An economic approach would concentrate on considering the development of new marinas. As outlined in the second alternative, intensive development will increase boating pleasures, but it can also strain the region's character.

Recommendations

The recommended approach is described in *priority order* below. It seeks to develop enough slips and moorings to meet most of the demand, but with minimal harm to the environment.

5. **Form state boating advisory committee to encourage the private sector. The Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles and the Rhode Island Department of Economic Development together with public works and natural resources agencies, coastal management, and private boating interests should form a state boating advisory committee to develop training programs and guidance for recreational entrepreneurs. State boating advisory committees should help plan and implement orderly development of boating and encourage fore-and-aft moorings in protected areas and expansion of existing marinas near centers of high demand.**

6. **Undertake authorized channel and anchorage improvements. The Corps of Engineers should proceed with authorized federal recreational channel and anchorage improvements in high use coastal areas, including, but not limited to Brush Neck Cove, Warwick; the Taunton River between Berkley and Dighton; and Boston Harbor.**

State guidance of private marina expansion could help minimize economically and environmentally undesirable impacts, especially those associated with business failures and the development of ancillary services such as repair, retail, and commercial enterprises. Confining further marina development to centers which already have roads and services checks the possibility of "marina sprawl" and encourages modernization. It thereby indirectly protects more fragile coastal stretches included in SENE Critical Environmental Areas. These lands could serve as buffer strips and wildlife habitats. Making better use of existing facilities is economically sensible. However, without support and stimulation, private action is unreliable. Publicly subsidized marinas are also needed, but they should be located in areas which are already developed, are centrally located, and non-sensitive environmentally. Several possible areas are suggested for study:

7. **Investigate new regional marina basins. The Corps of Engineers under expanded authority, in conjunction with the state coastal zone management programs, agencies in both states, and communities, should consider the feasibility of coordinating federal, state, and private interests in the development of major recreational boating harbors at Collins Cove in Salem; North Plymouth Harbor; the Seekonk River; Warwick-East Greenwich Bay; Coggeshall Cove, Portsmouth; Allen Harbor and Davisville, North Kingstown; and Coddington Cove, Middletown.**

Disposal of materials dredged from channels and harbors is a problem pursued further in Chapter 7. While the recommendation is to continue interim dredged materials disposal procedures, the SENE Study encourages research and practice in the field reusing dredged materials for construction of artificial islands and wetlands.

RECREATIONAL SALT WATER FISHING

The Situation

In 1961, the Massachusetts Division of Marine Fisheries estimated that salt water fishermen made about 650,000 day-fishing trips in Massachusetts. Accurate estimates on night-fishing are not available, but the activity is considerable in some areas. Interviews with bait shop owners and sportsmen's organizations indicate that night-fishing has increased on the order of 50 percent in the last 10 years. Updating the 1961 day-fishing and adding the night-fishing, USFWS estimates that, in 1970, more than a million fishermen-days were expended on salt water fishing in the Massachusetts area. According to unpublished information from the National Marine Fisheries Service, the number of Massachusetts salt water fishermen is actually twice that number.

Based upon the current Rhode Island population of about 950,000, the USFWS estimates that about 75,000 salt water fishermen spent about 900,000 days fishing along the Rhode Island coast. These estimates are probably low; Rhode Island is small and the percentage of salt water fishermen there is probably much higher than the New England average of 8 percent, which was used in the USFWS estimates.

Based on the USFWS estimates, and using the USFWS value of nearly $11 per day per fisherman, the approximate annual

dollar value generated by sport fishermen in the region is in the vicinity of $20 million. This amount covers costs of boats, gear, fuel, charters, lodging, food, and other usual expenditures by the fisherman. This estimate seems insignificant in monetary terms, as it does not include the use of SENE sportfishing resources by out-of-region fishermen. Another value more difficult to quantify is the availability of the salt water fishing experience in this coastal area.

As with most forms of outdoor recreation, lack of access – either boat launching ramps or publicly available shoreline – is the primary problem facing the region's sport fishermen. The Massachusetts Public Access Board has an active program for acquisition and, with the Division of Waterways, a program for developing ramps and parking facilities. The DEM through its Division of Forests and Parks, cooperates in maintaining the areas. Recently the Commonwealth built several new double-ramp facilities capable of serving several hundred trailers daily. MDC manages 15 miles of coastline for this sport in the most densely populated portion of the region.

The Rhode Island DNR, through the Division of Fish and Wildlife, locates new sites, acquires land, builds and maintains parking lots and boat launching ramps for both fresh and salt water resources. Currently, the state is concentrating on developing boat ramps and parking lots either upon request from municipalities or on state owned property. Although new acquisitions within the next few years are not likely because funds have been exhausted, DNR should plan to acquire and develop enough additional boat ramps to meet 1990 demands.

The Solutions

Recommendations

Plans to secure frequent public access to the shoreline *(see the Swimming Section of this chapter)* should be coordinated with efforts to improve recreational salt water fishing opportunities. Therefore, the SENE Study recommends:

8. **Construct public boat ramps and fishing piers. The Massachusetts Public Access Board and the Rhode Island Department of Natural Resources, in cooperation with appropriate state and municipal agencies, should construct boat ramps and fishing piers or similar facilities such as breakwaters, docks and coastal bridges, which provide walk-ways for surf-casters to productive salt water fishing areas. These facilities should be wide enough to provide space for surf-casting and traffic.**

9. **Encourage private construction of boat ramps and fish piers. The proposed state boating advisory committee (see the boating section of this chapter, recommendation 5) should encourage utilities or private industries which are developing facilities, such as wastewater treatment plants, power plants or residential, commercial or industrial developments along the coast, to provide well-landscaped (using vegetative screening) shore access and structures for fishing whenever possible. The proposed state boating advisory committees, or in Massachusetts, the Public Access Board, should oversee the development of innovative design standards showing prototypical construction features and materials specifications which should be considered in providing this access.**

Social and economic benefits would result from improved coastal access, especially in urban areas. The construction costs of slightly modifying shore protection or coastal bridge or highway projects in selected areas would be more than offset by significantly improved social benefits generated by the additional access. Cost of providing ramps and piers might be partially met by the BOR Land and Water Conservation Fund Program.

CAMPING AND PICNICKING

The Situation

According to Table 6.1, over twice the number of existing camping and picnicking facilities now available will be needed to meet 1990 demands. The Study distinguishes in this section between camping and picnicking activities needing facilities, and the more informal camping and picnicking covered under extensive recreation elsewhere in this chapter. The distinguishing factor – and the principal problem – is the need to provide for and maintain facilities: water supplies; sanitary facilities; picnic tables; and even electrical power.

The major impediment, other than consistently inadequate funds, is local resistance to the development of new camping or picnicking facilities. Concentrations of visitors attracted by these facilities severely tax local sewer, police, and fire protection services. At the same time, the nature of today's modern, fully equipped motorized camper vehicles is such that the campers rely on local businesses far less than they used to. In short, today's campers spend less but require more in the way of costly services; and the result is stiff local resistance to campground or picnic development.

In developing parks and recreation areas, the state can overrule local resistance through the powers of eminent domain. Rhode Island has managed to compensate for this unpopular step taken in beach development by sharing income derived from user fees with municipalities. The biggest problem with state management is that limited funds are squeezed between the need for daily and reliable maintenance at existing facilities and a need for new facilities. Preoccupation with maintenance problems should not stall efforts to provide needed new facilities. Unless facilities are available for these increasingly popular activities, there is the more unfortunate risk that campers and picnickers will proclaim their own territory.

The Solutions

Alternatives

The choice for meeting camping and picnicking needs is between (a) expansion of existing facilities (public and private); and (b) development of new facilities (public and private).

Expansion of Existing Facilities (Public and Private). This alternative involves the possibilities of expanding existing park boundaries and developing new facilities, actions primarily involving state responsibilities. Expansions could occur near existing cities, near tourist centers, or in both locations. However, campgrounds within metropolitan areas are, for the most part, underutilized by tourists. Consistent with Massachusetts SCORP policy, these urban campgrounds should be maintained for youth groups.

This approach is economically efficient. If properly implemented, it would have minor environmental impacts. Benefits of expanding park boundaries could accrue for other recreational activities, especially extensive activities. Citizens in a series of public workshops held mid-way in the Study favored this approach more than acquiring and developing new state forests and parks. However, later during the 90-day review period there was strong opposition to the expansions because of additional strain on municipal services, local traffic congestion, vandalism, and the threat to environmental quality. In this sense state parks become a kind of unwelcome facility for which municipalities could be compensated by some form of cost-sharing.

The point must be made that impacts on municipal services by expanding existing facilities on the whole would not be as great as developing new ones. The portion of needs met by expansion is difficult to assess because private enterprise has a large responsibility in expanding facilities, and its ability to respond is subject to economic and political vagaries. However, Rhode Island is evolving a policy opposed to state participation in campground development. What remains, therefore, is development by the private sector which cannot respond without the states' support.

Development of New Facilities (Public and Private). The private sector is generally viewed as the appropriate mode for filling the gap between user demands and the available supply of public facilities, especially for camping. Two current trends are likely to intensify the importance of the private sector in developing camping and picnicking facilities. First, people are looking more and more for "less government"; second, during economic crisis, state expenditures for recreation will receive low priority.

Expansion by the private sector will not persist as long as recreational entrepreneurs are beseiged with the problems of credit unavailability, inadequate training in business management, cyclical patterns in recreation use, and resistance from municipalities. As discussed in the *boating section* of this chapter, new public programs would help alleviate these problems.

Nevertheless, private development is the best alternative for meeting demands in the long-run. Carefully sited facilities would not irretrievably damage some Critical Environmental Areas, specifically flood plains, agricultural soils, and certain natural resources (Category B lands). These areas as mapped (Plates 1, 2, and 3 as described in *Chapter 3*) provide a good starting point for further investigation leading to purchase and development of facilities. It should, however, be emphasized that without careful planning and subsequently efficient management, the stress on roads, sewers, and other local services, from campground development can be expected to generate community hostility and resistance.

Alternative Plans

At best, it is difficult to distinguish alternative plans for enhancing environmental quality or stimulating economic development in the recreation field. However, the two alternative measures for meeting camping and picnicking demands, discussed above, offer a somewhat clearer opportunity for tradeoffs than is generally the case. The first alternative measure – expanded development of existing facilities – if emphasized in a campground and picnicking plan would have only minor impact on the remaining open space in the region and place minimal requirements on existing water supplies and sewer services. The second alternative – development of new sites and facilities – would, however, by definition, place new demands on open space for camping and picnicking sites. At the same time, especially if developed by the private sector, a plan emphasizing new development would generate a higher degree of economic activity, but with more adverse secondary effects on environmental quality. We have seen that the first alternative alone is unable to meet a significant portion of the demand. Consequently the recommended program includes elements of both alternatives. All three approaches – the alternatives and the recommendations – assume that state and local agencies will play important roles in controlling the placement of facilities. Such means as placement of utility lines

could be used to control the location of these developments and, therefore, the environmental impact.

Recommendations

The recommended approach emphasizes coordination among state, municipal, and private interests to develop as many camping and picnicking facilities as feasible without environmental damage. Recommendations are *listed in priority* below.

10. **Form state recreational advisory committees. The Massachusetts Departments of Commerce and Development and Environmental Management, the Rhode Island Departments of Economic Development and Natural Resources and Statewide Planning Program together with municipal representatives and private recreational interests should form state recreational advisory committees. These committees should assist and encourage the private sector to develop campground and picnic facilities. In an advisory capacity, the states should assess implications for the local infrastructure and guide development of these facilities to flood plains, agricultural soils, and other SENE Category B resources.**

11. **Expand state forests and parks near tourist centers. The R. I. DNR and Massachusetts DEM should add camping facilities and enlarge existing parks which are distant from urban concentrations, but convenient to tourist centers. Prior to the expansions the state and affected municipalities should assess the impacts on municipal services and traffic and determine appropriate means of cost-sharing. Examples are the Harold Parker State Forest in the Ipswich-North Shore planning area, Myles Standish State Park in Plymouth and Carver, and Arcadia State Park and and Pachaug State Forest in the Pawcatuck planning area. Protection of Critical Environmental Areas is implicit in this recommendation.**

A combination of the two approaches is essential for meeting about half of the tourist demands for campgrounds and picnic facilities; the second as a solution for satisfying midterm demands, and the first for the long-run. A third option of expansion and development of state parks near urban concentrations (see the section on *extensive outdoor recreation)* is not as important for satisfying regional camping demands, as it is for providing low-intensity outdoor recreation opportunities of a more local nature. Furthermore, the park expansions are coordinated with actions, either recommended or comtemplated, for satisfying regional beach demands.

State guidance is intended to minimize calamaties sometimes traditionally associated with privately owned campgrounds. If municipalities would implement protective zoning of Critical Environmental Areas (Category A and B lands) and guide growth toward areas with existing infrastructure *(see Chapter 3),* campground development could proceed with minimal environmental impact. Private development of these facilities should also contribute somewhat to the region's tourist economy.

WILDLIFE AND FRESH WATER FISHERIES

The Situation

It is estimated that by 1990 residents of the SENE region will spend 10,250,000 and 3,500,000 recreational days, respectively, on fresh water fishing and hunting.. As might be expected, hunting and fishing opportunities within the densely populated SENE region are inadequate. Overall, demand for fish and wildlife resources exceeds supply, and this is expected to continue into the future. Only the Cape Cod and Pawcatuck planning areas can hope to support their residents' 1990 hunting and fishing demands.

Insufficient fish and wildlife habitat both in extent and variety, and a general lack of public access to the existing resource base are the major factors limiting fulfillment of demand. Only 103,500 acres, or 3.6 percent of SENE's total area, are in public ownership and open to hunting. Approximately 900,000 more acres are open to hunting through the generosity of private land owners. How long these private landowners will tolerate hunting and other recreational uses without recompense is open to conjecture.

Of the 1000 fresh water ponds 10 acres and larger in SENE, only about 120 (16,000 acres) have guaranteed statewide public access. Of the 1200 miles of stream, the amount of streambank in public ownership and open to fishing is negligible. The vast majority of SENE's streambanks are privately owned and can be closed to the general public.

The states own and hold in trust for their people all of the fish and wildlife within their borders. The Massachusetts Division of Fisheries and Wildlife and the Rhode Island Division of Fish and Wildlife serve as the legal administrators and guardians of their fish and wildlife resources. They carry out responsibilities relating to the enforcement of game laws, conduct nature and education programs, and monitor, study, propogate, salvage, conserve, and manage the states' fish and wildlife population. Insofar as it is feasible, various fish and wildlife resources are maintained at a level that will have the greatest economic, aesthetic, and recreational value possible for all citizens.

These agencies have endeavored to spend funds prudently for habitat preservation and enhancement of fish and wildlife. On occasion a portion of their revenues is derived from legislative measures, for example, the recent $5 million bond used to acquire portions of the Hockomock Swamp and other areas in Massachusetts. However, this measure and other revenues are derived from, or paid for by, sportsmen through the sale of hunting, fishing, and trapping licenses. To enlarge this source in Rhode Island there is strong support for raising license fees and expanding the licensing program to include women (who presently pay no fees) and fishermen 12 years and older. In addition non-consumptive users of fish and wildlife resources who utilize public areas such as state parks and management areas should also share the costs of managing fish and wildlife resources, for example, through user-fees.

Aside from acquiring, developing, and managing their own parks and management areas, the states also provide financial assistance to communities through the Massachusetts Self-Help Program (administered through DEM) and the former Rhode Island Green Acres Fund (administered through DNR) and discussed earlier in this chapter. Consistent with the SENE Study policy of protecting Critical Environmental Areas (Category A and B lands), high priority should be given to using these funds for wetlands acquisition. Other actions for local wetlands protection are discussed in *Chapter 8, Flooding and Erosion.*

There are several sources of funds. Funds for acquisition and development through BOR's Land and Water Conservation Fund Program have been previously mentioned in this chapter. The USFWS administers the Federal Aid in Fish and Wildlife Restoration Program. The program provides federal aid money, resulting from the passage of two Congressional Acts, the Pittman-Robertson Act passed in 1937 and the Dingell-Johnson Act in 1950. These funds are collected from an 11 percent excise tax on fishing and hunting equipment. They are used solely for wildlife-fisheries restoration projects, and may include land acquisition expenditures. For each dollar spent by the state on approved projects, up to seventy-five cents may be reimbursed by the federal government within the limitations of any current apportionment and pending federal approval of completion of the project. The Soil Conservation Service makes cost-sharing grants to local sponsors under the Small Watershed Program (PL83-566, as amended) for land acquisition, easements, rights-of-way, and facilities needed to develop the water oriented potential of watershed projects. The Rural Environmental Conservation Program administered by the Agricultural Stabilization and Conservation Service (ASCS) of the U. S. Department of Agriculture provides for cost sharing funds and technical assistance to private landowners for erosion control, forestry, wildlife habitat improvement, and other similar measures. Also technical assistance is available to landowners through local Conservation Districts which exist for all of SENE, except Suffolk County, Mass. For forestry measures the Massachusetts Division of Forest and Parks and the R. I. Division of Forest Environment, in cooperation with the U. S. Forest Service, furnish this assistance. The National Park Service administers the National Registry of Natural Landmarks through which natural resources of outstanding significance receive national acclaim. Three important wildlife habitats in the SENE region so designated are the Acushnet Cedar Swamp and Lynnfield Marsh in Massachusetts and Ell Pond in Rhode Island. NPS has cited over 20 potential sites in the SENE portion of Massachusetts (including the North and South Rivers, Sandy Neck and Great Marshes, and the Hockomock Swamp) and 15 areas in Rhode Island (including Block Island Marshes, the Great Swamp and Wallum Lake Forest). Also, lands owned by National Park Service are often utilized under use agreement for public hunting purposes. In addition, The Corps of Engineers grants licenses to state fish and wildlife agencies to develop management areas on reservoir lands.

The Solutions

Alternatives

Six alternatives can provide major fish and wildlife opportunities (a) acquire wetlands; (b) acquire upland wildlife management areas; (c) provide public access to privately owned wildlife habitat; (d) use of wetland legislation; (e) acquire public access to ponds; and (f) acquire streambank access. Public access to water supply reservoirs, important for improving hunting and fishing, is also recommended in the section of this chapter entitled *"Extensive Outdoor Recreation."*

Acquiring Wetlands. Although this is one of the two most expensive options, acquiring highly productive wildlife habitats is the safest assurance that the values of wetlands for wildlife production, flood and erosion control, and recreation are preserved. Prime wetlands for acquisition by states are listed in Table 6.2. Through the efforts of the USFWS, BOR, National Park Service, state fish and wildlife agencies, and local conservation commissions, a combined acquisition effort could be undertaken.

Acquiring Upland Wildlife Management Areas. To increase natural wildlife production, furnish hunting areas, and provide release sites for game farm birds, several wildlife management areas in Massachusetts and Rhode Island could be established, or expanded, to help meet a portion of regional demands for consumptive and non-consumptive wildlife uses. Wetland areas for acquisition on Table 6.2 also include surrounding upland habitat.

The expansion of existing game farms and development of new facilities is required to satisfy expected needs for additional stocked game birds. Hunters who prefer this type of stocking should be paying the cost. This could be accomplished by requiring and selling a special game bird propagation stamp.

Providing Public Access to Privately Owned Wildlife Habitat. The Massachusetts Division of Fisheries and Wildlife could develop cooperative programs similar to those in Rhode Island between state and private landowners designed to open many wildlife areas currently closed to hunters. Cooperative agreements would provide access for hunting and other wildlife oriented recreation, in return for management of the land, hunter controls, tax breaks, or lease of the land. An amendment to the Massachusetts General Law (Chapter 21 §17 C) limits landowner liability, if he should open land to the public for recreational purposes. The Rhode Island General Assembly should hasten to pass similar legislation.

However, sentiment expressed at public workshops held by the SENE Study indicate that public access to privately owned lands is unpopular regardless of the wildlife management benefits for the landowner. Because private ownership does not assure hunting use of these resources in the long-run, this solution would most likely not meet a significant portion of the region's future hunting demands. Also, municipal by-laws often completely prohibit or restrict hunting.

Wetlands Legislation. The Massachusetts Wetlands Protection Act (Chapter 131, Section 40 as amended 1974), the Rhode Island Freshwater Wetlands Act (Chapter 201, Section 18-24), Intertidal Salt Marsh Act (Chapter 11-46.1), and Coastal Wetlands Acts (Chapter 2-1, Sections 13-17) prohibit altering of fresh water and salt water wetlands without a permit.

More vigorous local enforcement with state support is required if the environmental characteristics crucial to the region's quality of life are to be protected. In Massachusetts, municipalities can obtain technical assistance about wetlands protection through the Natural Resources Planning Program coordinated by the Conservation District Offices. In Rhode Island, wetland maps are being provided by the state. Protection of wetlands alone, however, is not completely adequate to ensure the preservation of these fragile resources. Development of adjacent uplands can quickly degrade "protected" wetlands. One tactic which both state and local authorities should consider is first acquiring a ring of uplands surrounding important wetlands and later protecting the wetlands themselves, either through outright acquisition or through special zoning.

Acquiring Public Access to Ponds 10 Acres and Larger. A significant opportunity for obtaining access to many of these ponds in Massachusetts rests with a revision of the "Great Ponds Law." A great pond is defined under the Law in two ways: for recreational use other than fishing, a pond must be of natural origin and 10 or more acres in size; for fishing, the pond must be of natural origin and 20 or more acres in size. Programs to identify great ponds and develop public access have been strengthened and now need to be accelerated. The inconsistency in the size factor should be corrected to provide the fishing as well as recreation on all natural ponds of 10 or more acres.

Presently over 60 water supply reservoirs in the SENE region, representing over 13,000 acres of water, are closed to public fishing. The possibility of providing public access to this vast untapped fishery resource should be fully explored, as described in the *Extensive Outdoor Recreation* section. In addition, all possibilities should be explored for obtaining public access to other ponds 10 acres and over in size which have significant fishery resource capabilities. The Massachusetts Public Access Board and Rhode Island DNR could acquire access and develop boat ramps and parking facilities near these reservoirs. This includes all ponds in Rhode Island, which does not have a Great Ponds Law.

Great ponds designation tends to be confined to water bodies several hundred acres in size. Although the Wetlands Protection Act leads to the regulation of activity along the shoreline, there is no guarantee of the rights of fishermen, or that the great ponds will remain of high recreational quality. The safest means of assuring fishermens' rights is acquisition of fresh water resources and streambanks.

Acquiring Streambank Access. The Massachusetts Division of Fisheries and Wildlife and the Rhode Island Division of Fish and Wildlife have extensive trout stocking programs which strive to meet the heavy demands of trout fishermen. However, lack of public access to major streams and tributaries severely limits "put-and-take" trout stocking and curtails use of existing warm water fisheries. If

viable stream fishery programs are to be improved and expanded, immediate steps should be taken to acquire streambank rights-of-way with a minimum width of 20 feet per bank. This might best be accomplished in conjunction with wetland preservation, flood plain zoning, scenic river designation (see discussion in *Extensive Outdoor Recreation* section), expansion of state forest and parks or of wildlife management areas.

Alternative Plans

Obviously the provision of land for hunting and fishing is primarily an environmental goal. Each of the aforementioned alternative measures is oriented toward the acquisition and preservation of the best wildlife habitat in the region. Together they constitute an extremely expensive environmental plan. An alternative which sought to maximize economic development would, at best, favor more intensive use of existing lands rather than acquisition. It might go so far as to forego hunting and fishing opportunities in favor of commercial or residential development of wildlife habitat lands. Looking further into the economic future, however, the SENE Study has determined, as discussed in detail in *Chapter 2,* that maintenance of the natural landscape is, to a large degree, in the economic interest of the region. Therefore, the recommended program below seeks maximum protection of these lands at the least cost.

Recommendations

The recommended program seeks acquisition of the most significant wildlife habitats and protection of others through legislative channels. In *order of importance,* the recommendations are:

12. Acquire SENE's most important upland and wetland wildlife habitat. To ensure the

TABLE 6.2 WILDLIFE HABITATS SUGGESTED FOR PUBLIC ACQUISITION (In Priority)

Priority		Area	Location	Possible Acreage
Region	State	IN MASSACHUSETTS:		
1	1	Parker-Little River Wetland area	Newbury	1800
2	2	Hockomock Swamp	Bridgewater	6000
3	3	North River tidal estuaries	Marshfield/ Scituate	*
5	4	Essex Marshes behind Castle Neck	Essex	3000
	5	Sandy Neck Area	Barnstable	*
	6	E. Sandwich Wetlands	Sandwich Harbor	*
	7	S. River Wetlands	Marshfield	*
	8	Eliminate in-holdings in Northeast & Crane Pd. management areas	Groveland	2000
	9	Dyke Meadow area	Marshfield	1000
	10	Chartley Brook	Attleboro	1000
Region	State	IN RHODE ISLAND:		
4	1	Great Swamp & vicinity	South Kingston-Richmond	1000 additional acres
6	2	Rockville Meadows Management area		*
	3	Narrow River Tidal Estuaries	Narragansett	*
	4	Winnapoag Pond	Westerly	*
	5	Area between Truston & Northwestern corner of Green Hill Pond	Kingston	600
	6	Undeveloped uplands to the southeast of Perryville trout hatchery, south of Route 1	Charlestown	*
	7	Wetlands along Blackstone River	Cumberland,etc.	*

* Acreage not available

continued productivity of important wildlife habitats, Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles and/or The Audubon Societies, and other private and public interests should purchase choice areas listed in Table 6.2, if not currently protected by scenic, conservation, or agricultural easements. Both upland and wetland habitats should be purchased for a variety of species production. Consistent with Study policy of protecting Critical Environmental Areas, other state purchases should focus on wetlands. Acquisition of wetlands might occur in two stages. Within the next 5-10 years the responsible state agencies could acquire a ring of surrounding uplands and within 10-20 years, the wetlands themselves.

13. **Acquire SENE's most important streambanks. Rhode Island Department of Natural Resources and Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles should acquire public access to streams (minimum 20 foot widths per streambank) listed below, which have high potential for cold water fisheries production.**

    Important Massachusetts Streams:

    1. **Ipswich River**
    2. **Palmer River**
    3. **Mashpee River**
    4. **Mattapoisett River**
    5. **Wading River**
    6. **Winnetuxet River**

    Important Rhode Island Streams:

    1. **Pawcatuck River System (Pawcatuck and Queens Rivers)**
    2. **Ponagansett River**
    3. **Flat River**

14. **Acquire public access to ponds. The state natural resources agencies should make every effort to acquire access to ponds 10 acres and greater (great ponds, public water supply, reservoirs, and other ponded waters) which have significant fishery resource capability. Suitable areas are identified for each planning area in the Study's inventory information, available from the NERBC offices.**

15. **Enforce wetlands legislation and local zoning regulations. Taken cumulatively, communities throughout the SENE region have a major responsibility in protecting wetlands. Consistent with the Study policy of limiting flood damages through nonstructural methods and of protecting Critical Environmental Areas, towns should zone or acquire wetlands and flood plains, and enforce existing wetlands protection legislation.**

EXTENSIVE OUTDOOR RECREATION

The Situation

Activities within this recreational category include nature study, wilderness camping, informal picnicking and trail uses such as hiking, trail biking, cross-country skiing. Extensive activities (walking for pleasure, viewing, nature study) are also important in urban environs, and open space and greenbelt planning are essential for meeting these needs. One attribute links them all: the requirement for publicly accessible lands of exceptional environmental quality. If this requirement is to be fully satisfied by 1990, some 150,000 acres will have to be made publicly accessible for extensive outdoor recreation, in addition to the 220,000 acres already available. To reiterate a point in the introduction to this chapter, the region's unspoiled wetlands, flood plains, agricultural soils, and unique cultural and natural sites included in SENE Category A and B Critical Environmental Areas *(see Chapter 3)* are more than adequate to meet the demand. This section explores ways to guarantee that opportunities are publicly accessible for extensive outdoor recreation and recommends ways to protect Critical Environmental Areas for extensive outdoor recreation uses.

The Solutions

Alternatives

Alternative measures for assuring extensive outdoor recreation opportunities include: (a) developing Boston Harbor and Narragansett Bay Island Parks; (b) making recreational use of publicly or privately owned but inaccessible urban resources; (c) acquiring Critical Environmental Areas; (d) limited public access to water supply watersheds; (e) multiple use of trails; and (f) scenic rivers legislation. Wetlands legislation is another measure; it protects resources for possible future acquisition. It is discussed in the *Wild-*

life and Fresh Water Fisheries section of this chapter, and more extensively in *Chapter 8, Flooding and Erosion.*

Developing Boston Harbor and Narragansett Bay Island Parks. Islands in Boston Harbor and Narragansett Bay offer excellent opportunities for satisfying swimming, camping, picnicking, and extensive outdoor recreation demands from Boston to Providence, if adequate inexpensive, public transportation can be provided. The Massachusetts Department of Environmental Management and the Metropolitan District Commission have acquired 13 islands, have implemented plans for three of the islands with water taxi service among them and developed comprehensive plans for recreational development of the remaining islands. In addition, legislation authorizing $20 million to set up a commission to further the Boston Harbor Islands Park is being introduced to the U. S. Congress. The Rhode Island Department of Natural Resources is currently negotiating the acquisition of surplus naval property among the Narragansett Bay Islands. Both state parks would provide a mixture of recreation facilities which would stimulate local economies and would protect these regionally significant island resources. Both island park systems together could meet as much as 10 percent of the total 1990 regional needs for swimming, picnicking, camping, shellfishing, and extensive outdoor recreation, much of which comes from low-income inner-city families. The islands offer extensive resources—nearly 5,000 acres in Narragansett Bay and over 1,000 acres in Boston Harbor – close to the two large cities. Considering the major needs these projects could help satisfy, the costs of developing the island parks are surprisingly small, each amounting to only several million dollars – the cost of a mile of highway or part of a town's sewer system. Participants in the SENE Study planning area workshops strongly favored new acquisitions of recreational resources and fiscal support for the states to get their programs underway.

Finally, preserving these islands – replete with natural and historic beauty – has two major regional implications. First, by absorbing urban demands, pressures on resources in other parts of the region will be lessened, thereby making them more useful for meeting tourist demands. Second, if past trends continue, enriching the quality of life in these metropolitan areas could have important economic multiplier effects of attracting and holding residents and businesses.

Making Recreational Use of Publicly or Privately Owned but Currently Inaccessible Urban Resources. Cities in SENE's three metropolitan areas are sorely lacking urban parks. The Massachusetts Access to Parks Program provides transportation for inner city dwellers to rural parks. The SENE Study encourages the continuation of this successful program. The cities of Boston, Cambridge, Somerville, Chelsea, Brookline, Providence, and Pawtucket could begin a major program of increasing recreation opportunity within the urban centers of SENE through every available means, including outright purchase when feasible, as well as improving and increasing the efficiency of existing areas.

To improve their urban recreation opportunities they could –

- Retain appropriate tax title land for recreational use.
- Solicit land donations.
- Rehabilitate phased-out sanitary land fills.
- Make multiple use of underutilized publicly owned lands such as some public works parking areas, yards, and other vacant land associated with city public facilities.
- Investigate agreements with private schools, YMCA's, Boys' Clubs, or other groups, whereby the city would assume part or all of the operation and maintenance responsibility in exchange for programmed use.
- Make multiple use of highway corridors for biking and walking trails.
- Improve access to existing urban park areas through improved transportation and pedestrian and bike overpasses.

Urban park planning, a topic not part of the Study's responsibility, is also important for improving the environmental quality of large metropolitan areas. The Housing and Community Development Act described earlier in this chapter is a convenient source of funds for these urban park programs.

Gaining Access to Critical Environmental Areas. The safest way of assuring that the public could use natural resources for extensive outdoor recreation is by **public acquisition.** *Chapter 3* has pointed out that Critical Environmental Areas (SENE Category A and B lands) such as beaches, wetlands, flood plains, and critical erosion areas can be protected without significant impairment to the region's economic health. The state recreation agencies could acquire 150,000 acres of the total available areas for extensive outdoor recreation. Workshop participants favored acquisition of new natural areas. This option has been most notably recommended for the acquisition of wetlands and the edges of forests and fields in the *Wildlife and Fresh Water Fisheries* section of this chapter and for fragile barrier beaches in the *Pawcatuck and South Shore planning area reports.*

Conservation and public easements are yet another means of of gaining public access for recreation, and the legal and institutional climate in Massachusetts is particularly favorable in this regard. One law (Chapter 21, Section 17 C) discussed earlier in the *Swimming* section, exempts landowners from liability for injury to persons using land for recreational purposes. Another program (under Chapter 184, Sections 31 and 32) authorizes any governmental body (with the approval of DEM) or private charity (with the approval of DEM and the municipality) to acquire

conservation easements. When state and federal funds are used, the landowner must be willing to open the land to some public use. This program helps to contribute opportunities for walking, nature study, riding, and other low-intensity recreational activities.

Rhode Island should develop similar legislation and programs and thereby promote acquisition of easements for conservation and recreational purposes.

Mill ponds are one kind of Critical Environmental Area which, at least in Massachusetts, offer great potential for satisfying extensive recreational demands. They are scattered throughout the SENE region and are reminders of America's Industrial Revolution *(see Chapter 2)*. Two problems need to be solved however: they presently are inaccessible to the public; and many of the old mill dams are in a terrible state of disrepair. Mill ponds were created in the latter part of the 19th century when the Mill Acts authorized private mill developers to seize lands important for the production of water power by eminent domain. The logic was that the production of power was in the public interest. Now that most of them have been abandoned, the question remains, to whom do access rights, reversionary rights, first choice to gain water rights belong. The extent to which such mill ponds would satisfy recreational demands should be substantiated as a basis for developing new legislation to gain public access rights.

But these rights cannot be gained without some assurance that the dams are safe. Experience has shown that for most dams in disrepair, the owners have no interest or finances to repair them, and that the choice is for the state to breach them. To insure their recreational and flood control functions, the Commonwealth must develop and pursue a program to acquire, repair, and maintain private small dams, where it is in the public interest.

Limited Public Access to Water Supply Watersheds

Many people in the United States and throughout the world draw their water from rivers and lakes that are used for navigation, for all forms of recreation, and for waste disposal. Among water authorities in the Northeastern United States, however, exclusive use of the watershed for water supply has become traditional. Local water authorities, legally responsible for injurious degradation of water quality, implement public health rules and regulations promulgated under Massachusetts General Law Chapter 111, Section 160 and under Rhode Island General Law Chapter 46-14. In both states, swimming is prohibited. Theoretically, other recreational uses may occasionally be allowed, but in practice they are effectively excluded. Hence, public access is usually prohibited on lands adjacent to domestic water supplies.

One result of the tight regulation has been the preservation of highly scenic, quasi-wilderness areas amidst the most densely populated part of New England. In the past, the issue of permitting recreational use of these water supply watersheds has repeatedly implied unrestricted public use of these lands for swimming, boating, and perhaps even camping. One possible danger of water-contact recreational use, particularly of the reservoir, is viral and bacterial contamination. Research into methods for removing these kinds of contaminants from water, referenced in *Chapter 7* of this report, could lead to solutions of this problem. Until the time such methods have been validated, water-contact recreational use of distribution reservoirs ("primary reservoirs" where water is stored after treatment and prior to distribution in the water supply system) is not recommended for Massachusetts and Rhode Island. Moreover, before such an intensive use policy could be implemented, the liability of water authorities for water quality degradation would have to be modified substantially, a measure not widely favored by Study participants.

However, evidence in the literature increasingly indicates that multiple use of domestic water supply lands is possible without significant effects on health and safety. For example, lands adjacent to storage reservoirs ("secondary reservoirs" where water is stored before it is treated and distributed) could be used in a limited fashion for casual activities such as hiking, picnicking, viewing, and nature study. Naturally, the suitability of watershed lands for such uses would have to be ascertained on an individual basis.

Costs of treating reservoir water to assure purity for subsequent drinking vary with the location, nature, and extent of activity and whether the reservoir is a storage or distribution impoundment (the latter requires more treatment than the former). However, additional treatment costs should be small, perhaps a few percent of the total water bill. Although these costs might discourage water authorities, the authorities should be able to recoup costs with user-fees, permits, or transfer of funds otherwise slated for acquisition. The states should be able to supplement their funds.

Widespread aesthetic and/or limited recreational use of SENE's water supply reservoirs, especially of those near cities, can contribute significantly to satisfying needs for natural open spaces which intensify with inflation and high costs of energy. One of the best examples is the Scituate Reservoir complex in Rhode Island with an area of 15,000 acres. To ascertain the amount of demand which could be satisfied on water supply reservoirs, more information is necessary. States should amend any existing inventories of reservoirs and other water bodies with data about reservoir lands such as ownership, legal status, the amount of adjacent upland open spaces, and access rights.

Multiple use of water supply lands makes efficient use of land set aside for public services. It also offsets the need

to acquire separate parcels of land to satisfy recreational needs. It would not require changes in existing statutory, regulatory or institutional structure. There are, however, two elements absent in the decisions on multiple use of watershed lands. The first is a comprehensive institutional mechanism for assuring participation of recreation, municipal, and public health officials in guiding the development of watershed land policy. The second is factual guidance about the nature, appropriate location, and extent of recreational activities for case by case decisions about recreational use. Review of existing policies by citizens and public agencies and research into the extent of permissible uses would provide local water authorities with a broader base upon which to make a decision concerning multiple recreational uses.

Multiple Use of Trails. Trail-related activities (hiking, biking, snow-mobiling) are gaining popularity as outdoor recreation activities. Careful planning of trails is extremely important if needs are to be met with minimal environmental impact. Certain trail uses are incompatible with Critical Environmental Areas, as in the instance of dune buggies on fragile barrier beaches. Further, certain trail uses are incompatible with one another, as in the instance of motor bikes and horses. It is important to assess all of the different kinds of needs and identify locations suitable in terms of environmental impact.

BOR has identified a number of trail opportunities in SENE for the development of a region-wide system of connecting trails. For example, Bostonians might hike or bike to the south shore areas of Massachusetts Bay or even to the tip of Cape Cod, largely through abandoned rail rights-of-way and public lands. The forested highlands of western Rhode Island and eastern Connecticut could be made accessible to the Rhode Island coast by a continuous trail linking the many public parks and forests found in that area.

Trail Advisory Committees in both states are authorized to suggest the location of possible trails and how they might be used. The Rhode Island Trail Advisory Committee (TAC) includes hikers, horseback riders, bicyclers, snowmobilers. The five regional Massachusetts Trail Advisory Committees, composed of similar membership will recommend feasible trails and uses and will help distribute information.

In addition to the committee efforts, the Departments of Transportation in both states have advanced the possible construction of bike-ways by applying for funds available through a special highway trust fund. In Massachusetts, the Public Access Board could assist in the legal procedures of acquiring public access as, likewise, could the Rhode Island Public Rights of Way Commission, with expanded authority. Costs of acquisition, development, and maintenance could be alleviated by concentrating on already existing routes.

Scenic Rivers Legislation. The National Wild and Scenic Rivers Act (PL 90-542) provides a National Wild and Scenic Rivers System which includes free-flowing streams and adjacent land that has "wild, scenic, or recreational values". The Act also restricts projects that would alter the characteristics of such rivers. The legislation authorizes federal acquisition of not more than 100 acres per mile on both sides of a river included in the system. SENE rivers might have difficulty qualifying under this national program because they are short and often heavily developed.

A more promising alternative to the federal system is better use of existing state programs. Chapter 21 Section 17B of the Massachusetts General Court, the Scenic and Recreational Rivers Act, enables the Commissioner of DEM to order the protection of whole portions of scenic and recreational rivers and contiguous land. The legislation regulates, restricts, or prohibits dredging, filling, removing, polluting, or altering streams or lands within 100 yards on either side of a designated river's natural banks. To date, no rivers in the Commonwealth have been so designated, although currently there are efforts to define guidelines. In Rhode Island, the Freshwater Wetlands Act accomplishes a similar objective. Chapter 2-1, Sections 18-24, of the Rhode Island General Assembly restrict the use of streambanks, i.e., an area within 200 feet or within 20 feet elevation above a flowing body of water.

BOR has identified portions of several rivers in the SENE region which have special scenic and recreational value – the Ipswich, Charles, North, South and Taunton Rivers in Massachusetts and the Wood, Beaver, and Pawcatuck Rivers in Rhode Island. The Massachusetts DEM could initiate the scenic rivers system which protects up to 100 yards of natural river banks and could acquire adjacent streambanks for recreational use. The Rhode Island DNR could begin acquiring access to streambanks already protected by wetlands legislation. Alternatively, Rhode Island could pursue efforts to develop its own scenic rivers legislation.

Alternative Plans

Any program designed to enhance opportunities for extensive outdoor recreation experience will make important contributions to the preservation of environmental quality of the SENE region. Again, however, as explained in *Chapter 2*, any effort to preserve or enhance the environmental quality or amenity value – of SENE is likely to have long-range beneficial economic effect. Two alternative plans can be developed in this case, based primarily on public cost. A plan stressing environmental values would place primary emphasis on acquiring the harbor islands and Category A and B resources, expanding the trails system, and designating scenic rivers. A plan stressing economic efficiency would place its emphasis on acquiring the harbor islands, using urban resources, making use of watershed lands, and in-

creasing use of existing trails.

Recommendations

Three themes should be applied when implementing most of the recommendations below: (a) absorb demands from, and increase the quality of life in, cities; (b) make increased use of land already publically owned; and (c) seek multiple, environmentally-sensitive use of Critical Environmental Areas. In *order of priority*, the recommendations are:

16. **Develop the Boston Harbor Islands and Narragansett Bay Island Parks.** The Massachusetts Department of Environmental Management and the Metropolitan District Commission should continue executing plans to develop Boston Harbor Islands Park. The U. S. Congress should pass legislation authorizing federal funds to further these developments. The R. I. Department of Natural Resources should execute plans to develop the Narragansett Bay Islands Park.

17. **Develop guidelines for limited recreation on selected secondary reservoir lands.** The Department of Natural Resources in Rhode Island with the Statewide Planning Program, and the Massachusetts Department of Environmental Management should promote low-intensity recreational use of water supply watershed lands. Working with the Massachusetts Department of Environmental Quality Engineering, the Rhode Island Department of Health, and the U. S. Environmental Protection Agency, they could develop guidelines, controls, and forms of assistance to local water authorities which can be used on a case-by-case basis to plan for low-intensity recreational use of secondary reservoirs.

18. **Make multiple use of urban lands.** Core cities in the Providence and Boston Metropolitan areas should begin a major program of increasing recreation opportunity using all means available including outright purchase and increasing the efficiency of existing recreation areas, including parks, playfields, and playgrounds. *(Further details are in planning area reports dealing with the Boston, Worcester, and Providence Metropolitan areas – see Boston Metropolitan, Blackstone and Vicinity, and Narragansett Bay, respectively.)*

19. **Implement or develop scenic rivers legislation.** Massachusetts should implement the existing Scenic Rivers legislation by establishing a scenic rivers system and considering the designation of the Charles, Ipswich, and Taunton Rivers as initial components, in that order of priority, as well as considering the North and South Rivers. Rhode Island should develop similar legislation and include the Wood, Beaver, and Pawcatuck Rivers. Both states should acquire access for recreation, especially along scenic river stretches.

20. **Expand existing forests and parks near urban centers.** The Rhode Island Department of Natural Resources and, in Massachusetts, the Metropolitan District Commission and Department of Environmental Management, should expand existing state forests, parks, and reservations near urban concentrations, particularly Douglas State Forest near Worcester, John Curran and Snake Den State Forests near Providence, and the Blue Hills and Middlesex Fells Reservations near Boston. In Massachusetts consideration should be given to some form of cost-sharing for municipal services.

21. **Develop a regional trail system.** The Rhode Island Department of Natural Resources and Massachusetts Department of Environmental Management, in cooperation with local governments and state Trails Advisory Committees, should define and publicize a regional trail network using existing trails, utility rights-of-way, rail abandonments, and exceptional natural corridors.

PRIORITIES

During the previous discussion, several problems have repeatedly emerged. First, many of the region's residents have difficulty getting to the most significant recreational opportunities. Second, the full potential of many existing recreational facilities or opportunities (marinas, state beaches, water supply watershed lands) is not being realized. Third, meeting certain kinds of recreational demands will require obtaining public access to, or acquiring, new natural areas. During the time funds are being raised, these areas should be protected from competing land uses.

The 21 recreation recommendations (also listed by title in

the "Overview") are solutions to these and other problems. To organize these solutions into a strategy for meeting recreational needs, the SENE Study has classified certain recommendations according to priorities: highest priority; high priority; and other priority. Recommendations having no indication of priority are as important as priority recommendations, but not as urgent. The criteria used to set these priorities include: portion of needs met, particularly urban needs; degree of economic efficiency; and consistency with the Study's themes of guiding growth to Developable Areas and protecting Critical Environmental Areas, of enhancing environmental quality to enchance economic growth, and of maximizing the use of ongoing programs and existing institutions.

There are *two highest priority recreation recommendations:* **recommendation 1 – expand facilities at existing state beaches and parks; and recommendation 16 – develop Boston Harbor and Narragansett Bay Island Parks.** The first recommendation received highest priority because it would meet a significant portion of future swimming needs, particularly from urban areas. It also maximizes the use of existing facilities. The recommendations to develop the island park systems merit highest priority because of the variety of recreation needs met; these islands are accessible to two of the three largest sources of recreation needs in the region – Boston and Providence; and because of the positive protection of Critical Environmental Areas. Because both these recommendations improve the accessibility of outdoor recreation opportunities for urban dwellers, they help to improve the quality of life in the urban centers. The combination of these values in the case of the islands parks recommendation was judged by Study participants to far outweigh the large public expenditures required.

There are *seven high priority recommendations.* **Recommendation 4, acquire public access to the shoreline at frequent intervals** is important to meet a variety of coastal recreation needs, without increasing public expenditures for beaches, bathhouses, marinas, etc.

Recommendations 5 and 10, for recreation and boating advisory committees, are important because there is the opportunity to meet more recreational demands at existing privately owned facilities, but only if there is the incentive for the operators to provide for them. Both states have programs to encourage tourism, wherein lies the expertise for stimulating private recreational enterprise. If properly implemented, this approach would help stimulate local economies, while meeting recreational needs.

The boating and recreational advisory committees will probably be most effective in terms of helping to meet recreational needs in the long-term. Meeting boating needs for small-boaters and salt water fishermen requires more urgent action. A large number of boats can be accommodated by means of boat ramps. These facilities are compatible with certain Critical Environmental Areas and require relatively lower expenditures. Therefore, **recommendation 8 to construct boat ramps and fishing piers** also ranks among the high priority recommendations. This recommendation complements **recommendation 4 to secure public access to the shoreline.**

High priority recommendations for meeting extensive outdoor recreation needs are **recommendation 17 to permit limited recreation on secondary reservoir lands** and **recommendation 18 to make multiple use of urban lands.** Both involve making more efficient use of existing publicly owned areas. The potential recreational resources – municipally owned water supply reservoirs, school yards, transportation corridors, and tax title urban lands – would be convenient opportunities for meeting the large urban recreation needs. Publicly accessible open spaces and numerous urban parks would contribute to the quality of life in these areas.

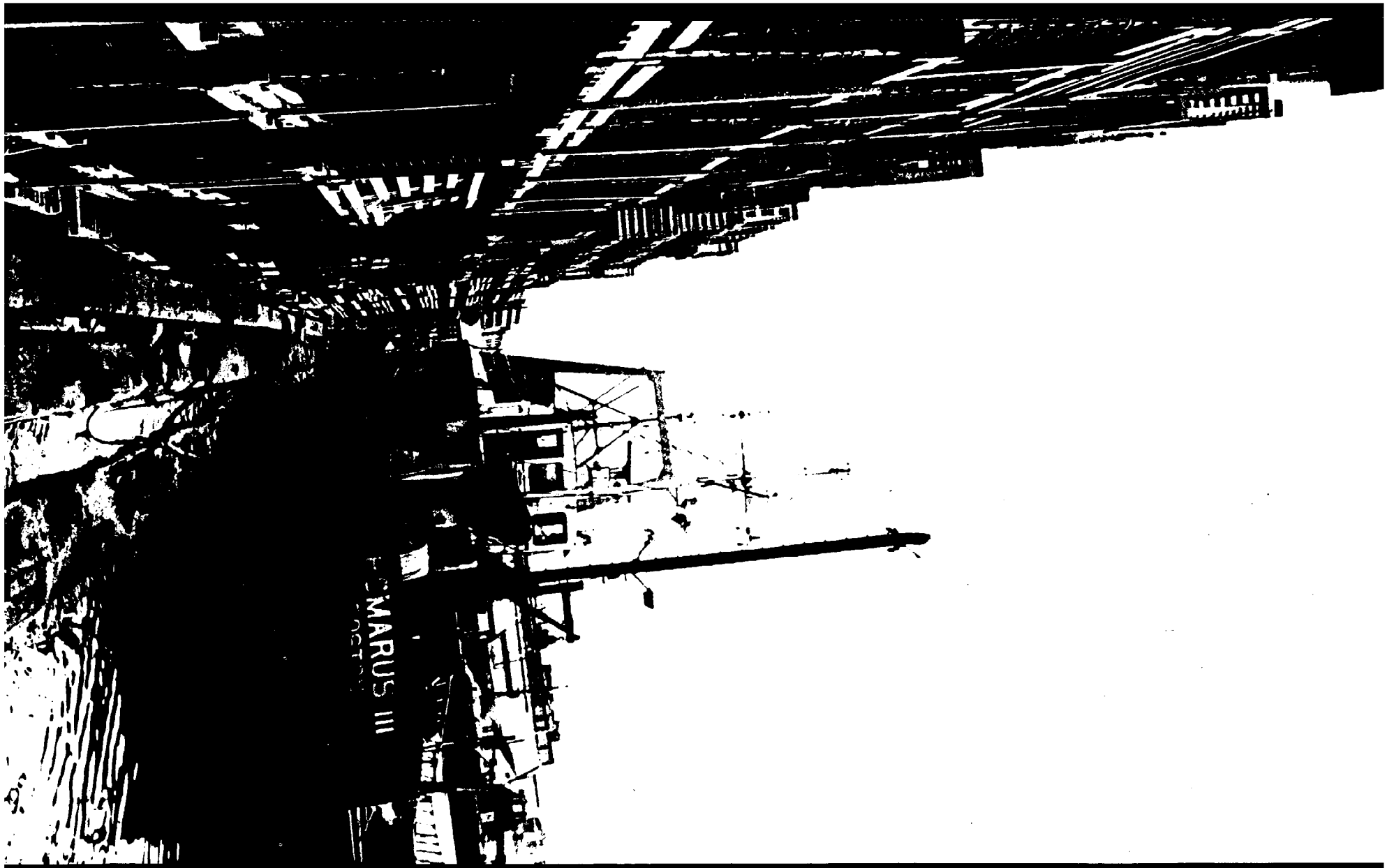
Recommendation 19 to implement Massachusetts scenic river legislation or develop similar legislation in Rhode Island merits high priority as an additional safeguard for protecting Critical Environmental Areas and as a means of setting aside recreational options for future development and use.

The *three other priority recommendations* are essential for meeting future recreational needs, but for the expenditures, will likely have somewhat lower benefits than the highest and high priority recommendations. They are: **11, expanding state parks near tourist centers, and near urban centers, (19),** and **12, acquiring SENE's most important wildlife habitats.** The expansion of state parks is important for ensuring that a major portion of camping, picnicking, and extensive outdoor recreation needs is met near the source of demand, and it appears to be more cost-efficient than the alternative of acquiring and developing new state parks. The wildlife acquisitions would not only meet a significant portion of wildlife enthusiasts' and hunters' needs, but are also important for carrying out the Study's theme of protecting Critical Environmental Areas.

IMPLICATIONS

If the recommended program is carried out, what difference will it all make, environmentally, economically, and socially? In this program the three perspectives tend to overlap, but the greatest advantages are probably social

The anticipated growth in recreational requirements cannot be entirely satisfied, but can be accommodated, although careful planning must occur in order to harmonize with, and make dual use of, Critical Environmental Areas in environmentally sensitive ways. Meeting all of the currently unmet portion of anticipated 1990 recreational demands would yield an estimated economic value in the range of a quarter of a billion dollars annually. More importantly, meeting these demands will improve the region's attractiveness as a place to live and work and thereby help it draw and hold the skills essential for its services-oriented economic future. Socially, meeting the anticipated needs fully can mean an additional 10-15 days annually of outdoor swimming, picnicking, boating, camping, fishing and hunting for those who will be living here in 1990. That represents a total SENE-wide participation of about 80 million days annually. This figure ranks with total annual attendance of all professional sporting events throughout the United States. The year 1990 may seem far away, but most of the programs and policies recommended in this chapter require that we act now.



Marine Management

7

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CHAPTER 7 MARINE MANAGEMENT

The Setting

For over 350 years, life in Southeastern New England has been shaped and guided by the sea – socially, culturally, economically. The places which have been so closely tied to the sea – Newburyport, Gloucester, Boston, New Bedford, Newport and Nantucket – are all in the Southeastern New England Study region. As a result, any water and related land resources study, if it is to be useful in this region, must deal with marine and coastal issues. The same degree of sensitivity which is focused upon the planning of fresh water and related resources should also be devoted to the region's *salt water* and related resources: its marine environment.

There has been no overall coordination of problem-solving for marine-related issues. Coastal zone problems for individual states are now being addressed through federally supported coastal zone management programs. The SENE Study has identified the following marine-related issues to be of regional and New England-wide significance: fisheries, shellfish and aquaculture, port development, offshore sand and gravel mining, and urban waterfronts.

Fisheries. The region's fishery resources have been seriously depleted by inadequate offshore management. In the U. S. there are several agencies and programs which are attempting to unravel the problem.

At the **federal** level, the National Oceanic and Atmospheric Administration (NOAA of the Department of Commerce) has the primary role in helping to maintain the fisheries. Through the National Marine Fisheries Service (NMFS) it monitors local fisheries landings and administers quotas to preserve the fisheries. In addition NMFS conducts fish processing inspections on a voluntary basis at the request of the fish processor. There are at least two NMFS programs which assist fishermen in financing commercial vessels. The Fishing Vessel Capital Construction Fund Program allows owners of commercial vessels of 5 net tons or over to defer federal income tax on income earned by the vessel, and thereby accelerates an ability to accumulate funds for use on fishing vessels. The Fishing Vessel Obligation Guarantee Program aids in financing or refinancing up to 75 percent of the construction, reconstruction, or reconditioning commercial vessels of at least 5 net tons or over. NOAA's New England Fisheries Development Program assists in creating technical base for marketing underutilized species. NOAA funds various research and development projects at local universities, which are attempting to develop linkages to the industry for implementation through the Office of Sea Grant. The **states'** Departments of Natural Resources (R.I. DNR) and Fisheries, Wildlife, and Recreational Vehicles (Massachusetts) cooperate with Sea Grant research and development projects with technical assistance to the fishing industry. These states also regulate the industry by issuing licenses. The Rhode Island DNR has also assisted fishermen by issuing experimental gear and developing primary data on fisheries populations to aid in species management.

Shellfish & Aquaculture. Not enough clams or scallops can be harvested to supply the demand, yet these are an underdeveloped resource. Pollution has closed many recreational shellfish flats, especially those near urban centers. In Massachusetts, the lack of consistent management practices from town to town further reduces overall shellfish productivity. Aquaculture, as a means of meeting excess demands, is potentially a viable industry, given proper development conditions.

There is little direct **federal** involvement in shellfish and aquaculture. The Environmental Protection Agency does have some regulatory authority with respect to water quality and its affect on the preservation of shellfish beds. Another indirect federal insurance of high quality shellfish beds is that funding for coastal wastewater treatment plants favors plants which have non-estuarine discharges.

The **states** also have a role. Rhode Island, through the DNR, controls its coastal shellfish beds through overall policy guidelines. Massachusetts allows individual communities to retain control under state health guidelines and provides some technical assistance. Massachusetts has legislation which regulates aquaculture, while Rhode Island has very limited and outdated regulations.

Local control in Massachusetts is carried out by municipalities which manage their shellfish resources. While limited technical assistance is available from the states, it is not widely used by the municipalities.

Port Development. Once a leader of world maritime and mercantile trade, SENE ports have been left in the backwash of modern day shipping activities. Major capital investments, backed with regional cooperation in distribution and marketing, are needed if the region is to compete in today's maritime trade. Careful study of economic and environmental tradeoffs will be needed, each having implications at the local, state, and regional level. Yet policy for such regionally important facilities is set by local vote in the narrow perspective of town meetings.

Federal agencies such as the Maritime Administration (MARAD), conduct overall review of port development activities and set national guidelines for shipping operations and facilities. The U. S. Army Corps of Engineers oversees the planning and construction of commercial shipping and recreational boating channels. Environmental considerations regarding the disposal of dredged materials are in need of further research.

NOAA, through the Office of Coastal Zone Management, is setting guidelines and providing funds for the **state** coastal management programs, in Massachusetts, the Office of Coastal Zone Management and in Rhode Island the Coastal Resources Management Council. Massport is the most active **local** agency involved in port development operations, having developed major container terminal facilities. Various deepwater oil tanker mooring systems at offshore sites have also been under discussion.

Offshore Sand and Gravel Mining. As onshore prices of sand and gravel rise, offshore sources will become more economically feasible to exploit. Currently not enough is known about environmental impacts to the marine ecosystem, although near-shore mining may have adverse impacts.

At the **federal** level, the Bureau of Land Management (BLM in the Department of Interior) controls the licensing of offshore mineral rights for both sand and gravel and oil, in waters adjacent to the Massachusetts and Rhode Island territorial areas.

The **state** coastal zone management programs will be the agencies most apt to exert an interest in the control of offshore mining at the state level. Rhode Island is already investigating such guidelines, while Massachusetts is pushing for the development of analytical methods for determining need and supply before granting licenses.

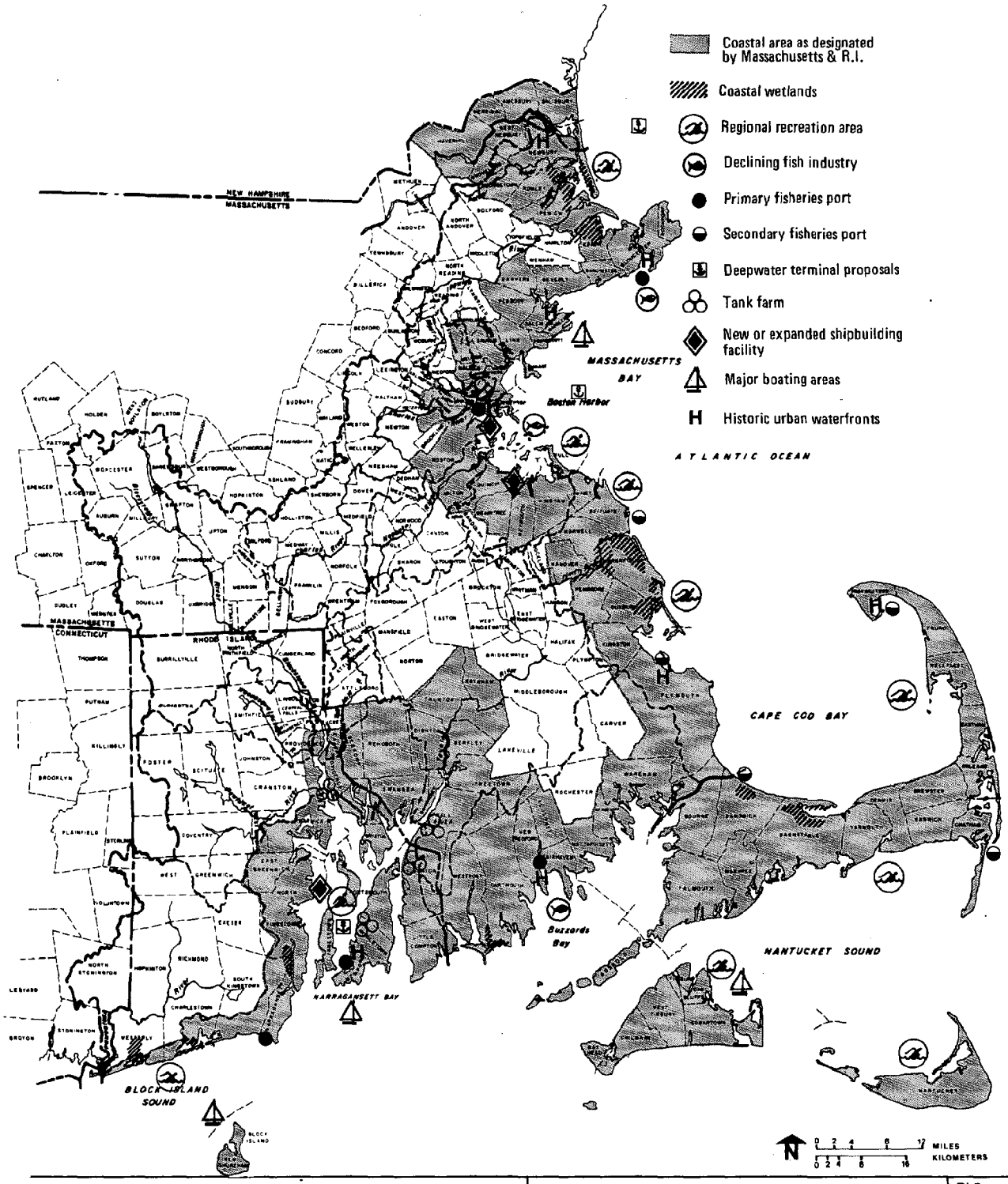
Urban Waterfronts. The decline of SENE's ports and water-powered manufacturing activities has left many urban industrial waterfront areas in decay. With the region's rapid population growth, pressures have increased for the redevelopment of waterfronts for multiple uses, combining business, industry, residential, and recreational facilities.

In recent years, attention has focused again on urban waterfronts as central and attractive locations for business and industry, and as exciting places for tourism and recreation. Spurred by the availability of **federal** funds, several cities on their own have initiated major renewal and redevelopment efforts which have included reuse of areas along the waterfront. Funds have come from the Department of Housing and Urban Development (HUD) for urban renewal, the Corps of Engineers for flood protection and for on-going harbor debris removal studies, the Department of Transportation (DOT) for highway construction, and the Environmental Protection Agency (EPA) for wastewater treatment plant construction. Sometimes these efforts have resulted in creative reuse of waterfront buildings and facilities, inviting business and recreational activities side by side. But in many other cases, redevelopment has not been sensitive to the potential for multiple uses of central waterfront locations. Yet ongoing **state** coastal zone and land use planning programs in Massachusetts and Rhode Island offer a basic framework for ensuring efficient and sensitive use and reuse of urban waterfronts. Coordinated with **local** planning and development activities, these current approaches can be effectively linked regionally to put new life in urban waterfronts.

In the various aspects of marine management discussed in this chapter, several of the fundamental concepts covered in *Chapter 1, Goals and Approach,* and *Chapter 2, The Setting,* have been used to provide a framework. Those chapters describe, for example, the importance of the environment to enhancing the region's economy, and that existing knowledge, programs, and institutions can provide tools for achieving results. *Chapter 3, Guiding Growth,* outlines a rationale and policies for protecting Critical Environmental Areas, many of which should be taken into account when dealing with such issues as fisheries, shellfish, and sand and gravel mining. The approaches, described in this chapter, take these principles into account. Although references are also made in this chapter to several other portions of this report, *Chapter 11, Tying the Recommendations Together,* can be referred to in order to determine the implications of the recommendations in this chapter, on those described in other chapters of this report.

This chapter will now deal with the following topics: offshore fisheries; shellfish and aquaculture; port development; offshore sand and gravel extraction; and urban waterfronts. Current problems of supply and demand, alternative measures for meeting demand, and a recommended program of management actions are presented within an overall objective of *maintaining the region's renewable marine resources at a level sufficient for sustained future use, and developing the region's non-renewable marine resources in an environmentally sensitive manner.*

Other coastal marine issues are examined elsewhere in the report. For analyses of coastal flooding, beach and shoreline erosion, and coastal wetlands, the reader is referred to *Chapter 8.* Recreational boating, swimming, salt water sportfishing, and coastal access are discussed in *Chapter 6.* Discussion of the region's petroleum needs and policies which affect the delivery and distribution of oil are found in *Chapter 9.* The SENE region's combined coastal and marine issues are shown on Figure 7.1.



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

MARINE MANAGEMENT
PROBLEMS & RESOURCES

FIG. NO. 7.1

OFFSHORE FISHERIES

The following analysis of key fisheries issues, a display of alternative measures for resolving the issues, and the recommended actions program are aimed at two objectives: (1) maintaining the fisheries resource to assure future supplies; and (2) improving the competitive standing and economic health of the domestic fishing industry.

The Situation

Long before the American Revolution, SENE fishermen were working the productive offshore fishing grounds on Georges Bank, which lies some 50 to 200 miles east-southeast of the Massachusetts coast. The commercial fishing industry was at one time a major industry in the region, but in the last several decades, it has declined dramatically.

From their 1960 landings, which totaled nearly 550 million pounds, the SENE fisheries declined to 314 million pounds by 1972. Massachusetts was hardest hit by this decline, losing 63 percent of its total landings by 1972. If this rate of decline continues unchecked, SENE landings will fall to roughly 165 million pounds by 1990, or less than a third the 1960 volume. According to Massport estimates, $27 million in annual payrolls, 27,000 jobs, and $160 million worth of vessels could be jeopardized in Massachusetts by a continuation of the present situation.

According to a report prepared for the R.I. Coastal Resources Council, Newport and Point Judith Harbors are the exceptions to this trend. Newport Harbor has attracted landings from other ports in the region. The success of Point Judith Harbor can be directly attributed to the Point Judith Fishermen's Cooperative which has developed an efficient system of marketing tailored to the needs of the fishermen and a unified approach among all facets of the fishing industry. This approach is innovative, unusual but highly successful and should be viewed as a model for other commercial fishing harbors in the SENE region.

Despite declines in most parts of the SENE region, the fishing industry remains an important part of the region's economy. During the 1969-1972 period, NMFS has estimated that the average annual value of total finfish and shellfish landings for the SENE coastal zone was over $56 million (Massachusetts $45.8 million, Rhode Island $11 million). As a SENE coastal zone economic activity, commercial fishing is second only to recreation in terms of value of transactions. For example, offshore fishing, fish processing and boatyard activity (directly related to commercial fishing) generated over $12 million in transactions to 1971 on Cape Cod alone. University of Rhode Island Professor Neils Rorholm estimated that the commercial activity in shellfish and finfish harvesting, frozen and fresh fish processing and wholesaling in the southern New England region generated over $63 million in 1965. Moreover, commercial fishing activities rank among the highest of all coastal zone economic activities in terms of regional output and personal income multipliers.

Foreign Offshore Fishing Activity.

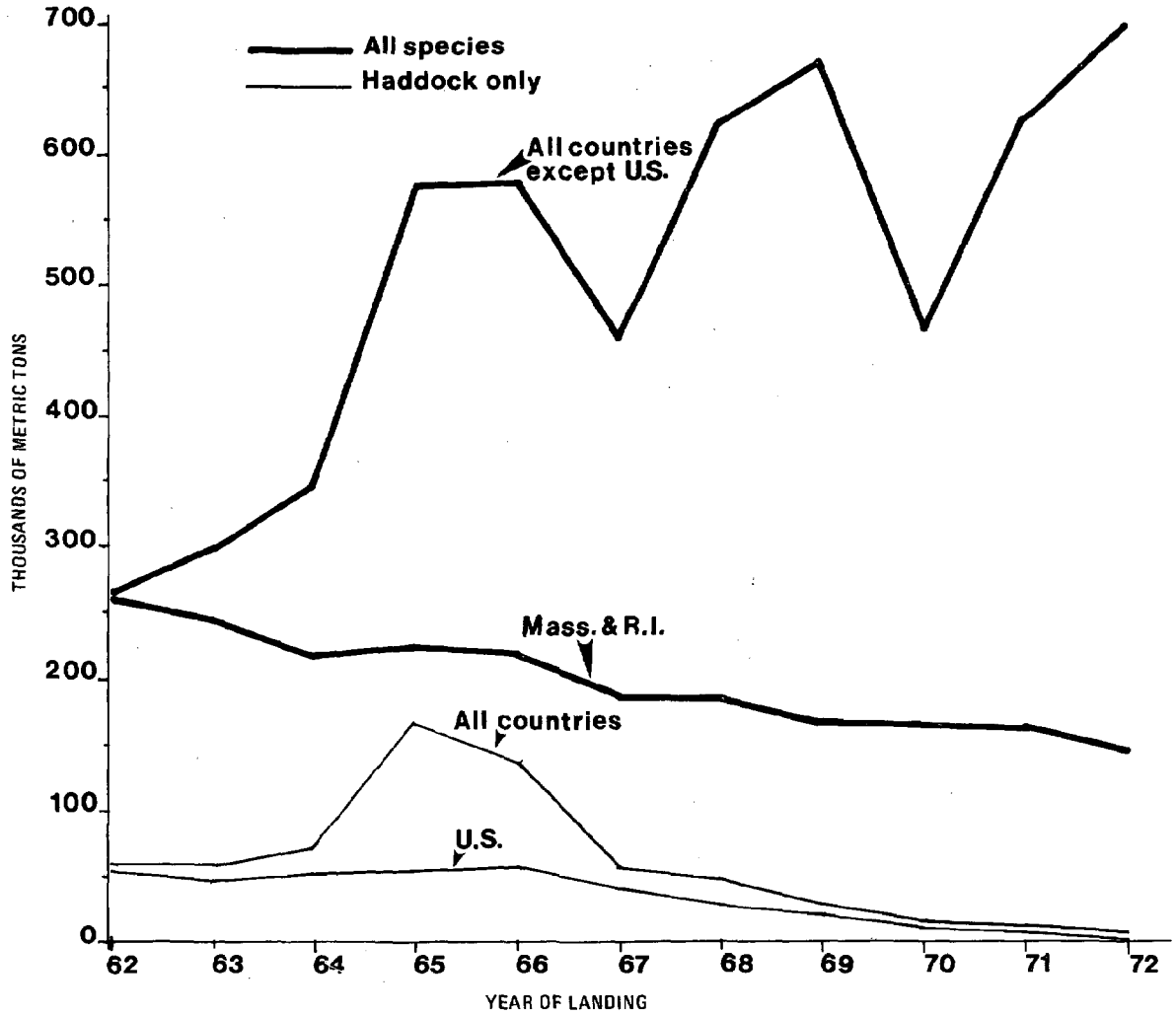
Since 1960 many foreign nations have mounted a massive assault on groundfish, oceanic species, and squid in waters off the Northeast coast of the United States. In 1961, the Soviet Union began exploratory fishing on Georges Bank, and by 1962 over 500 Soviet vessels were actively fishing for herring and groundfish. The success of the Soviet trawler fleet in 1961-1965 (more than 480,000 metric tons in 1965 alone) influenced the development of fleets in Poland, East Germany, and Romania, all of which appeared in the two years that followed. By 1968, Spain, Japan, and West Germany were also fishing off the U. S. Atlantic Coast and more recently, Bulgaria, Greece, France, Italy, and Cuba have begun to harvest these waters.

Using highly advanced equipment, and through the force of sheer numbers, the foreign fleets have become highly efficient competitors with the deteriorating domestic fishing industry. Foreign overfishing has been blamed for dramatic declines of haddock, yellowtail, and herring, the preferred foodfish on historically productive fishing grounds.

Figure 7.2 illustrates the impact of this overfishing, displaying the high foreign landings beginning in 1962 and the concurrent steady decline in landings from SENE ports. The impact of a concentrated effort on a particular species, haddock, is superimposed to illustrate graphically the pressing need for some kind of resource management in order to head off a similar depletion of other species. As haddock disappeared, concentrated fishing efforts and resulting dramatic declines have moved to yellowtail flounder (1968-69) and ocean perch (1971-73). If combined foreign and domestic landings continue without adequate controls, the entire fishery will be jeopardized and an important world food source will be lost.

The State of the Domestic Fishing Industry.

The decline of the domestic fishing industry cannot be attributed solely to foreign overfishing. Many other factors affect competitive ability. From the point of view of distance from port to fishing grounds and distance from port to market, New England is in a far better position than other competitors. Moreover, the local processing system is fairly efficient. In addition, the region and the nation benefit from a tariff on imported fish products.



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY	COMPARISON OF FISH LANDINGS SENE VS. FOREIGN FLEETS	FIG. NO. 7.2

The key negative factors are the costs of capital, labor, and management, and the volume of imported fish. Operating costs of New England's fishing vessels are much higher per unit of fish landed than those of the region's competitors. Foreign vessels are modern, efficient, and, more often than not, heavily subsidized by their governments. To complicate matters, the cost of building a vessel in this country is twice that of construction in some foreign countries. However, American fishermen cannot buy foreign-built boats. The Jones Act forces them to buy from higher cost, domestic ship builders. This situation – the high cost coupled with high downpayment requirements – has forced many New England firms to buy foreign vessels and fish out of Canadian ports.

The greatest cost in the New England fishing industry is labor. Of the gross catch profits, typically 40 percent goes to the boat owner(s) and 60 percent to the crew, after trip expenses have been deducted. In addition, 10 percent of the boat share (or 4 percent of gross after trip expenses) is paid to the captain. To attract labor, the fishing industry must be able to pay higher wages than can be obtained from onshore job opportunities.

Other U. S. industries have traditionally faced lower foreign wages, but have been able to compete through efficient operation and substitution of capital for labor. In the trawler fleet, however, only 32 percent of the gain from increased use of capital goes to the vessel (with 40 percent profit share). Moreover, the New England fishing industry is facing considerably higher cost of capital than its foreign competitor. Higher cost of labor, vessels, gear, and operating capital represent the key problem in the New England fishing industry, and one of the prime reasons for its inability to compete against subsidized fleets.

As stated earlier, it is one of the SENE Study's offshore fisheries objectives to improve the competitive standing and economic health of the domestic fishing industry. A case might be made, since we already import 70 percent of the fish we consume, for allowing the fishing industry to simply "go under." The direct impacts on employment and certain other economic parameters would probably have only a minor effect on total regional income. From a broader point of view, however, the impacts would be considerable and unacceptable. Much of the cultural background of the SENE region – its social habits, its institutions, the tourism "draw" it has – can be directly or indirectly attributed to the tradition of fishing and seafaring. To allow the further decay of the commercial fishing industry would jeopardize much of the character of the region. With one of the world's best fishing grounds immediately adjacent to the region, it was the Study's conclusion that much potential exists for improvement of the status of the industry and its share in the regional economic picture. Coupling this with the predicted increase in demand for fishfoods, it is clearly in the regional, national, and international interest to make every effort to rejuvenate the industry. For this reason the Study considered strengthening the industry as a *planning objective* rather than a *planning alternative.*

The Fishing Regulation System.

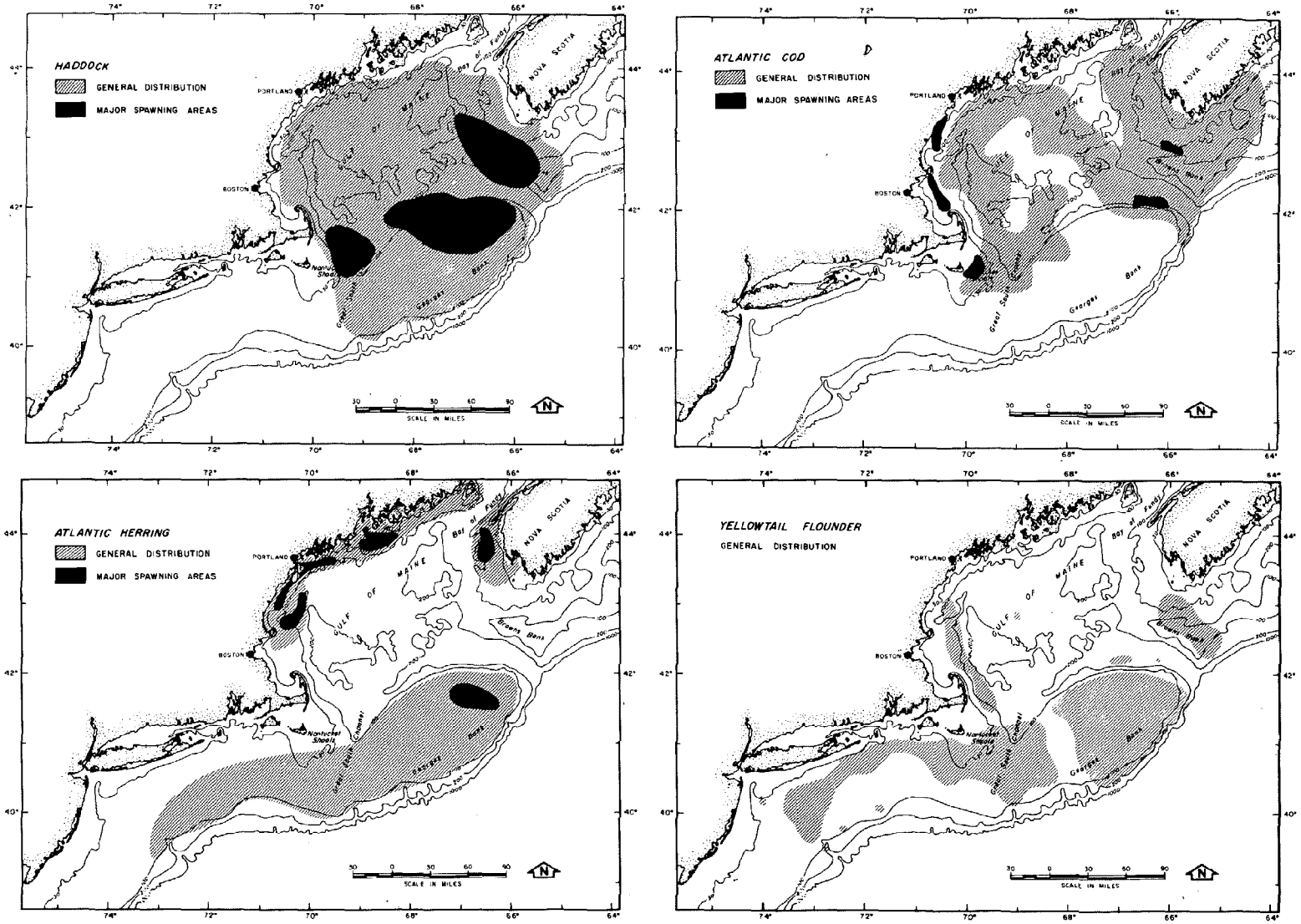
Management and utilization of fishery resources in the waters off Southeastern New England are formally regulated by the laws of adjacent states, federal agencies, and the International Commission for Northwest Atlantic Fisheries (ICNAF). Present management within the territorial seas lies mainly with the states. Because policies, interests, and authority often differ from one state to another, conflicting and inefficient regulations often result. Moreover, the roles of state and federal government in management beyond the territorial sea have not been clearly defined. However, ICNAF, established in 1974 to manage and preserve the fisheries beyond the U. S. contiguous zone (3-12 miles), set up its first overall quota system for preserving Georges Bank haddock stocks in 1970. Unfortunately, these limitations were implemented too late. In recent years, the United States has led efforts to ensure the preservation of stocks at productive levels for those species of primary domestic concern. Figure 7.3 maps the locations of some of these key domestic fish species and their spawning grounds.

U. S. fishermen resent the presence of foreign fishing vessels off the U. S. coast, assuming that the resource adjacent to their coast belongs to them. Agreements reached at several Law of the Sea Conferences, however, point out that except for "creatures of the shelf" and andromous species, fisheries resources beyond the 12-mile contiguous fishing zone are an international resource and are not "owned" by the United States.

Recent federal legislation (i.e., the Studds-Magnuson Bills: HR 8665 and S 1988) would change the contiguous zone boundary to 200 miles offshore or the edge of the continental shelf. This would give the U. S. jurisdiction over the key offshore fisheries. However, current and scheduled International Law of the Sea Conferences are considering equitable means for all nations to benefit from off-bottom outer continental shelf resources, while maintaining the principle of the right-of-free-passage for high seas navigation. Some officials feel that a unilateral 200-mile declaration by the U. S. could be counterproductive at this time from an international perspective, while others point out that the resources will be jeopardized if the U. S. waits any longer.

Marketing Underutilized Species

Many of the traditionally popular fish commonly found off the New England coast have been harvested near, or beyond, their capacity to sustain their populations. At the same time, however, while the tastes of the American people



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SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

OFFSHORE FISHERIES DISTRIBUTION

FIG. NO. 7.3

are often highly particular, per capita consumption of fish in 1973 was at an all time high – 12.6 pounds. Moreover, to meet that demand, imports of fish reached 70 percent of total consumption. However, the consumers' "favorite fish" are only a very small portion of the potentially valuable and marketable foodfish species.

There are three underutilized resources which seem to have good marketing potential. These are offshore crabs, squid, and mixed finfish species such as sea herring, dogfish, small silver hake, red hake or butterfish. Many of these mixed finfish are caught regularly, often averaging 20 to 30 percent of current trawl landings, but because of low relative value never make it to the marketplace.

The National Oceanic and Atmospheric Administration (NOAA) has recognized the potential economic boost for the industry that could be realized if new markets could be developed for such species. NMFS's New England Fisheries Development Program seeks to find a market for the three key under-utilized resources – crab, squid, and mixed finfish – to reduce the share of the domestic market which foreign imports have captured. Several developments are important to note.

Two pilot plants, one in New Bedford, Massachusetts, and one at Point Judith, Rhode Island, have been processing Jonah and red crabs, with technical assistance from the New England Program. In the case of red crab, a ready market appears to exist; however, with squid, the evidence is that considerable domestic market work is needed, although there is a strong export market.

Recent progress in more effectively separating fish flesh from the "frame" or skeleton has made it possible to recover more of the edible product. This process opens the potential for extensive use of a variety of species now discarded or used for purposes other than human consumption. The New England Fisheries Development Program is developing a method for handling mixed species catches of fish at sea, part of which may be used to make fish blocks from which fish portions and fish sticks can be produced. More research is needed, however, to develop an automated system to process large quantities of small irregular sized fish and to sort them into groups.

Related Environmental Issues.

The loss of, or threat to, vital saltmarsh, estuarine, and offshore marine habitats has become an increasingly important issue – one which relates directly to the objective of assuring future supplies of fish.

The filling, dredging and pollution of the region's saltmarshes and estuaries in response to development pressures along valuable coastal lands may have a critical impact on the marine food production system and spawning cycle. Estimates made within the region, notably by the Woods Hole Oceanographic Institution, indicate that as much as 70 percent of the commercially valuable marine fishlife is in some manner dependent on the continued health of the region's network of saltmarshes and estuaries. Elements of recent national legislation – the Federal Water Pollution Control Act Amendments of 1972, the Coastal Zone Management Act, and the Marine Protection Research and Sanctuaries Act – deal directly with the relationships between coastal wetlands and marine life.

In addition to saltmarshes and estuaries, productive offshore habitats and spawning grounds face possible damage from offshore sand and gravel mining and outer continental shelf (OCS) oil and gas development. The pace of such development, notably the acceleration of OCS drilling activities, threatens to outstrip efforts to provide adequate marine biological and oceanographic baseline data from which to determine short-and long-term environmental and, in the case of the offshore fisheries, economic impacts.

Further discussion of these issues and recommendations to solve some of these problems can be found in *Chapter 3, Guiding Growth; Chapter 8, Flooding and Erosion; and Chapter 9, Locating Key Facilities.*

The Solutions

Alternatives to Assure Future Fishing Supplies.

The SENE Study has dual objectives for offshore fisheries as described in the lead paragraph of this section. The alternatives listed below are presented to maintain the fisheries resource to assure continued future supplies.

Continue the Existing International Commission for Northwest Atlantic Fisheries (ICNAF). Since a form of fisheries control currently exists through ICNAF, it could obviously continue to function in its present role. ICNAF's regulations are designed to contribute to the wise use of marine resources, and to minimize conflicts between fisheries and other marine resource users. Current ICNAF regulations are aimed at sustaining yields through such devices as quotas, closed seasons and fishing areas, and net mesh size controls. More often than not, however, these regulations have been too little too late. Moreover, they appear to be generally unenforceable.

Improve and Strengthen ICNAF. This may be a better alternative for assuring adequate future fishery resources. Streamlining the monitoring and quota setting systems would help that body to deal with issues in a more timely manner. Once the system of regulation setting has been streamlined, strict enforcement measures would be necessary if the regulations are to have any validity. How-

ever, given past performance, it is highly unlikely that agreement on regulations or enforcement measures could be reached in time to provide adequate protection for the threatened fishery resource.

Enact a U. S. Interim 200 Mile Economic Zone. In light of the inability of ICNAF to respond to the issues, yet another alternative is unilateral action. An economic zone is distinct from a 200-mile *limit* in that the *economic zone* guarantees rights of passage to all vessels provided they do not engage in fishing activities, and to fishing vessels provided they operate within the regulations for maintaining harvests at a level which will permit sustained yields. Enforcement is provided under such a system through fines, ship quarantine, or cargo confiscation.

Alternatives for Improving the Domestic Fishing Industry's Competitive Base.

Several internal and external forces are interacting to create the present condition of the domestic fishing industry. Several alternatives exist which would have varying degrees of effectiveness in resolving these problems. Those listed are designed to improve the competitive standing and economic health of the domestic fishing industry.

Continue the Present Situation. The fishing industry could attempt to continue holding its own against the impacts of large, subsidized foreign fishing fleets and their high-volume landings. This option would not necessarily maximize returns or benefits to the region from its important offshore resource. Major economic opportunities in wholesale, retail, supply, and related marine activities would be foregone and, quite possibly, a significant sector of the industry displaced. As was earlier noted, in Massachusetts $27 million in annual payrolls, 27,000 jobs, and $160 million worth of vessels could be jeopardized by a continuation of the present situation. For these reasons, it was felt that efforts should be made to improve present conditions.

Increase Tariffs on Imported Fish Products. Tariffs would help to reduce the effect of foreign subsidies, thereby giving U. S. fishermen a more equitable basis for competing with foreign fleets in the domestic market. The setting of the tariff certainly should be made with regard to keeping all fish products prices attractive in relation to costs of either food products. The revenues collected could be applied to the management of the offshore fisheries resource.

Governmental Subsidies to the Fishing Industry. The federal government could designate the SENE region as a depressed fisheries area and provide direct subsidies to the region's fishermen. However, there would be resistance from various governmental agencies due to the cost of such a program in relation to national benefits. In addition, priorities for subsidizing other industries, such as railroads, would likely be more important. Besides, subsidized boats might not inspire the care and attention a privately-owned boat would receive. Such a situation could prove unsafe and would not spark the initiative of the industry to pull itself up by its bootstraps. For these reasons, it was felt that emphasis should be placed upon creating conditions which would enable the fishing industry to rehabilitate itself, though not on governmental subsidies.

Coordinate Components of Fishing Industry In Major Fishing Ports. The experience of the Point Judith Cooperative mentioned earlier in this section indicates that a unified approach to the fishing industry is the most successful even during a period of decline. Those involved in marketing, processing, fishing, leasing, and vessel ownership and maintenance in the SENE region's other harbors should also join forces in coordinating their efforts and sharing resources to support the local industry. Such unity will result in a greater degree of flexibility and efficiency of operations.

Allow Privately-Financed Purchase of Foreign-Built Boats. Wider availability of vessels would enable the industry to improve its fishing fleet. Since vessels built in foreign yards are lower-priced than domestic-built boats, fishermen in depressed fishery areas (who would otherwise be unable to afford a new boat), should be allowed to purchase foreign vessels. Modifying the Jones Act would permit this. Two controls should be considered if this action is implemented: (1) limit the privilege to states experiencing a depressed fishing industry; and (2) prohibit the use of federal funds to be applied toward such purchases.

Improve the Market for Underutilized Fish Species. NOAA's New England Fisheries Development Program is studying the potential marketability and processing of several species. The industry could actively develop a promotional campaign to educate the consumer to use these new species. The Development Program estimates that an increase of 3 percent in the region's landings each year could be worth nearly $18 million in 10 years to the fishermen. While this is not, in and of itself, a panacea for the industry, it is felt to be a sound start towards making it more viable.

Accommodate Fishing Industry Facilities Through Improved Coastal Planning. The state Coastal Zone Management Programs could provide technical assistance to local planning officials. Guidelines should be developed for designing local land use or zoning bylaws which regulate commercial fisheries' shore-based activities, such as processing plants and docking or transshipment facilities. In preparing such local ordinances, special care should be given to Critical Environmental Areas, such as SENE land use Category A or B lands, especially those vital estuarine areas which are supportive of the offshore fisheries.

Alternative Plans

This Study has attempted to present alternative plans for each subject area which emphasize either environmental enhancement or national economic efficiency and regional economic development. Most of the alternatives presented above, however, satisfy both economic and environmental plan considerations.

For example, establishing a 200-mile economic zone would enhance environmental considerations by providing better control over the offshore fisheries and preserving the resource. In the long-run this would reduce the cost of locating and catching fish and also increase the size of the catch. It would also allow SENE's fishing industry to compete on a more equitable basis and allow long-term world use of the resource as a food source.

In addition, increased U. S. control over the fishing grounds could stimulate economic development of underutilized resources while depleted stocks are rebuilding. However, before the harvest of these resources can become a reality, the fishermen must develop a market for the catch. This involves consumer education through promotional advertising on the part of both government and industry.

In order to foster an economically healthy, yet relatively independent and efficient industry, loans at low interest rates should be favored over direct subsidies or grants for vessel construction. Nonetheless, lifting the restrictions on purchase of foreign-built vessels would not only bring modern vessels within reach of many SENE fishermen, but could establish better competition among domestic boat yards. Such activity will enhance the economic development of the region, although it increases the need for quotas or controls on harvests.

It can be seen, therefore, that in the case of offshore fisheries, environmental controls coupled with some governmental priming of the pump will reap important economic returns to the region. In this instance, environmental objectives go hand-in-hand with economic development.

Recommendations

In summary, to maintain a valuable fisheries resource for the world and American consumer, and to provide a strong economic base for the region's fishing industry, the following actions are recommended *in order of priority:*

1. **Declare interim offshore 200-mile economic zone. The U. S. Congress should extend, as soon as possible, the nation's jurisdiction over fisheries to 200-miles offshore or to the edge of the continental shelf. The economic zone concept guarantees rights of passage to all vessels provided they do not engage in fishing activities, and to fishing vessels provided they operate within the regulations for maintaining harvests at a level which will permit sustained yields. This recommendation would provide better control over the offshore resource base as an interim measure pending final proposals by the Law of the Sea Conference.**

2. **Adopt national fisheries management policy and program. A national management policy and program should immediately be adopted by Congress which could be administered by the Department of Commerce through the National Marine Fisheries Service (NMFS) with U. S. Coast Guard monitoring and enforcement assistance, in order to manage the offshore fisheries resource. These federal agencies should work in conjunction with the states of Massachusetts and Rhode Island to consider establishing a joint federal-state management program allowing limited foreign entry, quota enforcement, seasonal or species control limitations and fishing gear specifications within the 200-mile economic zone. The objective of the preceding actions would be to increase the supply and variety of fishery products without depleting stocks of any given species.**

3. **Increase tariffs on imported fish products. The U. S. Congress should selectively adjust tariffs on imported fish and related fishing items so as to lessen the impact of foreign fleet subsidies by their governments on the U. S. market price of fishing products.**

4. **Allow privately financed purchase of foreign built fishing boats. Congress should consider amending the law prohibiting the purchase and importation of foreign-built fishing vessels to allow their use specifically in depressed fisheries states if purchased with private capital. Federal monies should not be granted for purchase of such foreign vessels.**

5. **Improve market for underutilized fish species. The SENE commercial fishing industry, with technical assistance from National Marine Fisheries Services under the New England Fisheries Development Program, should actively develop a domestic market for underutilized fish species by applying innovative marketing techniques in educating the public to the use of new fish stocks.**

6. **Accommodate coastal fish facilities through improved planning. The state Coastal Zone Management Programs, in cooperation with**

Departments of Community Affairs, should develop guidelines and provide technical assistance to local planning boards. Such assistance should be provided when making land use or zoning bylaws for shore-based support services for commercial fisheries, such as fish or shell-fish processing plants, or updated docking and transshipment facilities. Such planning should also carefully consider Critical Environmental Area (Categories A and B) so as to protect those estuarine resources which are of vital importance to the commercially valuable offshore fisheries.

Implications

Implementation of these actions would be a major step toward regenerating the offshore fishing industry, which, despite its decline, still represents a significant economic activity for the SENE region as a whole.

Increased and longer-term availability of a wider variety of fish products and stimulation of spin-off benefits such as increased employment in related industries would contribute both to the economy of the region and the well-being of its people. While increased cost to the consumer would result from increased tariffs on imported fish and from capital improvement cost to rebuilding the domestic fishery, these costs are not likely to be of such a magnitude as to preclude fisheries products from continuing as relatively low-cost food commodities to the consumer.

In time, given enlightened management and federal support, a healthier, more stable fishing industry could regain its stature as a major force in the economy of the region, making a significant contribution to regional income and generating development of related processing, storage, and shipping facilities in existing ports.

It is possible that as fishing fleets modernize, they will be considered by some as less aesthetically desirable assets to coastal communities, leading eventually to pressures to isolate them. The various processing activities associated with the fishing industry have in the past suffered less than total acceptance, but the negative externalities of smell and waste generally associated with them are less undesirable than those of many other industries. These fishing related industries are subject to relatively less expensive and less complicated anti-pollution technologies than many of the more complex industries. In addition, commercial marine fishing is one economic activity for which there is no alternative to locating in the coastal zone. Thus, to some extent, the harbor facilities required by the fishing fleets will compete with other coastal industries and some private recreational uses. In general, however, the facilities associated with the fishing industry are compatible with many recreational uses, and most other industrial activities which do not depend on waterfront sites can find alternative locations within the region.

Perhaps of overriding social significance is the inescapable fact that as world food shortages become more acute, management to preserve fisheries as a significant world food resource could become increasingly important. Continued use of the Georges Bank fishing grounds as a world food source will at least partially close this food gap, but only if careful management practices for sustained yield and economic optimum yield are rigidly enforced. Fish products are important sources of protein used as human foods, farm feeds, and farm fertilizers. The United States should assume responsibility for the preservation of this significant resource, but will have to give careful regard to international interests, perhaps by allowing some form of international participation in developing fisheries management regulations. Control and management of the SENE region's offshore fisheries would have far-reaching implications in preserving an international food supply, as well as aiding the restoration of the SENE fishing industry.

SHELLFISH AND AQUACULTURE

The Situation

Shellfish Production

The value of shellfish beds in the SENE region has been estimated to be in the order of several hundred thousand dollars. In the Ipswich-North Shore planning area alone, four towns in 1970 had a combined total of over 2,000 acres of productive shellfish beds producing an annual crop worth more than $1.7 million. There is estimated to be a total of 252,000 bushels of harvestable clams on more than 2,700 acres of clam flats throughout North Shore, worth in excess of $2,780,000 each year. Narragansett Bay has the most productive shellfish beds in Rhode Island, and the estimated annual values of this area appears to be roughly $10 million. There are over 37,000 acres of shellfish beds in SENE, many of which cannot be used to obtain shellfish for human consumption because of

sewage and other pollution sources. However, the estimated cost of technical assistance and improved management on the remaining flats appears to be far less than the potential value of shellfish harvest foregone.

The major problem with shellfish production in Massachusetts is management (a local responsibility) which is exercised unevenly from town to town. While some towns can afford to hire trained personnel to manage their shellfish beds, more often than not, the extent of local management is the sale of commercial digging licenses. As might be expected, the impact of this management system is fragmentation of authority and inconsistent regulations from town to town, resulting in the underutilization of a valuable resource.

This is not the case in Rhode Island, where the state has the responsibility of managing shellfish beds. The difficulty in this state is the lack of information about harvesting. A recreational shellfish license which the Rhode Island legislature will consider early in 1976, for residents and non-residents would provide information crucial to management of the resource.

In both states, municipal, industrial, and private discharges of water pollutants, and the recent regular outbreaks of paralytic shellfish poisoning ("red tides") have temporarily closed thousands of acres of shellfish beds. However, rigid enforcement of federal and state water quality legislation and the construction of more advanced waste treatment facilities with deep ocean outfalls *(See Chapter 5, Water Quality)* should have the effect of reopening long closed shellfish areas, perhaps as much as tripling the available resource.

"Red tides," however, are not well understood and despite intense state and private research efforts, we know practically nothing about either the causes of the blooms of deadly dinoflagellates or the methods for stopping them.

In a so-far successful program aimed at maintaining harvest opportunities, municipalities in Massachusetts, under the supervision of the Division of Marine Fisheries with the approval of the Department of Public Health, is "relaying" quahogs and oysters from polluted flats to clean and underpopulated areas. Private experiments in re-oxygenating barren shellfish beds through spray-jetting the bottom sediments have also been successful on a small scale. This revitalizes the clam flats and allows new crops to be seeded, although such revitalization can occur naturally in some barren flats. In addition, steps are being taken to convert the chief reason for the closure of shellfish flats – polluted wastewater effluent – to a substance useful for shellfish propagation.

Interestingly, extensive beds of edible blue mussels exist along the region's coast but are not utilized to any great extent. This valuable resource enjoys wide use in Europe and could become more popular here by a vigorous educational drive. In some European countries, the mussel is preferred to soft-shell clams and there may even be a potential for developing an export market. Although tastes of American people are very particular, they are responsive to innovative, low-cost, and healthful products.

The existing acreages of available flats may be sufficient to cover *recreational* shellfish demands through 1990, although that demand cannot accurately be measured for Rhode Island since there is no recreational shellfish licensing. However, *commercial* diggers are not able to fulfill the out-of-state demand for clams. Moreover, increased yields through better management and pollution abatement would still not provide enough clams to meet this commercial demand. As a result, interest in developing local aquacultural operations in order to capture a portion of this market is increasing and is therefore examined below.

Aquacultural Development

Practiced extensively elsewhere in the world, aquaculture only recently was determined to be economically feasible in the United States. Given the harsh environmental conditions in New England several criteria have to be considered prior to initiation of culture activities, according to research at the University of Rhode Island:

(1) Develop only those species which are indigenous to the region or are capable of adapting to physical extremes associated with the region, unless onshore closed systems are to be attempted;

(2) Limit operations to those species with proven reproductive capability in capacity;

(3) Utilize species which reach a marketable size within two years (i.e. have a fast growth rate and have simple larval development stages);

(4) Develop species with potential for having a suitably high price and good sales marketability; and

(5) Utilize species which can be sustained on readily available and inexpensive feeds.

Several species meet most of these requirements and could be the initial "targets" for aquacultural emphasis in New England. These include the hard shell clam (quahog), eastern oyster, and Coho salmon. It has recently been reported

that the American lobster has borne eggs in captivity, although additional difficulties in rearing this species to marketable size still need to be overcome. Aquacultural operations in Buzzards Bay and on Cape Cod have enjoyed initial success, although they are relatively small in scale at the present time.

Extensive culture operations require large land areas for ponds, whereas **intensive** culture utilizes dense propagation per unit area. Because of the limited availability of suitable coastal land in SENE, intensive culture is almost mandated by both environmental and economic considerations. If such intensive operations are not carefully monitored, wastes could lower water quality and thereby threaten the surrounding resources. Appropriate regulations to minimize environmental impacts should be clearly spelled out prior to enabling aquacultural operations.

The SENE Study has identified several locations which appear to have high potential for aquacultural operations, but which should be investigated thoroughly to determine their suitability. The criteria used to identify these areas include the following: degree of protection from wind and waves; area large enough to support commercial operations; depth -- less than 15 feet of water at high tide; existing water quality; and compatibility with nearby land and water uses. The areas suggested for further study include: Brigg's Harbor in North Scituate, South River estuary, Duxbury Bay, and Plymouth Bay in the South Shore planning area; Winnapaug, Quononchontaug, Ninigret, Green Hill, Potter, and Point Judith Ponds in the Pawcatuck planning area; Cape Poge Bay, ponds on the south shore of Martha's Vineyard, in the Cape Cod planning area; Sippican Harbor, Mattapoisett Harbor, and Nasketucket Bay, in the Buzzards Bay planning area.

Institutional Constraints on Aquaculture. One of the main deterrents to development of aquaculture as a viable commercial enterprise in SENE has been the confusion and uncertainty over the use of public waters for aquaculture farms. In 1973, the Massachusetts legislature somewhat alleviated the confusion by passing an aquaculture law. Massachusetts General Laws Ch. 130 § 68A authorizes towns and cities to grant licenses to individuals to cultivate shellfish through aquaculture.

Unlike Massachusetts, Rhode Island has made no provisions for aquaculture. Chapter 20-10-1 of the Rhode Island General Laws does allow the director of the Department of Natural Resources to lease to any inhabitant of the state, or to any corporation chartered in the state, "any piece of land within the state, covered by four feet of tidewater at mean low tide . . . not within any harbor line, for the purpose of oyster culture and the oyster business." However, no more than one acre in any one lot or parcel may be leased to any one person or firm.

While the above law may allow for limited aquaculture enterprises, it has many drawbacks: (1) there is a residency requirement; (2) the area available for lease is limited to economically unfeasible size; (3) the problem of conflicting uses (such as recreational and navigational uses) is not addressed; (4) no protection is offered to the potential aquaculturist's racks, rafts, or floats; and (5) only oysters, not shellfish in general, are mentioned.

Wastewater Use Research. Related to the growth of the aquaculture industry is the possibility of using municipal and industrial wastewater effluents as a stimulus to the growth of fish and shellfish. The federal Environmental Protection Agency has published proposed rules for the approval of pollutant discharges in connection with an aquaculture enterprise. The regulations are intended to authorize, on a selective and carefully-controlled basis, discharges which would otherwise be unlawful in order to determine the feasibility of utilizing by-products in wastewater to grow aquatic organisms which can be harvested, while at the same time protecting other beneficial uses of the water.

Over the past four years the Woods Hole Oceanographic Institute has experimented with, and succeeded in, using secondary treated wastewater to propagate shellfish. The two major obstacles to using this technique in New England are climatic changes and viral and bacterial contamination. To overcome the former, preliminary research has shown that power plant cooling water effluent is a fairly reliable and inexpensive source of heated water which stimulates rapid growth of cultured organisms. Knowledge about the latter obstacle is incomplete. Finding techniques to remove bacterial and viral contaminants from wastewater could have widespread application in the field of public health.

This kind of research requires continuous funding until such time as a successful solution is found. Careful research, sustained by adequate and continuing funding, is therefore essential not only for the advancement of this technique for aquaculture, but also for advancements in the field of public health. Little can be done on practical application of this technology until the problems are solved and the Department of Health, Education, and Welfare and the Food and Drug Administration approve the use of secondary treated wastewater for shellfish aquacultural operations.

The Solutions

Alternatives

Within the objective of improving the quality and quantity of shellfish in SENE through natural and aquacultural production, a number of alternative resources were examined. However, these alternatives are difficult to classify in pure "economic" or "environmental" terms due to their multiple effects and impacts. Each alternative is therefore discussed as to its individual economic or environmental implications.

Delegate Management of Shellfish to the State. Already the case in Rhode Island, the Massachusetts Divisions of Marine Fisheries could also be designated as the primary control of shellfish beds in order to obtain minimum irregularities and maximum utilization of the resource. A state recreational shellfish license could provide some of the resources for the operation of such a management and enforcement program. While this alternative might help achieve uniformity in shellfish management, costs to support such a program would likely be high. Because of additional problems with staffing and the strength of the home rule tradition in New England, this alternative was not considered operationally or politically feasible at this time.

Increase State Assistance in Massachusetts for Local Shellfish Management. This alternative would upgrade present management techniques used at the local level in Massachusetts. Moreover, it could be partially paid for by requiring increased local recreational shellfish license fees. This alternative provides the opportunity for towns to continue in their present managerial role, but as recipients of increased technical assistance from the states to establish coordinated shellfish management programs. Costs would be shared on a pro-rated basis.

Develop Market for Underutilized Shellfish Species. Potentially valuable and marketable shellfish, such as the blue mussel, could be promoted for domestic use in order to more efficiently utilize available resources. Such promotion would enhance local economies by providing new shellfish harvest opportunities.

Research Removal of Virus and Bacteria to Enhance Shellfish Habitats. Methods for detecting and removing virus and bacteria during the wastewater treatment process could minimize closure of shellfish beds due to health restrictions which result from municipal wastewater discharges. This might also allow the eventual use of wastewater for aquacultural purposes, therefore being an environmentally sound method for recycling previously unused wastes. Viral and bacterial contamination is a major obstacle to permitting recreation near water supply reservoirs *(See Chapter 6)*. Findings about cost-effective methods for treating this kind of contamination in wastewater could illuminate similar problems faced by water managers.

Site New Wastewater Discharges away from Estuaries. Until such time as viral removal is practicable, new coastal wastewater treatment facilities which incorporate deep ocean outfalls should be built to reduce the number of shellfish flats closed due to municipal discharges in coastal waters. Although costly, benefits would be realized not only to shellfish, but also to recreation activities.

Subsidize Aquaculture Industry Using State and Federal Funds. While this would contribute toward the objective of increasing the quantity of shellfish available in the SENE region, state agencies feel that it is inappropriate for public monies to be applied for private gain. They also noted that specialized technical assistance services and development loan programs were already available.

Enact Specific Aquaculture Legislation in Rhode Island. A basic need to set the stage for the young aquaculture industry are clearly framed laws regulating the activity. Massachusetts has such legislation which could serve as a guide in developing a legislative package for Rhode Island.

Increase State Guidance for Aquaculture Development. Both states, through their marine management agencies, could be funded to assist communities and private groups in planning for aquaculture activities. In cooperation with the on-going coastal zone management programs, potential coastal sites might be identified, increased technical assistance might be provided to towns, and research on innovative re-use of wastewaters could be supported. Improved technical assistance for aquaculture development would assist local economic development by providing better conditions for such operations.

Recommendations

Of the alternatives available, the following program of actions is recommended for improving management in SENE.

7. **Increase state technical assistance in Massachusetts for local shellfish management.** **Massachusetts should upgrade local management of shellfish resources by increasing Division of Marine Fisheries technical assistance to the towns.**

8. **Increase shellfish license fees in Massachusetts and require recreational licenses in Rhode Island.** **The Departments of Fisheries, Wildlife, and Recreational Vehicles in Massachusetts should urge coastal towns to increase user fees for shellfish licenses commensurate with the demand for local resources in order to support improved technical management programs.**

The Rhode Island General Assembly should pass legislation requiring recreational shellfish licenses for residents and non-residents. The licensing program should be administered through the Rhode Island DNR.

9. Develop underutilized shellfish market. The Departments of Natural Resources (R.I.) and Fisheries, Wildlife, and Recreational Vehicles (Mass.) should actively encourage the harvesting of edible shellfish, such as the blue mussel, for both recreational and commercial use. A public education program, with National Marine Fisheries Service funding, using innovative media techniques would greatly assist in developing public awareness at the local level.

10. Research removal of virus and bacteria to enhance shellfish habitats. EPA should accelerate research into the detection and removal of viral contamination during the wastewater treatment process. This would minimize closure of shellfish beds due to health considerations resulting from municipal wastewater discharges and allow the eventual use of wastewater for aquacultural purposes. (see below).

11. Site new wastewater discharges away from estuaries. Until such time as the removal of virus and bacteria is feasible, the Water Quality Branch of EPA, in conjunction with the Rhode Island Division of Water Supply and Pollution Control and the Massachusetts Division of Water Pollution Control should consider giving approval only to designs for new coastal wastewater treatment facilities which incorporate deep ocean outfalls in order to reduce the number of shellfish flats closed due to municipal discharges.

In addition to the above recommendations on shellfish management, the following actions are recommended to produce a more favorable basis for aquacultural operations:

12. Enact aquaculture legislation in Rhode Island. Rhode Island should enact legislation similar to that passed in Massachusetts in 1973. Such legislation should include the following elements: (a) definition of aquafarming; (b) acknowledgement of responsibilities regarding water quality; (c) definition of power to grant and revoke leases and licenses with provisions included for explicit definition of lease duration conditions at an administrative level; (d) methods for applying, advertising for, assigning, renewing, transferring, etc. leases; (e) rights to be conferred or withheld, such as navigation, recreational fishing rights, access, etc.; (f) rental and fee structures; (g) safety provisions and requirements, such as markers for rafts, racks, etc.; (h) offenses and subsequent penalties; and (i) relation of aquafarming laws to existing fisheries laws.

13. Investigate potential aquacultural sites. The Massachusetts Division of Marine Fisheries and the Rhode Island Division of Fish and Wildlife, in conjunction with state coastal zone management programs, should verify the stability of various locations for aquacultural operations. The SENE Study's preliminary list mentioned previously in the Regional Report and the appropriate planning area reports are a strong beginning for this investigation.

14. Increase technical assistance to towns for aquaculture management. The Massachusetts Division of Marine Fisheries should be funded to take a more active role in providing technical assistance to communities in identifying suitable sites and in developing suitable local management controls to maintain the area's potential for aquaculture. Once aquacultural permits are applied for, the Division of Marine Fisheries should assist the communities by evaluating the applicant for the necessary technical, financial, and administrative qualifications prior to the granting of licenses.

15. Increase research on use of wastewater for aquaculture. The New England Regional Commission, with technical support by the states, should increase research into the feasibility of using heated cooling water from existing or proposed coastal atomic power plants (such as Pilgrim Atomic or the proposed Charlestown, Rhode Island plant), to support aquaculture activities. These agencies should also emphasize support for accelerated research such as that under way at Woods Hole Oceanographic Institute which is investigating the feasibility of using treated wastewater effluent for aquacultural purposes.

Implications

As was described in *Chapter 2, The Setting,* and again in the *Offshore Fisheries* section of this Chapter, the fisheries industry is an important segment of the region's economic base. Shellfish harvesting provides important local income and tax benefits to local coastal areas as well. Implementation of these recommendations to increase availability of shellfish resources will help strength-

en and stabilize the economies of many of SENE's coastal communities. An improved-yield shellfish industry, supplemented by aquacultural production, could also stimulate local economies by providing a labor-intensive employment base and increase the volume of shellfish available to the commercial trade.

PORT DEVELOPMENT

The Situation

Once world leaders, today Southeastern New England's ports are being left in the backwaters of international trade. The reversal has been due as much to changes within the region as to changes in world trade. The shift away from a manufacturing to a service economy, emphasis on low-sulphur fuels, sharply decreasing coal receipts, growth in the scope and efficiency of highways and trucking services have had as much effect as have the changes in ship sizes and drafts and world trading patterns.

While petroleum tonnage dramatically increased in the past years, general cargo tonnage moving through SENE ports has been declining steadily since World War II, resulting in loss of job opportunities in the region and excess capacities at conventional piers, transit sheds, and warehouses in each port.

Within SENE, dry cargo movements have shifted from sea to land. Many of the region's once active ports – Newburyport, Salem, New Bedford, Fall River and Newport – have become virtually inactive. Today, activity concentrates in Boston and Providence, first and fourth busiest ports in New England, respectively.

Port Development in Boston and Providence.

The advent of containerization has revolutionized cargo transport throughout the world. In New England, only Boston has been able to raise the capital necessary for two competitive container facilities. The newer facility at Mystic River, Charlestown, is operated by Massport. The older facility at Castle Island, South Boston, is operated by Sea Land Service, Inc.

Petroleum receipts region-wide have shown similarly drastic increases which threaten to overtax existing port facilities. During 1972, over 1000 trips by large tankers were required to transport petroleum products into SENE's major ports. Current projections by the U. S. Army Corps of Engineers show that continued use of the present class of tankers now servicing the region's ports would require about 1,600 trips by 1980, 2,200 trips by 1990, and as many as 5,400 trips by 2020. The rapidly worsening harbor congestion and the world trend toward larger deep-draft tankers point to the need for a new system for handling petroleum product deliveries and distribution in SENE and the New England region as a whole. A study done for the Massachusetts Port Authority suggests a multiple-use deepwater crude oil terminal to serve the eastern Massachusetts, southern New Hampshire and Maine market area. Several oil companies have recently expressed interest in refinery construction in New England and Massport has temporarily shelved the study until such time as it has received a firm commitment from a major oil company.

Energy receiving facilities are the major port development concern in Providence as well. In addition to oil terminals, the largest liquid natural gas (LNG) facility on the East Coast has been proposed for the Providence area, and one 600,000 barrel capacity tank has been constructed. If completed, it would consist of three storage tanks with a total capacity of 1,800,000 barrels, served regularly by six large LNG carriers. These vessels run almost 1,000 feet in length, 135-145 feet in width, carry 125,000 cubic meters of liquid gas, yet have only a 36 foot draft fully loaded.

Due to limited expansion capability and potential incompatibility with adjoining residential areas at the Providence LNG site, some Rhode Island officials are giving consideration to concentrating future LNG storage at the surplus Navy property in Davisville. Although some of the Davisville site is subject to coastal flooding, LNG tanks on diked and filled sites (possibly even using dredge material) is a real alternative. Several options are being considered, including: (a) deepening the existing channel to 40 feet along its 2½ mile length to the Davisville docks; (b) deepening the same channel 1½ miles to Quonset Point docks with a pipeline to Davisville; and (c) a deepwater terminal at Gould Island with a 5-mile pipeline to Davisville.

Dredging Projects and Dredged Materials Disposal.

Navigation needs within the port of Boston include the deepening of the Mystic River, Reserved Channel, and Inner Harbor Channel to 40 feet, and the possible deepening of the Outer Harbor main channel. The Chelsea River Channel, which serves nine oil tanker berths and other facilities, cannot be deepened beyond its current 35-foot depth without endangering existing petroleum

wharves and piers. Dredging of the 40-foot Main Ship Channel to Providence (previously delayed by litigation concerning the location of satisfactory dredged materials disposal sites) is presently scheduled to be completed by mid-1976. Other dredging projects proposed by the Corps of Engineers through 1985 include Cape Cod Canal, Fall River, New Bedford, Newburyport, Plymouth and Point Judith Harbors and Buttermilk Bay, on Cape Cod.

Channel dredging releases polluted sediments deposited by industrial wastes, municipal sludge discharges, and combined sewer overflows. There is little undisputed data on the long-term effects of dredging and disposing of these sediments which have high concentrations of heavy metals and other toxic materials. The U. S. Army Corps of Engineers has researched the implications of dredged materials disposal and found that, in many cases, the adverse effects of the accumulation of oxygen demanding material and heavy metals may continue long after disposal operations have been terminated. An additional problem is that present equipment available to the dredging industry does not support technical and economical transport of dredged materials further than 10,000 feet from any dredging location. A five-year nationwide study of dredging and disposal problems is currently being conducted by the Corps of Engineers. In addition, the Corps has undertaken a special inventory of potential dredged materials disposal sites for Rhode Island and Massachusetts through the SENE Study. Possible sites up to three miles inland and in a zone 3 to 15 miles from shore have been identified using aerial photography for the Boston Harbor and Narragansett Bay areas.

Need for Coordinated Port Planning.

Certainly the biggest problem facing SENE port operations today is the general lack of coordination of port development schemes, terminal construction plans, and inland distribution systems, particularly for petroleum. In a market as distinct as SENE's, the region's ports would be more efficient if they were planned jointly to complement each other. Planning for development of future key facilities at ports best equipped to handle a given commodity would benefit the shippers, the ports, and the region as a whole. Detailed regional economic analysis is needed to determine the extent that regional port planning should play to serve both SENE and New England.

There have been many proposals recently, for example, for development of deepwater terminals for both the greater Boston and Providence-Narragansett Bay area. At this time it is not clear if just one or both facilities are necessary to meet the region's needs, and the picture is further clouded by indecision about similar proposals outside the SENE region. Moreover, there is no evidence as to which site is the most suitable in terms of port capabilities and existing infrastructure. These proposals have been made in a policy vacuum, without analysis of the strengths of each port from a regional viewpoint. Such an analysis could help determine whether or not the current development of LNG facilities on Narragansett Bay might be complemented by petroleum facilities development near the Boston metropolitan area.

The Solutions

Alternatives for Port Development

Within the objective of modernizing the SENE region's port facilities and improving the region's marine trade potential, several alternative measures were examined.

Continue to Plan Local Port Improvements on an Individual Basis. Port authorities and economic development commissions could continue to plan improvements for local port facilities and promote private investment on an individual basis. The Massachusetts Port Authority, for example, has been highly successful in its port development activities and this success can be expected to continue. Yet to continue individual port planning without evaluation of regional forces is economically wasteful, often sacrificing economies of scale which might be derived from specialization.

Plan Port Development Based on a Regional Study. A study of the region's port capabilities and opportunities, as they relate to other New England ports could yield multiple benefits. In addition to the conventional economic implications discussed earlier, such a program could result in the renovation of some of the blighted urban waterfront land now bordering the region's major ports. *(See Urban Waterfronts Section, this Chapter).* The key elements of such a study might include the following considerations.

(a) **Accelerating the development of container ship facilities in Boston as warranted.** With immediate access to major highway systems to the rest of New England, the port of Boston could become a major general cargo center.

(b) **Developing an economically feasible and environmentally acceptable deep water petroleum terminal.** Both proposed sites near Boston and in Narragansett Bay should be evaluated in these terms: a deepwater offshore terminal would alleviate existing and projected tanker congestion and the threat of spills in both the Port of Boston and in Narragansett Bay; coupled with a pipeline distribution system to major population centers – Worcester, Providence, and Fall River/New Bedford – these central petroleum receiving

facilities could provide for the region's oil needs in a safer and more efficient manner than is currently the case.

(c) **Possibly developing Narragansett Bay as an LNG Center.** Centralizing LNG storage and distribution on Narragansett Bay would capitalize on the existing Algonquin Gas infrastructure, the Davisville development potential, and the Bay's relatively deep water.

Recommendations for Port Development

In light of the preceding options and considerations, the following action is recommended to maximize regional economic efficiency with regard to port development:

16. **Plan a regionwide port development. Massachusetts and Rhode Island, as well as Connecticut, New Hampshire, and Maine, through the New England Regional Commission, and with assistance from the New England River Basins Commission, should jointly undertake a regional port planning program. Federal participation should include the Corps of Engineers, Department of Commerce, U. S. Coast Guard, and the Maritime Administration. The central objective of the program should be to determine the most economically efficient port development system for meeting the region's petroleum needs, and to some extent its shipping and cargo distribution needs. The study should also consider: (a) the various navigation projects proposed to serve petroleum distribution facilities, existing or potential power plants, or possible refineries which might be constructed; and (b) cost-sharing measures that would be submitted for consideration by Congress, concerning federal assistance for local port planning purposes, and federal assistance to state authorities for port improvements.**

Alternatives for Dredged Materials Disposal.

Regardless of the direction taken by the region's port decision makers, dredging will be required in several harbors and dredged materials will have to be disposed of. Here again, a number of alternatives are available:

Treat Dredged Materials. Treatment of dredged materials is a process which decomposes organic materials. However this may have mixed environmental effects. The addition of chemical oxidizers, such as chlorine, to treat material prior to dredging may be toxic to the surrounding ecosystem. Conversely, aeration of highly organic material may be quite beneficial. Getting this technique under way requires time and money. Treatment of dredged materials is expensive because of the need to develop sophisticated new facilities which have high operational and maintenance costs. The process has not been used to date in the New England area.

Incineration. Burning rapidly oxidizes pollutants in dredged materials. This may be effective for small projects, but the danger of air pollution must be weighed very carefully.

Dispose Dredged Materials on Land and Expand Federal Authority in this Regard. Dumping dredged materials at sites on land has been used to a limited extent in the SENE region. However, the potential for pollution of ground water is considerable and this Study has urged maximum development of ground water in the region *(Chapter 4, Water Supply)*. The environmental impact of any such purposes would, of course, need careful consideration.

Obtaining suitable land disposal sites for materials from authorized navigation projects has proved to be problematic. Because there is no federal authority to pay for land disposal sites, the Corps of Engineers must rely on donations of private landowners or compensation with municipal funds. This process requires negotiations which often delay the project, prolong the problem, and frequently force the Corps to select sites judged second or third best in terms of environmental, economic and social criteria. Congress should consider expanding federal navigation authority to permit federal acquisition of or payment for land disposal sites.

Create Artificial Islands. The construction of islands by diking and filling an area with dredged materials is an attractive possibility, especially if the site is near the dredging area and the dredged material has good bearing capacity. Combining this concept with the need for power generation could help lessen the pressure for the siting of such key facilities in coastal areas, as well as eliminate a portion of the large volume of dredged materials which could need disposal. However, in some past instances this measure has proven socially objectionable because of unsightly appearance and odors.

Ban All Dredging. This action would have serious repercussions for both the regional economy and navigational safety, and was therefore not considered viable.

Continue Disposal to Ocean Waters. Transporting dredged materials from the excavation site to an offshore disposal area has been questioned due to potential adverse impacts on fisheries. Yet, of all currently available alternatives, ocean disposal of minimally-treated materials appears to be the least costly and may also be the least environmentally damaging. Unless new technologies

are developed it may continue to be the only viable alternative.

Recommendations for Dredged Materials Disposal.

In the 1975 summer the Corps of Engineers, as authorized under Section 404 of the 1972 Federal Water Pollution Control Act, issued for public review final interim regulations for dredge and fill activities. Regulations would require a permit from the Corps with state participation for such activities in coastal and inland waters and contiguous lands.

Until new procedures become law, the SENE Study suggests:

17. **Continue interim dredged materials disposal procedures. Until new techniques for dredged materials disposal are developed, the recommended policies regarding offshore disposal for the SENE Study area are:**

    a. **As is present practice, all proposed dredging projects shall first have exhausted all possibilities for safe on-land disposal of dredged material.**

    b. **All offshore disposal sites must be clearly identified with buoys marking only those approved sites. This is standard practice for all dredging projects.**

    c. **No polluted dredged material (as defined by EPA and the state agencies) shall be disposed of within any ocean sanctuary as defined by state or federal law. Heavily polluted dredged materials and industrial wastes which would unduly burden the aquatic environment should be placed in inland diked areas, or containerized and buried in designated disposal areas.**

    d. **Sidecast dredging of clean dredged material will continue to be permitted in selected areas.**

Possible sites identified by the Corps of Engineers, and referred to under the alternatives section, above, can be used as a starting point for selecting appropriate disposal sites.

Implications

If for no other reason than the extremely high capital costs involved, future port development plans will have to be regionwide in scope. No one port can be expected to be internationally competitive without support of the region as a whole. Competitive port development programs resulting in duplication of facilities, in spite of regional traffic projections which indicate limited regionwide demand, are in neither the national or regional economic interest. In the long-run they may not even be in the local interest. Implementation of the Study's recommendations on port development in New England will permit a degree of control over liquid and bulk commodity handling in the region and could give a significant boost to the region's shipping and cargo industries.

OFFSHORE SAND AND GRAVEL EXTRACTION

The Situation

Although the rate of increase in demand for sand and gravel is beginning to slow as highway and building construction tapers off, the overall demand for these products can still be expected to increase in the next few decades. While Rhode Island appears to have sufficient onshore sand and gravel deposits to meet its needs if properly managed, Massachusetts, specifically the Boston Metropolitan area, does not *(see Chapter 9, Locating Key Facilities).* Sand and gravel used in the Boston area is trucked in from more rural districts or hauled by rail from as far away as southern New Hampshire. The steadily increasing transportation costs of these construction materials has made the heretofore uneconomical extraction of offshore deposits more attractive in recent years.

Market and Environmental Considerations

According to studies by Schlee in 1968 and Manheim in 1972, quantities of sand and gravel sufficient to meet the region's needs for several thousand years exist off the coast of the Northeastern United States. Whether these offshore deposits are ever mined or not will depend upon two factors: (1) the delivered cost of sand and gravel from onshore deposits; and (2) the degree of public regulation to minimize adverse impacts of offshore mining operations.

Price increases of conventionally mined sand and gravel from June 1973 to June 1974 ranged from 10 to 50 percent in SENE. Moreover, in June 1974, the price of

washed and screened concrete sand was $2.33 per ton in the high-demand Boston metropolitan area. In contrast, industry experts now estimate that by 1976 far-shore sand and gravel could be extracted, processed, and delivered dockside at $1.00 per ton. Adding transportation to this dockside cost, far-shore sand and gravel could be competitive up to 30 to 40 miles inland from port of entry.

The degree to which offshore sand and gravel mining affects the marine environment varies considerably by site. Some effects are known to be minor and temporary, others major and permanent, while for others little is known. Three areas of potential conflict exist: fisheries; recreation; and navigation and communications.

Given the importance of both the commercial and sportfishing industries to the SENE region, offshore mining will require careful scrutiny and more information than is presently available. From the research which has been done to date, it appears that if mining is restricted to far-shore waters, away from near-shore shellfish beds and delicate spawning grounds, detrimental effects to the fisheries would be minimal.

The SENE region's coastal beaches are a major tourist attraction and thus a valuable economic as well as environmental attribute. According to initial investigations in 1973 by University of Rhode Island, near-shore mining in depths up to 80 feet is likely to upset the delicate natural equilibrium maintaining the natural contours of existing beaches. Mining of deposits beyond the 80 foot depth appears to have little effect on active beach movements. Additional research sponsored by the R. I. Coastal Resources Management Council will help determine more precisely the effects of such activities on the marine environment.

Much of the SENE coastline is heavily traveled by commercial, military, fishing, and recreational vessels, and the potential conflict between sand and gravel mining operations and such marine traffic generally is greater nearer the shore. Similarly, pipelines, sewage outfalls, and cable crossings line the bottom of many of the region's bays. In virtually every case, removal of such facilities to permit sand and gravel mining would be economically unjustifiable.

It should be clear from the above that the best information currently available indicates certain environmental and economic limitations to near-shore mineral extraction operations. The mining industry appears to have anticipated these problems and has focused its attention and development on far-shore mining. In addition to the need to reduce conflicts with other uses, the industry is interested in far-shore mining because: (1) far-shore waters currently lie outside of state jurisdiction; (2) ocean transport costs are low; and (3) recent technological developments have significantly increased the efficiency of mining in depths exceeding 100 feet.

Just as the need for sand and gravel minerals is increasing, Rhode Island is beginning to take some steps toward regulating marine mineral extraction. The Coastal Resources Management Council has prohibited sand and gravel mining for commercial purposes in state waters, but not for beach replenishment or navigational dredging. This moratorium will last until the Council feels sufficient data are available about how extraction can occur without conflicts with other uses of tidal waters. In fact, the Council is sponsoring a 2 year research project concerning the effects of extraction activities on the marine environment, particularly benthic communities. This information is valuable for determining the appropriate degree of regulation for extraction activities.

In Massachusetts, the Ocean Sanctuaries Act gives the Commonwealth the authority to regulate any kind of exploration, development, or activities, including sand and gravel extraction, in designated areas along Cape Cod Bay and the Islands, the North Shore, and Buzzards Bay, but falls short of designating the responsible agency. Until such time as the authorized agency is spelled out, the Coastal Zone Management Program is the appropriate agency to determine the appropriate degree of regulation for commercial extraction activities in various coastal waters.

When a survey of marine ecosystems along the Massachusetts shoreline has been completed, the CZMP should decide which are critical and require restrictions, particularly in terms of sand and gravel extraction activities. Ongoing research sponsored by the Rhode Island Coastal Resources Council about the affects of mining coastal waters on the marine environment will contribute information essential for developing such regulations.

Offshore Mining Technology.

Technological advances in offshore sand and gravel mining have resulted largely through the development and expansion of the industry in the United Kingdom (U.K.). The sand and gravel vessels currently in use range in length from 150 to 350 feet and have cargo capacities of 500 to 10,000 tons. Most of the vessels are suction hopper dredges equipped with centrifugal pumps designed to work in waters up to 100 feet deep. High quality gravel is being found in deeper water however, and many vessels are converting to jet-assisted suction pumps or pure jet pumps in order to take advantage of gravel beds in 100-150 feet of water.

Theoretically, unlimited dredging depths can be achieved with this type of equipment. Dredged material is separated and washed using underwater vibrating screens. Separated materials are discharged into a mechanically clean hopper

tank and de-watering equipment allows dry materials to be unloaded dockside. This eliminates frequent fouling from onboard seawater, previously a problem with dredges.

Commercial trailing section hopper dredges scheduled for operation around the world by 1975 range in capacity from 600 to 4,500 cubic meters. Larger dredges (up to 15,000 tons) are available. However, few coastal markets in the United States are capable of consuming such large amounts of aggregate on a sustained basis. Industry experts suggest that a dredge with a hopper capacity of approximately 7,000 tons is the most economical size unit to operate. One such dredge could deliver as much as 1.5 million tons annually, operating at sites as much as thirty to forty miles offshore. This is an amount equal to roughly 75 percent of Rhode Island's total 1972 consumption of sand and gravel, or roughly 10 percent of the projected consumption for SENE region in 1980.

The amount of onshore processing required for marine sand and gravel products depends upon the level of technology employed on the mining vessels. Highly automated shipboard operations (currently used in the U. K.) are capable of producing a complete-range of washed and sized aggregate products for delivery at port. The economic and environmental considerations appear to favor on-board processing, although it is not possible from available data to compare the dollar costs of such an operation to the alternative of onshore processing. It is also not known to what extent washing with fresh water to remove all, or some, salt from sand and aggregate is a requirement for use in asphalt or cement. Initial experiments using salt-water-washed aggregate in concrete have met engineering standards, but the industry is cautious. If fresh water washing operations are required, the economic and environmental costs will obviously increase.

As far as the industry is concerned, the key factor in determining the feasibility of offshore mining is the existence of a market within thirty miles of the unloading facility capable of consuming enough sand and gravel to make the operation profitable.

The Solutions

The objective of this portion of the SENE findings is not to provide the region with sand and gravel from offshore deposits, but should such deposits at some point be needed, to extract them at the least economic and environmental cost to the people of the region. Accordingly, several alternatives seem to be available.

Alternatives

According to the best information available on the industry, three primary offshore mining systems appear to exist:

Use Near-Shore Small Conventional Bucket Dredges. This system will require loading on barges for unloading in port, dockside processing, washing, and storage facilities. Moreover, harbor pollution from seawater discharges, and the significant environmental effects outlined earlier would constitute unacceptable problems.

Use Hopper Dredges without Onboard Processing Capability. These large vessels could operate in either near- or far-shore waters, would cause essentially the same problems as conventional dredges, but of a greater magnitude.

Use Hopper Dredges with Onboard Processing and De-Watering Capacity Operating in Far-Shore Areas. This approach, although initially expensive, would cause minimal environmental problems and require less complex dockside facilities.

Recommendations

In the event that conventional onshore sand and gravel deposits are no longer available in supplies sufficient to meet the region's construction needs, or offshore mining becomes economically competitive, the following recommendations are presented to facilitate such ventures and protect the surrounding marine environment:

18. **Develop policy and program regulating commercial mineral extraction activities in coastal waters. The Rhode Island Coastal Resources Council and the Massachusetts Coastal Zone Program should continue efforts to define a policy and program regulating commercial sand and gravel extraction in coastal waters. Massachusetts' efforts to identify critical marine ecosystems and Rhode Island's support of efforts to determine the effects of mining activities on the marine environment are essential for defining such regulations.**

19. **Coordinate future federal leasing of far-shore sand and gravel sites with coastal zone management programs of adjacent states. The Bureau of Land Management of the U.S. Department of the Interior and the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, should coordinate the licensing of far-shore sand and gravel operations with the coastal zone management programs of adjacent states in order to minimize conflicts among programs. Such licensing should consider the following criteria as requirements: (a) living resources should not be jeopardized by construction or operation of mining devices; (b) mining operations should be timed to occur in waters not used as seasonal**

spawning areas by fish; and (c) operators should be required to use latest equipment such as trailing suction hopper dredges capable of on-board processing.

20. **Develop predictive modeling techniques for offshore sand and gravel operations. The above participants should seek funding for a study to develop an interdisciplinary predictive model capable of identifying post-operational biological, chemical, and physical effects of mineral extraction on living and non-living marine resources at alternative extraction sites. The Rhode Island Marine Experiment Station is half-way to completion of a study for predicting environmental impacts of offshore mining. These kinds of efforts should help produce operational guidelines for industry regulation in order to improve offshore mining techniques and minimize adverse impacts on the fisheries resource.**

Implications

In light of the direct relationship in mineral extraction between closeness to shore and potential environmental damage, it is in the best economic and environmental interests of the SENE region for the states to virtually prohibit near-shore mineral extraction. The existing Massachusetts marine sanctuaries legislation regulates activities in almost all of the state's coastal waters except Boston Harbor. Implementation of these recommendations would assure both states equal protection. However, the program is also designed to support the far-shore mining operator, should such extraction be needed, by providing sensitive site selection mechanisms and clear operating criteria and regulations. By clarifying operating standards and identifying approved extraction sites, the program of recommendations provides opportunities for extraction while being sensitive to the importance of these same far-shore waters to the region's fishing industry, Thus, implementation would be to both the environmental and economic advantage of the region's people.

URBAN WATERFRONTS

The Situation

Perhaps one of the SENE region's most unique resources is its urban waterfronts. They provide exciting visual diversity and a variety of activities not found elsewhere. Boston, embraced by the Harbor, still retains much of its maritime flavor. It spills down in an easy walk from the State House on Beacon Hill; through the newly completed and ultra-modern Government Center; past the eighteenth-century Colonial State House, Faneuil Hall, and Quincy Markets; to Long Wharf and the ever-changing, always active, harborfront itself. Beyond lie the undeveloped islands of the Outer Harbor, major recreational resources languishing in scattered profusion within eyeshot of Beacon Hill.

A contemporary account of the 1840's is a helpful reminder of the values many are trying to reclaim for waterfront areas:

> "Our wharves . . . were in every truth water parks for the people, and contained no end of object lessons. On pleasant Sundays whole families resorted thither. On holidays and special gala occasions they were immensely attractive; each vied with the other in all manner of decoration. Every description of craft from sloop to a full-rigged ship, was rich in display of canvas and bunting. . . It was a picture that . . . can be more easily imagined than described."

The potential to recapture the waterfront's vitality lies just beneath the surface. Most of the SENE region's port cities have a curious but stimulating ambience of old and new, of progress and history, juxtaposed in a comfortable pedestrian scale. Nearly every historic port city – Gloucester, Salem, Plymouth, Nantucket or New Bedford, Providence, and Newport – have grown from early bonds to the sea. Most retain this sense of history in varying degrees alongside newer development.

Today despite the run-down condition and inaccessibility of the urban waterfront, the residents still persevere. They fish from rattling bridges. They spend their lunch hours on decaying docks. They sunbathe beneath monolithic oil storage tanks. For many, just being able to view a sliver of the harbor from their windows provides a reassuring sense of open space.

But what led to the decay? The explanation seems to be tied to the absence of a tradition of intensive multi-use of urban lands, in contrast to the heritage of European cities such as Stockholm or London. America, with its vast amounts of land, offered cheaper development alterna-

tives inland. These inland areas offered open space and amenities which the waterfronts with their commercial/industrial character did not seem to offer. But now even suburban and exurban lands are relatively expensive and increasingly remote. The remaining activity along the waterfront is now considered attractive and recognized as an important component of a varied urban life. And the waterfront offers an expanse of open space relatively rare as more and more areas are built up.

The process of decay along urban waterfronts has left a tremendous amount of land abandoned, both publicly and privately owned. Yet there appear to be no structural impediments to active waterfront use. From an architectural and construction standpoint, waterfronts can be developed economically. In fact, the juxtaposition of urban and natural landscapes provided at the waterfront has a strong, almost magnetic, appeal for a variety of legitimate uses – housing, restaurants, parks, marinas, office space, and traditionally water-based industries. Furthermore, people are now indicating a willingness to pay even more than the average market rate for housing and office space on the waterfront because of the amenities offered.

Much can be done to restore SENE's urban waterfronts. The principal stumbling blocks appear to be administrative and institutional. We need to expand the public awareness and appreciation of the unique problems and opportunities of urban waterfronts, including commercial, historic, and recreation features, as well as natural features. With an informed and aware population, priorities need to to be given to the urban waterfront and to appropriate land uses along the waterfront. We need to create new institutional mechanisms, or innovatively apply existing ones, which, coupled with dynamic leadership, can balance local, regional, and state concerns, and resolve conflicts between public and private sectors as well as between various governmental levels. Local governments need strengthened planning, regulatory and renewal capabilities, and there is a need for a strong regional or state role in land use decisions having greater than local implications. A stronger governmental role should be supported by increased public and private investment. Such investment would be consistent with the concentration of commercial and recreational markets in urban areas, plus the existing infrastructure which can bring down some costs of development.

Although several cities and towns have initiated or carried out sound programs for waterfront development or renewal, their success has occurred in spite of, rather than because of, current institutional and public policy. Most successful programs appear to have resulted from a fortuitous combination of private economic forces, concerned private citizens and public officials, and the creative use of the state and federal assistance programs. The basic legal tools exist. These give existing local, state, and federal agencies broad powers and authority to plan, fund, and carry out programs for wise use of urban waterfront areas.

The Solutions

The federally assisted Coastal Zone Management Program, for which both Massachusetts and Rhode Island have received funding, can serve as a vehicle for developing the planning and integrating management mechanisms that are required. Within the framework of the Coastal Zone Management Program, coastal urban waterfronts should be defined as areas of "particular concern", and accorded the same attention and funding priority as critical ecological or environmental resource areas in the non-urban portions of the coastal zone.

Similarly, inland urban waterfronts deserve equal attention with regard to planning and development. While passage of a National Land Use Act would facilitate consideration of inland waterway resources, appropriate federal agencies, such as HUD, should support state management programs for inland waterways that parallel the coastal zone programs.

Alternatives

Based on an investigation of eleven urban waterfront areas in the SENE region, there are three possible approaches for initiating and carrying out land use planning, and for controlling urban waterfront activities:

(1) Planning and development control activities could be carried out primarily by local governments;

(2) Local and state (or substate regional) jurisdictions could share responsibility; and

(3) State (or substate regional) jurisdictions could be the principal decision makers in the process.

Reliance on the functioning of private market forces or utilization of direct state or federal controls are conceivable theoretically, but are unlikely alternatives for urban waterfront planning and development control activities. While the economic forces of the private market are a fundamental component in any urban waterfront planning and development process, a reversal of the more than fifty-year tradition of major public involvement in planning and development actions is beyond reasonable consideration. Although various agencies of the federal government are heavily involved in funding state and local programs, setting and enforcing environmental standards, regulating and maintaining navigable waterways, and the use of federally-owned lands, direct federal control would be contradictory to the recent federal policy of state and substate leadership in planning and management.

In short, the most likely course in the SENE region is to focus on the role of local, regional (substate), and statewide agencies.

Recommendations

In light of the previously discussed options, the following actions are recommended in order to enhance the reuse of urban waterfronts in a rational and balanced manner:

21. **Coordinate local waterfront planning and development. Municipalities should prepare and inventory or plan for the long-term use, or reuse, of waterfront areas. In undertaking such activities, towns should give special consideration to factors such as the protection of flood prone areas, the preservation and enhancement of historic sites and buildings, the provision of public access easements (both physical and visual) in new development, building height, and so forth, consistent with Critical Environmental Areas** *as specified in Chapter 3, Guiding Growth.*

By integrating master planning and development control functions in urban waterfront areas, local governments can focus public interest and concern on relevant development issues and establish administrative framework at the local level.

Local waterfront master plans should incorporate appropriate implementation procedures. These could include revisions to local ordinances and the creation of urban waterfront special districts such as that adopted by the Town of Plymouth, Massachusetts. High priority land uses, as defined by the master plan and statewide guidelines, can be encouraged, while low priority land uses can be prohibited, or permitted by variance only.

While primary responsibility for initiating and carrying out land use decisions should remain at the local level, the state should perform the following critical functions.

22. **Provide guidance and set criteria for priority waterfront uses. Massachusetts and Rhode Island, through their coastal zone planning programs or state land use planning programs, should develop urban waterfront planning and management guidelines and criteria for deciding priorities for uses to be incorporated into local waterfront master plans. In arriving at priorities for waterfront uses, state programs should include the following considerations:**

    a. Water-Dependent Uses: **These require direct land-water interface and should receive first priority. Examples include port facilities and shipping; fishing and fish processing; boat yards; public access for sport, solitude, and water related recreation including swimming, boating, fishing, water skiing, surfing, and scuba diving; irreplaceable fresh water and estuarine salt marshes, flood plains, and wildlife refuges.**

    b. Water-Using Uses: **These require large volumes of water for industrial purposes or make some use of water transportation, but do not require direct waterfront locations. Examples include port storage, especially bulk fuel storage such as gas and oil which may be easily piped to inland storage locations; wastewater treatment plants; pollution control facilities.**

    c. Complementary Uses: **These positively influence urban waterfront quality and may be planned and located so as not to conflict with water-dependent uses. Examples include commercial activities, particularly fish markets, restaurants, and retail stores, which draw on, and add to, tourist trade and other waterfront activities; transportation, to the extent that it is intended primarily to service priority uses; residential housing, if it provides public access to, and along, the water's edge; education-oriented institutional uses.**

    d. Low-Priority Uses: **These neither require, nor complement, water-dependent uses and have neutral or detrimental effect on scarce waterfront resources. Their waterfront location has been determined by non-water-related economic factors such as inexpensive former mill space, good transportation, and site access. Examples include general storage facilities; transportation, particularly railroads and expressways whose water's edge location isolates large stretches of urban water frontage, and which are not designed to service priority waterfront uses.**

23. **Review and coordinate waterfront use at state and substate regional level. Massachusetts, through its regional planning agencies, and Rhode Island, through its Statewide Planning Program and Department of Community Affairs, should exercise their powers to review and re-**

vise major waterfront development proposals of more than local concern. Such review and revision should be coordinated with state coastal zone management programs when coastal projects are involved. Impact statement reports should be prepared which document anticipated effects and outline corrective measures required to eliminate, or reduce, adverse impacts. Specifically, state and substate regional planning agencies should:

a. Review, concur in, and assist in financing the preparation of local waterfront master plans, zoning ordinances, and related implementation procedures to the extent that regional or statewide interests are involved.

b. Review and approve the location and design of major development projects or other major changes in land use or activities having significant effects in more than one local jurisdiction.

c. Mediate major conflicts or differences between governmental jurisdictions that may result from, or affect local land use decisions.

d. Coordinate the allocation of regional or statewide development and funding assistance programs (including land acquisition, physical facility, and administrative assistance programs) and articulate regional or statewide funding priorities regarding the importance of urban waterfronts vis-a-vis other competing recipients of financial aid.

e. Review federal agency programs and funding patterns in view of regional or statewide funding priorities and recommend adjustments where appropriate.

24. Support state and local waterfront development plans. The U. S. Congress and The Office of Management and Budget should approve adequate federal funding for state coastal zone planning programs and for other planning programs which enhance waterfront redevelopment. Other federal planning programs and project development activities should be consistent with state or regional policies, as well as with local needs, expressed in urban waterfront plans and programs. Exceptions in the national interest should be agreed to in the context of state coastal zone programs and statewide land use programs or policies.

Implications

Implementation of coordinated local and state approaches to waterfront use should help to minimize fragmentation of decisions in waterfront areas while recognizing the appropriate roles of the different levels of government. Agreement on appropriate guidelines and priorities should help to reduce conflicts between uses and increase the chances for a variety of uses along urban waterfronts.

More sensitive and sensible use of waterfronts will reinforce the use of existing infrastructure and help to reutilize urban areas which have considerable economic and aesthetic potential.

Flooding and Erosion

8

CHAPTER 8 FLOODING AND EROSION 8-1

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CHAPTER 8 FLOODING AND EROSION

The Setting

Southeastern New England, with many of its major population centers clustered along the coastline, is particularly susceptible to tidal flooding. The region has a long history of severe damage from hurricanes and "northeasters." In contrast, damages from inland riverine flooding are local in nature and usually less severe, largely because there are still extensive inland wetlands in the region which serve as natural valley storage areas holding and slowing unusually high flood flows. If they resist the temptation of filling and developing these wetlands and flood plains, the people of the SENE region have the opportunity to minimize future riverine flood damages. However, in the Pawtuxet and Blackstone planning areas, where past flood damages have been high and fewer natural valley storage areas occur, other solutions will have to be considered.

Flood control policy has been set at the national level by such directives as Executive Order 11296 and related flood hazard evaluation guidelines. The Department of Housing and Urban Development's National Flood Insurance Program has reinforced the growing realization around the country of the need to recognize the importance of anticipating and avoiding flood damages. Planning and construction programs of the U. S. Army Corps of Engineers (including major structural protection projects such as dams, dikes, and diversions), related programs of the Soil Conservation Service (in the U. S. Department of Agriculture), as well as state laws to protect wetlands and some coastal areas, and local zoning and other regulations, offer the basic framework for flood plain management.

Strengthening these current programs is the recently-passed Water Resources Development Act in which Section 73 authorizes federal cost sharing for non-structural solutions. One of the three major examples in the country of the kinds of non-structural measures that could be considered under Section 73 authority, is in the SENE region. The Corps of Engineers Charles River Watershed Project (authorized prior to the passage of Section 73) calls for federal acquisition of over 8400 acres of wetlands. Although implementation of Section 73 has presently been deferred by the Office of Management and Budget (OMB), application of the cost sharing authority is expected to be an important factor in using non-structural solutions, especially in flat riverine areas and exposed coastal areas where structural measures are often not economically feasible.

The conclusions of *Chapter 3, Guiding Growth,* provide the basis for the recommendations in this chapter. Flood plains, wetlands, coastal flood hazard areas, beaches, and critical erosion areas are all classified as Critical Environmental Areas – lands which are either too fragile to support any development, or whose development would constitute a hazard to public health and safety. At the same time, *Chapter 6, Outdoor Recreation,* has shown that many of these critical areas can serve to meet important recreation needs throughout the region. *Chapter 10, Strengthening the Management System for Natural Resources,* presents the relationships between implementation aspects of this chapter's recommendations and those of other report chapters. *Chapter 11, Tying the Recommendations Together,* describes the implications of recommendations in this chapter to those described in other chapters of this report.

COASTAL AND INLAND FLOODING

This section of the chapter examines the extent of the flooding problem in SENE, and focuses on ways to control appropriate uses of inland and coastal flood plains, within the context of a comprehensive flood plain management planning process which considers both structural and non-structural measures for reducing flood damage.

The Situation

Extent of Flood Damages

According to the North Atlantic Regional Water Resources Study (NAR) of the Corps of Engineers, average annual damages in the SENE region were about $10 million in 1966. As indicated above, SENE's major cities – Providence, Fall River, New Bedford, and Boston – are particularly vulnerable to coastal storms. The same is true for the dozens of smaller communities which line the SENE coastline. According to the NAR Study, the worst damages have been caused by hurricane tidal flooding. The hurricane of August 1954, for example, caused flood damages estimated at $70 million along the Rhode Island Coast and within Narragansett Bay. In fact, Narragansett Bay, and Providence in particular, is a classic example of an area highly susceptible to tidal flooding. It is a large, low-lying urban area, at the

end of a funnel-shaped estuary. In addition, it is at the mouth of a river with relatively heavy and rapid runoff. Finally, it is an area of substantial tidal range and opposite a long fetch of deep water, where huge storm waves can be generated. These factors, combined with the fact that Rhode Island's coastline is in the historical track of hurricanes, explain, to a great degree, the reason for the area's past history of high tidal flood damages.

While the southern coast of SENE is susceptible to hurricanes, the most frequent causes of tidal flood damages in the northern coast communities – from Newburyport to Plymouth, Massachusetts – are the region's famous "northeaster" coastal storms. A 1960 Corps of Engineers report describes the tidal flooding and wave action effects of the December 1959 northeaster on shoreline structures, protective installations, beaches, private properties, highways, and utilities. According to that report, the storm caused total estimated damages of $6 million along the coast, including $1 million in Boston.

Although riverine flooding has occurred in many communities in the SENE region (see Table 8.1 and Figure 8.1), only two planning areas, the Pawtuxet and Blackstone and Vicinity, have had serious inland flooding. Based on flood losses experienced in the lower nine miles of the Pawtuxet River (Cranston, Warwick, and West Warwick, Rhode Island) the Corps of Engineers has estimated that a 100-year frequency flood would cause nearly $15 million in damages today, and nearly $18 million in 1990 even with no growth, thereby reflecting changes in flood stage created mainly by urbanization elsewhere in the watershed. New development above the 1970 100-year flood level would be subject to an additional $9 million of damages. This is again because the 100-year level is expected to rise, meaning higher flood stages.

Within the Blackstone and Vicinity planning area, riverine flood damages have been more severe than anywhere else in the Study region. The 1955 flood caused $65.5 million in damages in the planning area. A recurrence of the 1955 flood of record in the Blackstone River basin would result in damages estimated at more than $26 million (in 1972 dollars). Elsewhere in the planning area, a recurrence of the 1968 flood of record would today cause damages exceeding $1 million in the Ten Mile River Valley, $300,000 in the Woonasquatucket Valley and only $100,000 in the Moshassuck Valley. Without the existing structures, however, the damages in the entire planning area would total $88.8 million. A list of coastal and inland flood damage centers is presented in Table 8.1 and also shown in Figure 8.1.

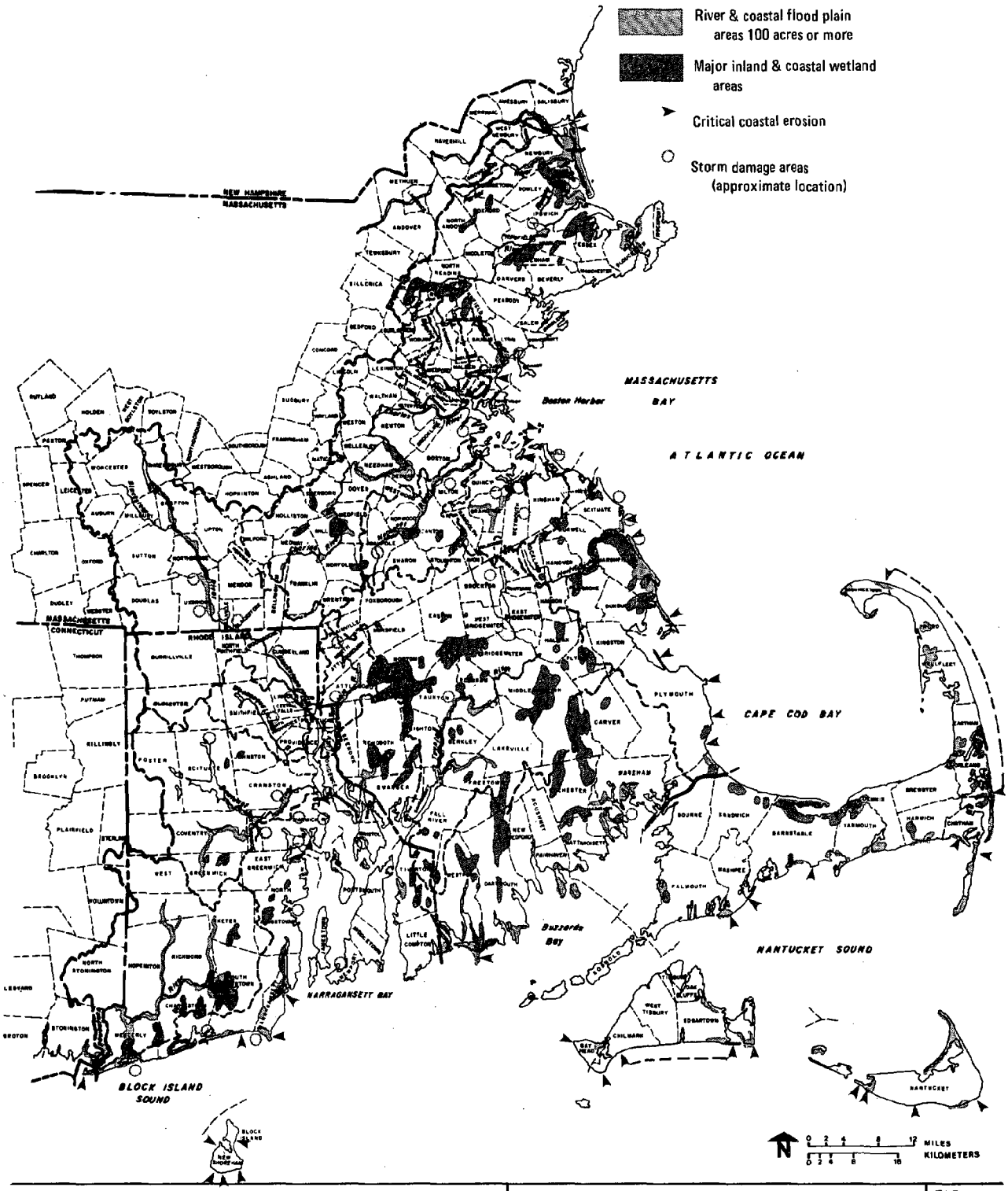
Causes of Flooding

The major contributing factor to the steadily increasing flood damages in SENE is the region's traditional pattern of settlement. As discussed in *Chapter 2, The Setting,* SENE's coastal waters and inland streams were major transportation routes and largely determined the location of industrial and secondary development. During the rapid industrialization of the region in the 19th century, the level topography of the flood plain was – as it continues to be – highly valued for commercial, industrial, and residential development. The encroachment of urban development on the flood plain has, in several parts of the region, increased the normal rate of precipitation runoff

TABLE 8.1 INLAND AND COASTAL FLOOD DAMAGE CENTERS

Inland Flood Damage Centers		Coastal Flood Damage Centers	
Ipswich	Northbridge	Ipswich estuary	Providence River
Wilmington	Uxbridge	Lynn Harbor – Saugus	Riverside
	Millville	Revere	Cranston
Boston	Blackstone		Warwick
Cambridge	Cumberland	Hull	Greenwich Bay
Newton	North Providence		Wickford Harbor
Quincy		Scituate	Point Judith
Milton	North Attleborough		Middletown
Walpole	Attleboro	Wareham	Newport
Braintree	Seekonk	Marion	Lower Narragansett Bay
Weymouth	East Providence		
		Mount Hope Bay and Fall River	Southern Coast of Rhode Island
Brockton		Warren	
Taunton		Bristol	
	Cranston	Barrington	
	West Warwick		
Lincoln (RI)	Warwick		

Source: U.S. Army Corps of Engineers



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

WETLANDS & FLOOD PLAINS
EROSION & STORM DAMAGE AREAS

FIG. NO. 8.1

and reduced the capacity of the region's rivers to handle higher flows from spring thaws and heavy rainfall. Table 8.2 presents estimated inland and tidal *flood plain* acreages for each of the ten SENE planning areas, based on a 100-year frequency storm. Altogether, the SENE region has an estimated 340,000 acres of tidal or inland flood plains, roughly 12 percent of the total area of the Study region. Flood plains are included in map category "B" on Plates 1, 2, and 3, found at the back of this report.

Also contributing to the region's increasing flood damages is the steady destruction of upstream wetlands which, under normal circumstances, serve to retain and slow seasonal or storm-related flood flows. In 1970, the SENE region had nearly 291,000 acres of fresh water wetlands (including some 67,000 acres of open fresh water wetlands) and 44,500 acres of coastal wetlands. These figures represent a decline of 6 percent of the region's open fresh water wetlands and a loss of nearly 14 percent of the salt water wetlands since 1960 *(see Table 3.1 in Chapter 3).* Together they constituted about 12 percent of the total area of the Study region. As might be expected, those planning areas experiencing the most severe flooding are also the areas with the least remaining upstream wetlands. Only 7 percent of the land area of the Pawtuxet planning area and 9 percent of the Blackstone and Vicinity planning area is in wetlands. This fact, plus hilly topography in the Blackstone planning area, tends to reinforce the occurrence of high flood flows. In contrast, approximately 18 percent of the land area of both the relatively flat Ipswich-North Shore and Taunton planning areas is in wetlands.

Wetlands have a number of other important values. Some wetlands overlie valuable sources of ground water. They are among the most productive environments for plants and wildlife. Coastal wetlands act as stabilizers of shorelines and first line buffers for storms and flood damage. Moreover, wetlands offer important recreational, scenic, aesthetic, and educational values.

The sensitivity of wetlands to destruction by any kind of development is great. Draining, filling, or paving destroys a wetland's ability to store water and therefore destroys its value for flood control, ground water recharge, or wildlife habitat. Even development on the higher areas surrounding wetlands can cause pollution, erosion, or other problems which disturb the effective functions of wetlands.

Table 8.2 displays the relative distribution of *wetlands* in each of the ten planning areas of the SENE Study region. Figure 8.1 shows the location of major *wetland* areas. Wetlands are included in map category "A" – Critical Environmental Areas – on Plates 1, 2, and 3 found at the back of this report. Both Rhode Island and Massachusetts have established innovative new legislation for the protection of valuable wetlands. These programs and their current weaknesses are discussed in the *Ongoing Programs* section which follows.

Principal Existing Flood Control Structures

In those few areas of the SENE region which have histories of flooding, a number of major flood control structures

TABLE 8.2 DISTRIBUTION OF MAJOR FLOOD PLAINS AND WETLANDS IN SOUTHEASTERN NEW ENGLAND (in 1000's of acres)

Planning Area	Inland Flood Plains	Tidal Flood Areas	Total Flood Plains	Freshwater Wetlands**	Saltwater Wetlands	Total Wetlands
Ipswich-North Shore	20	24	44	33	15	48
Boston Metropolitan	39	8	47	46	1	47
South Shore	15	15	30	12	5	17
Cape Cod & Islands	*	8	8	11	15	26
Buzzards Bay	18	18	36	27	5	32
Taunton	33	3	36	60	*	60
Blackstone & Vicinity	40	1	41	37	*	37
Pawtuxet	16	0.5	16.5	13	*	13
Narragansett Bay	21	21	42	21	2	23
Pawcatuck	28	11	39	31	1	32
Total	230	109.5	339.5***	291	44	335***

* Negligible
** Includes both open and wooded wetlands.
*** Some wetlands areas (A resources) are also included in flood plain areas (B resources). For the region as a whole, all B resources not in A resources total an estimated 420,500 acres (see also Chapter 3, Guiding Growth). These figures are rough estimates based on 1970 data supplied by the Corps of Engineers.

have been built or are under construction. A major portion of the costs of these projects has been federally funded. These structures, listed in Table 8.3, are primarily in the Blackstone planning area, the region's principal riverine flooding damage center.

Two Corps of Engineers coastal hurricane survey reports were published in the mid-1960's, one for Rhode Island and the other for Massachusetts. In both reports, the Division Engineer concluded that no further federally supported structural protection projects could be justified at the time.

Despite the extremely high tidal flooding damages incurred in Rhode Island and coastal Massachusetts, four flood damage reduction projects are being considered for deauthorization by the Corps of Engineers due to lack of non-federal financial support. In Massachusetts, the Wareham-Marion project (Buzzards Bay planning area) has been proposed for deauthorization. Authorized in 1962, this was a $6.6 million project (1965 estimate). In Rhode Island, three projects are being considered for deauthorization: Pawtucket (in the Blackstone and Vicinity planning area) authorized in 1944 with an estimated 1974 cost of just under $1 million; Point Judith (in the Narragansett Bay planning area) authorized in 1962 with an estimated 1966 cost of $7.4 million; and Westerly (in the Pawcatuck planning area) authorized in 1965 with an estimated 1974 cost of $10.9 million. The Governor of Rhode Island has requested that alternative measures be explored before the three Rhode Island projects are deauthorized. In addition, a $2.5 million tidal flood control project, proposed and authorized for Narragansett Pier, Rhode Island, has been officially deauthorized, again because of lack of non-federal support.

The major projects completed or under construction, combined with a number of smaller local protection works, are expected to significantly reduce damages which may be caused by a recurrence of floods of record in the region's major riverine and tidal flood damage centers. Apparently, state and local officials in those areas where major coastal flood control structures have been deauthorized prefer to take non-structural steps to reduce future losses, and to some extent, accept a degree of tidal flooding damages rather than make further public investments in structural solutions.

Ongoing Federal Programs

Flood plain management policy has been stated at the federal level with such directives as Executive Order 11296 and related flood hazard evaluation guidelines, which called on all federal agencies to recognize flood hazards in their construction and grant programs. Further, the U. S. Water Resources Council has provided national direction for integrating many federal programs through its Unified National Program for Flood Plain Management, which calls for full consideration of non-structural, as well as structural, techniques in evaluating flood control projects. The EPA and U. S. Department of Agriculture also have policies to protect the nation's wetlands.

More recently, this national direction has been reinforced by the passage of the Water Resources Development Act of 1974, in which Section 73 requires that any federal agency engaged in the survey, planning, or design of any project involving flood protection give consideration to non-structural alternatives to prevent or reduce flood damages. It also authorizes federal cost sharing in non-structural project costs. Implementation of Section 73 has been deferred by OMB until concerned agencies, under the aegis of the U.S. Water Resources Council (WRC), have considered questions of sound methods of economic analysis of non-structural alternatives.

TABLE 8.3 MAJOR FLOOD CONTROL PROJECTS IN SOUTHEASTERN NEW ENGLAND

Project	Planning Area	Total Cost ($million)	Date Completed
Charles River Dam	Boston Metro	$40.0*	**
Amelia Earhart Dam	Boston Metro	17.0***	***
New Bedford	Buzzards Bay	18.6	1966
Fox Point (Providence)	Blackstone	15.9	1966
Worcester Diversion	Blackstone	6.0	1960
West Hill Dam	Blackstone	2.4	1961
Upper and Lower Woonsocket Projects	Blackstone	14.0	1959-66

* Estimated cost.
** Under construction
*** Includes $6 million for a pumping station and related equipment and engineering costs. The dam was completed in 1969; the pumping station is scheduled for completion in 1976.

Section 73, by authorizing federal cost sharing for non-structural measures, offers federal agencies the opportunity to actually carry out non-structural projects. While federal agencies have been considering non-structural measures as part of their planning processes, these agencies have frequently chosen structural measures for federal implementation, recommending associated non-structural measures for state, local, and private action. This is because the authorities under which federal agencies have participated in flood control projects have been worded in such a way as to require that non-structural solutions would be a non-federal responsibility. An important exception is the Charles River Study, of the Corps of Engineers, which calls for federal acquisition of the important natural valley storage areas of the Upper Charles as a multi-purpose project for flood control, recreation, and fish and wildlife management. Previously, federal authority for funding flood control projects was often based on the provision by non-federal participants of the costs of lands, easements, rights-of-way, and utility modification and relocations. Examples of non-structural measures now being considered for cost sharing under authority of Section 73 are land acquisition, open space preservation, permanent evacuation and relocation, warning systems and temporary evacuation, and flood proofing.

Other major federal programs for flood control and flood damage reduction are described below.

Housing and Urban Development. Under the National Flood Insurance Program, administered by the federal Department of Housing and Urban Development (HUD), state and local communities with flood prone properties are required, as a condition of future federally related financial assistance for building, construction, or acquisition within the HUD-identified flood hazard area, to participate in the Program by adopting adequate flood plain ordinances with effective enforcement provisions. New development in areas of special flood hazard would not be excluded, but would be subject to special construction and building material requirements, more careful siting and drainage, special treatment of wastewater disposal systems, and elevation of the first floor above the level of the 100-year flood. All Massachusetts and Rhode Island communities have been declared flood prone. Each state has designated contacts to assist municipalities in meeting HUD requirements.

Corps of Engineers. The Corps of Engineers is conducting a number of flood control studies such as Section 205 flood control studies, the Charles River Watershed Program, the Quincy coastal stream studies, and the PNB Study. The PNB (Pawcatuck-Narragansett Bay) Study area covers nearly five SENE basins: The Pawcatuck (except the south coast of Rhode Island), Narragansett Bay, Pawtuxet, Blackstone-Ten Mile-Woonasquatucket-Moshassuck, and Taunton. Authorized shortly after the major storm of March 1968, the PNB will have as its initial emphasis the development of comprehensive flood management programs. Priority is being given to the Pawtuxet, and the Blackstone-Ten Mile-Woonasquatucket-Moshassuck basins, which suffered the most extensive damage in the 1968 floods. Preliminary drafts of the final reports for these two planning areas are expected in 1976.

The Corps is attempting to broaden the PNB Study in accordance with newly promulgated guidelines for urban studies, to include wastewater management, urban flood control and flood plain management, municipal and industrial water supply, extensive flood protection, navigation, water related recreation, and conservation of fish and wildlife resources. The reoriented study requires confirmation by the two states and the federal EPA.

USDA Programs. The federal Soil Conservation Service (SCS in the U. S. Department of Agriculture) is studying several projects under PL-566, which authorizes SCS to develop flood plain management and flood damage reduction programs. Under study in the Woonasquatucket portion of the Blackstone planning area are one multi-purpose structure for recreation and flood control, two floodwater retaining structures, and some stream channel work. Two flood retaining structures and some channel improvements are under consideration for the Moshassuck. On the Ten Mile River, a PL-566 investigation includes study of the Bungay River flood control reservoir and the Manchester Pond diversion. Further discussion of these projects is contained *in the planning area reports.*

The U. S. Department of Agriculture (USDA) also participates in three Resource Conservation and Development (RC&D) Projects in the SENE region. Areas covered are the three Connecticut towns in the region, all of Rhode Island, and Bristol, Plymouth, Barnstable, Dukes, and Nantucket Counties in Massachusetts. These programs are flexibly designed to bring federal and, to some extent, state expertise to rural localities to manage a variety of resource problems. The programs have been project-oriented and include the following categories: critical area treatment, flood prevention, water-based fish and wildlife and recreation developments, land drainage, accelerated soil surveys and other services; technical and financial assistance is available under the program. The projects are joint efforts of state natural resources agencies, conservation districts, and regional planning agencies, assisted by the USDA, and other federal, state, county, and local agencies and groups.

National Weather Service. Hurricanes no longer sweep ashore without warning. New aids available to the National Weather Service Hurricane Center include photographs from NASA's Applications Technology Satellites, an improved

pattern for aircraft reconnaissance, and a computer program to identify the coastal area most likely to be affected. Combined with improved radar coverage, the new techniques permit watch times up to 36 hours and warning times of 15 to 18 hours. New forecasting techniques developed by the Hartford River Forecast Center and the addition of a well located radar at Chatham, Massachusetts in the late 1960's have materially improved both the accuracy of the flash flood warning service and the precision of the stage and crest forecasts for locations on the major streams in the SENE area.

Ongoing State Programs

At the state level there are several programs for protecting natural valley storage areas. In Massachusetts, these include the Wetlands Protection Act and the Massachusetts Self-Help Program. In Rhode Island the programs include the Fresh Water, Intertidal Salt Marsh, and Coastal Wetlands Acts, the Green Acres Land Acquisition program, and special components of the state's coastal zone management program. Additional federal sources of financing, sometimes used in conjunction with these state programs, are the Land and Water Conservation Fund, a program authorized through the National Historic Preservation Act, revenue sharing, and the Migratory Bird Conservation Fund.

As discussed in *Chapter 3, Guiding Growth*, the critical nature of wetlands as a resource has long been recognized in Massachusetts and Rhode Island, and both states have developed innovative programs for their protection. Detailed analysis of the Massachusetts Wetlands Protection Act (Chapter 131, Section 40) done for the Study identified several inadequacies in the present law which, if corrected, would make the law even more effective:

(1) The present law is unclear regarding Conservation Commission authority to conditionally grant, or completely deny, an application to alter a wetland;

(2) The present law limits the review of the Conservation Commission to the area and activity covered by the application, rather than to the entire watershed or aquifer;

(3) Conservation Commissions for the most part, have neither the necessary training and experience to properly administer the law, nor the financial resources to hire outside consultants;

(4) Although the legislation presently includes penalties for violations, illegal activities persist. This situation suggests a need for stronger penalties.

(5) The present Act will not protect many areas which are potentially major sources of fresh water supply; and

(6) Due to budgetary and manpower limitations, the number of Natural Resource Officers is not adequate for the enforcement needs of the entire state.

An additional weakness regarding the agricultural exemption has been corrected by the adoption in June 1975 of an amendment allowing the exemption only for those agricultural lands actively devoted to such uses.

Similar evaluation was made of the Rhode Island Coastal Wetlands Act, Intertidal Salt Marsh Act, and Fresh Water Wetlands Act. Recommendations resulting from these analyses are included in a subsequent section of this chapter.

State Departments of Public Works can be requested by municipalities to conduct studies and carry out flood protection projects. But in recent years, in Massachusetts for example, state funding has not been approved.

The federal and state programs described above can go a long way toward keeping down future flood damages. But unless present rates of development in flood plain and wetland areas are actually curtailed, flood losses could well approach the NAR estimates.

The Solutions

According to the Corps of Engineers' North Atlantic Regional Water Resources Study (NAR), average annual flood damages are expected to increase from $10 million in 1966 to $60 million by 2020 if development continues in classic patterns and no flood damage reduction steps are taken. The NAR Study developed two plans to reduce these damages, one emphasizing an environmental quality objective, the other an economic efficiency and regional development objective. Under the environmental plan, the 2020 flood damages would be reduced from $59.12 million to $6.33 million, $44.29 million reduced through non-structural measures, and $8.5 million through structural measures. Under the economic plan, 2020 damages would be reduced to $6.02 million, $42.13 million through non-structural, and $10.97 million through structural measures.

Alternatives

Using the NAR findings for guidance, the SENE Study considered three basic methods of meeting the objective of reducing flood damages: (a) controlling uses of the land (non-structural solutions); (b) bringing the river (or ocean)

under control through structures; and (c) protecting people and buildings already in the flood plain. Each of the alternatives is discussed below.

Controlling Uses of the Land Using Non-Structural Controls. The principle behind land use controls or "non-structural measures" is to keep people away from flooding, rather than flooding away from people. The philosophy behind these measures is that it is unwise, indeed generally futile, to try to place a natural system, such as a river and its watershed, under structural control. These non-structural land use control measures include *flood plain zoning, wetlands protection, subdivision regulations,* and *building code restrictions.* Recent federal initiatives (as detailed in the *Ongoing Programs* section above) have stressed that it is far more economically efficient to prohibit adverse development from entering the flood plain in the first place, than to provide disaster assistance and ultimately construct flood control structures after the fact. The National Flood Insurance Program does require adequate flood plain zoning with effective enforcement provisions.

Because of its importance to flood damage reduction, several options for wetland protection were investigated. The alternative of giving full control of wetlands to the state was rejected because, while it would have an effect similar to the action discussed under the recommendations section below, it provides no mechanism for local participation. The alternative of allowing full control of wetlands by municipalities was rejected because existing local incentives are strong for development and weak for protecting natural valley storage areas. Municipalities have always had the right to control wetlands through zoning, but few have made significant attempts to protect wetlands in the past. The alternative of recommending regulatory agencies to control development of wetlands was rejected because, while in theory it is an ideal solution to reduce the loss of wetlands, it would be difficult to organize and implement such a program. In addition, two other approaches to wetland protection were the formation of regional conservation commissions made up of representatives of each conservation commission in the region; and innovations in zoning by-laws, such as a model aquifer by-law which could also protect some wetlands.

Bringing the River (or Ocean) Under Control Using Structures. The major types of structural controlling measures applicable to SENE basins are flood water diversions, sea walls and dikes, and dams and flood control reservoirs. These corrective flood control measures remove, retard, or contain, excessive runoff during riverine flooding, or block rising tidal floods. Other structural measures considered possible were removal of dams, channel improvement, and urban redevelopment.

However, the generally low topography of the SENE region is particularly unsuitable for most structural solutions. Areas such as the Taunton planning area, with flat terrain, extensive wetlands, and numerous small tributary streams, offer no suitable major dam sites. Moreover, state and local officials have begun to express a preference for non-structural controls where such measures can resolve flooding problems. In Narragansett Bay, the scene of extensive tidal flood damages in the past, the Corps of Engineers' 1965 Hurricane Survey Report indicated that the most effective protection for Bay communities would be a series of barriers across the Lower Bay. The project met with considerable local opposition because of concern that the barriers would hinder navigation and the ecology of the Bay, and would be unacceptably costly. The Corps' PNB Study, however, may provide further insight into those areas of Rhode Island where structural flood controls will provide protection to development of major economic significance.

Protection of Existing Development Already Subject to Flooding. There are several measures for protecting or reducing damages to people and their buildings already in the flood plains. Flood proofing is severely limited in its application by cost. Even where economically feasible, lack of financial assistance can limit its use. It should, however, be more widely used as cities and towns pass new flood plain ordinances and building code modifications to qualify for the flood insurance program. Relocation was found to be uneconomical as strictly a flood damage abatement measure. But where recreational and other benefits could be derived as well, particularly along beaches, relocation of flood prone buildings becomes much more feasible. Weather modification was rejected mainly because changing nature assumes a risk considered unacceptable.

One of the beneficial ways of trying to ameliorate the damaging effects of storms and flooding is a proper warning service which seeks to improve the observation, understanding, and prediction of storms. It also includes the dissemination of knowledge quickly and widely, as well as guiding the community in its use. Such a system ensures tremendous benefits but it needs sufficient money and personnel to operate. While the many benefits to the communities are difficult to evaluate, estimates of average annual flood losses avoided because of warnings range from 30 to 40 percent (based on two studies of New England sites outside the SENE region). The National Weather Service estimates its annual cost in providing the flood warning service to all of the SENE area at $30,000.

Alternative Plans

The recommended policies and actions are based on analysis of two feasible alternative plans. The *first* alternative plan was aimed at reducing flood damage costs below existing levels using solutions which maximized reduction of flood damage costs. Included were actions and policies to protect development from flooding using structural solu-

tions, requirements of the National Flood Insurance Program, and protection of some natural valley storage areas – whichever yielded maximum benefits. The *second* alternative plan accepted a higher degree of damages and was aimed at keeping current levels of damages from rising; there was not as much emphasis on reducing costs as in the first alternative. Policies and actions were designed to protect flood prone areas from development with an emphasis on non-structural solutions including maximizing flood plain and wetlands protection.

Recommendations

To summarize, the recommended policies and actions contain elements of both alternative plans. However, non-structural measures are emphasized wherever possible. There are several reasons for this approach: (1) it is sensitive to the natural roles that wetlands and flood plains play in flood water retention and their particular susceptibility to the damaging forces of nature (as further indicated in SENE's classification of both wetlands and flood plains as critical resources); (2) it reflects the finding in *Chapter 3, Guiding Growth,* that future growth in the region can be accommodated without using wetlands or flood plains; (3) it takes advantage of the relative importance of non-structural measures in reducing flood damages, as demonstrated by the NAR analysis (reducing some 75 percent of estimated future damages); (4) it recognizes the importance of Section 73 of the Water Resources Development Act of 1974 which authorizes federal cost sharing in non-structural solutions; (5) it recognizes that a number of structural measures that have been under consideration since major recent storm damages have occurred have already been approved, or are still under study; and (6) it notes that non-structural measures generate multiple benefits in terms of recreation, water supply, and preservation of landscape quality. Only where existing development is of significant importance to the economy or social well-being and non-structural solutions are not practical should structural measures be used.

In keeping with the Study recommendation in *Chapter 3* that flood plains be classified in category B and wetlands in category A, the overall SENE policy is:

1. **Prepare flood plain programs with non-structural emphasis. Comprehensive flood plain management programs should be developed for riverine and coastal flooding areas. Such programs should make use of non-structural solutions wherever possible.**

This approach is designed to protect undeveloped flood plains and wetlands in their natural state. It is intended that balanced consideration be given to structural solutions and that such measures be used selectively where non-structural solutions are no longer available.

Areas particularly appropriate for development of such comprehensive flood plain management programs include the Ipswich River and the Neponset River in Massachusetts. As mentioned earlier, such programs are being developed for five SENE planning areas as part of the PNB Study. All such programs should be developed in close cooperation with states and municipalities, and be coordinated with related programs such as the National Flood Insurance Program, forecasting services of the National Weather Service, state wetlands acts, state land use planning programs, and for coastal areas, with state coastal zone management programs. Completed flood plain management programs should be made part of state level land use and coastal zone management programs. These management programs offer an opportunity for assuring that the flood plain management recommendations are carried out. Actions by federal and state agencies should be consistent with these flood plain management programs.

The specific recommendations of the SENE Study are divided into (a) non-structural and (b) structural measures.

Non-structural Recommendations. The description of the recommendations which follow presents actions first for flood plains and then for wetlands in particular. There are several non-structural measures applicable to the SENE area. It is recommended to:

2. **Adopt local flood plain zoning to regulate new flood plain construction. Municipalities should adopt flood plain zoning to prevent adverse development in flood prone areas (particularly in the 100-year floodway) as defined under the National Flood Insurance Program.**

Municipal flood plain zoning regulations should take advantage of guidelines and restrictions under state wetlands legislation, scenic rivers designation, soils map information, etc. Zoning in those municipalities with coastal flood prone areas should complement the state coastal zone management programs as those programs are developed. HUD is considering new ways of delineating coastal storm hazard areas in order to make the mapping process and insurance rates more accurately reflect local conditions. Maps upon which the zoning is based should include, in addition to the 100-year flood level and floodway: wetlands, storms of record, erosion areas, barrier beaches, beaches, scenic river zones, and soils information.

There are three important reasons for this approach: (a) the development capability analysis of *Chapter 3* has shown that, for the region as a whole, there is enough land to accommodate expected development without encroaching on Critical Environmental Areas which include flood plains; (b) flood plain lands can be used, as described in

Chapter 3, for other important uses, such as agriculture and recreation, which do not alter or increase channel capacity; and (c) ongoing flood control studies have shown that predicted growth outside the present 100-year flood plain is expected to raise future flood heights.

Together with flood plain zoning,

3. **Establish local regulations to control runoff and erosion. Municipalities should establish subdivision regulations and building code restrictions which include control of the effects of stormwater runoff to control erosion and sedimentation; included in the regulations should be guidelines for on-site water detention basins in new construction to reduce peak runoff, which can also serve as ground water recharge basins and perhaps recreational ponds.**

These regulations and restrictions should be consistent with, and meet the requirements of, the National Flood Insurance Program. These regulations should also require that local interests submit for approval by the Town Planning Board and Conservation Commission any proposed alteration or modification of existing roadways, utilities, and bridge or culvert openings which could affect drainage characteristics.

To reinforce local flood plain zoning and regulations, appropriate agencies should:

4. **Provide technical assistance to local officials.**

Programs to assist local planning boards, town councils, and conservation commissions in mapping zoned areas and in carrying out the intent of the regulations, have been set up jointly by such agencies and organizations as the Massachusetts Executive Office of Environmental Affairs, the Rhode Island Department of Natural Resources, regional planning agencies, the Massachusetts Association of Conservation Commissions, and the Massachusetts Federation of Planning Boards, all in cooperation with the County Extension Service. Flood plain identification studies are conducted by the SCS, Corps of Engineers, and U. S. Geological Survey.

5. **Acquire significant flood plains and wetlands. States or municipalities should acquire flood plain areas (including wetlands) for uses not subject to flood damages or for maintenance in an undeveloped state.**

Because it is expensive, acquisition should be used where multiple benefits are achieved. Among the considerations for acquisition should be public and private costs avoided, the economic impact of removal from the real estate tax rolls, and the need for public access to the shoreline.

Other, less expensive means of acquiring land include purchase of development or conservation easements, purchase through sale and saleback or leaseback, and purchase with life tenancy.

Acquisition could also be considered for buffer lands around important wetlands. Financing could be sought through the several programs mentioned in the previous subsection on ongoing programs. Additional sources of federal funding may become available through the cost sharing provisions of Section 73.

Unique natural and cultural sites are included by the SENE Study in its Critical Environmental Area classification (categories A and B). Unique cultural sites on flood plains could be protected by public purchase or other restrictions financed through the National Historic Preservation Act. Those wetlands and flood plain areas designated as unique natural sites have also been proposed for protection; techniques are discussed in a report on the Natural Areas Project of the New England Natural Resources Center. Further discussion on acquisition of flood plain and wetland areas is contained in *Chapter 6, Outdoor Recreation.*

6. **Locate in existing safe buildings in the flood plain. Where development outside the flood plain is not feasible, municipalities should encourage private interests to consider locating in existing safe buildings in the flood plain, rather than permitting new construction in the flood plain.**

Flood proofing, especially of existing buildings, is particularly appropriate where only moderate flooding is expected, where other types of flood protection are not feasible, or where activities requiring a waterfront location need some degree of protection. All wastewater treatment plants in flood prone areas must be flood proofed.

7. **Require relocation out of flood plains where appropriate. Local regulations and state guidelines should also require, as they are reviewed or expanded, relocation of facilities presently located in areas vulnerable to flooding where structural protection is not available or practical and where flood proofing is more expensive than relocation.**

High priority for planning attention and funding for relocation should be given to state and federally-financed facilities such as hospitals and schools, and particularly those structures in the flood way.

Through flood plain zoning and building code restrictions,

8. **Discourage reconstruction or redevelopment after storm damage. Municipalities should discourage or prohibit recon-**

struction or redevelopment after substantial storm damage, particularly in high hazard storm areas and along barrier beaches.

Further,

9. **Update and establish flood warning and evacuation programs. Municipalities, guided by state-level Civil Defense programs, should review, update, and in some cases establish, programs for warning and evacuation.**

Such programs should take advantage of the forecasts and warning systems of the National Weather Service, including NWS-directed self-help programs. For example, on the basis of weather patterns approaching conditions similar to the 1938-1960 period when several major hurricanes hit the East Coast, the NWS in June 1975 alerted the Defense Civil Preparedness Agency to advise state and local governments in the Northeast to check their storm warning systems. To permit the National Weather Service to expand its flood and storm surge prediction services:

10. **Increase funding for storm forecasting. Congress should provide funding to support additional stream gauging and precipitation stations operated by the National Weather Service, the Corps of Engineers, and the U. S. Geological Survey.**

A principal component of municipal zoning regulations and building code restrictions should be restriction of development in wetlands, particularly those wetlands which are in the flood plain. A special study of the strengths and weaknesses of existing state wetlands laws has yielded the following series of important and detailed recommendations.

11. **Amend and strengthen administration of wetlands laws.**

In Massachusetts it is recommended that:

- **The legislature should amend the Wetlands Protection Law to expressly provide that an application may be denied if the proposed action would cause significant damage to the protected area and there is no possible way to prevent such damage. Alternatively, the Department of Environmental Quality Engineering could, through its regulations, empower conservation commissions to deny an application.**

- **The Department of Environmental Quality Engineering should authorize the conservation commission to require any landowner to submit plans for all activity planned or anticipated by him within a reasonable time period on land in the immediate area of the proposed action, to prevent piecemeal development. The landowner would be prohibited from submitting additional applications for such activity for a specified time period from the date of the original application. Alternatively, local conservation commissions under supervision of the state Department of Environmental Quality Engineering should be empowered to review the entire watershed or aquifer to assess the maximum development which will be permitted in the area, and landowners would be assigned a proportional development right.**

- **The Soil Conservation Service should provide federal technical assistance to the conservation commissions through the Conservation Districts.**

- **Additional staff in the State Department of Environmental Quality Engineering should be provided to administer and enforce the Inland Wetlands Program (Chapter 131, Section 40A), and especially to complete identification and mapping of wetlands.**

- **The legislature should amend the act to increase maximum penalties under the act to $5,000 for each day of illegal activity, beginning upon violation of a valid court order, and may be made retroactive except in cases where wetland delineation is already a matter of record, or the legislature could provide alternative penalties such as either mandatory restoration of the land for violation of the act or contempt citations.**

- **The legislature, with cooperation from the Water Resources Commission, should amend the act to include as protected areas, major aquifers or potential water supplies susceptible**

to ground water pollution and associated recharge areas.

- **The legislature should create regional conservation commissions empowered to examine an entire watershed, wetland area or aquifer and set limitations on the maximum amount of development in the watershed or wetland area.**

- **The Division of Water Resources and the Attorney General should prepare a model aquifer by-law and supporting memorandum of law for innovative use under local zoning by-laws.**

For wetlands in Rhode Island, it is recommended that:

- **Additional staff should be provided to the State Department of Natural Resources to administer the Fresh Water Wetlands Act.**

- **Using the existing inventory and survey of wetlands, baseline data should be developed and used to establish a rating system for designating critical fresh water wetlands of the state. Restrictive orders should be used to protect the most critical areas.**

- **The results of an inventory and rating system of coastal wetlands, now being carried out, should be implemented using restrictive orders for the most critical wetlands.**

- **Consistent with judicial interpretation of "taking" situations, provisions for compensation and a statutory definition of a"'taking" should be added to the Fresh Water and Coastal Wetlands and Intertidal Salt Marsh Acts. Above the broad definition of "taking", the legislature should appropriate funds to enable damages to be paid to a restricted landowner as provided under existing law, to encourage use of the Coastal Wetlands Act.**

- **To clarify, standardize, and provide uniformity in the application of compensation to restricted landowners the State legislature should enact a statutory definition of a "taking", setting the limits of permissable regulation consistent with current judicial interpretation. This would be applicable not just to the Wetlands Laws, but to other regulatory situations as well.**
  (In a landmark case in Wisconsin – Just v. Marinette County – the court ruled that the restriction on filling a wetland was designed to prevent harm to the natural status quo of the environment, as opposed to being designed to produce a public benefit. Therefore filling could be restricted under the state's police power, not requiring compensation to the landowner.)

- **Local assessors should reassess restricted wetlands under the Fresh Water and Coastal Wetlands Acts for purposes of property taxation, to reflect lower values.**

- **The Coastal Resources Management Council's enabling legislation should be amended to provide penalties for violation.of its regulations including regulations for salt marshes. Authority for enforcement should include the power to arrest and fine violators.**

- **The Enforcement Division of the Department of Natural Resources should be expanded to reflect the expanding authority of the Coastal Resources Management Council.**

Structural Recommendations. In built-up and heavily used areas such as the Pawtuxet and Blackstone planning areas, storm and flooding damages are already severe, and natural storage area protection and other non-structural measures are often not adequate.

A number of the structural measures under consideration in the region have already been approved or are still under study and evaluation (such as for the Pawtuxet and Blackstone planning areas). Instead of making specific recommendations for structural projects, the SENE Study includes discussion of the proposed projects and suggests where they should be coordinated with other programs or reconsidered in light of preferred non-structural measures where available.

12. **Construct flood protection projects selectively. To reduce future flood damages, the Corps of Engineers, Soil Conservation Service, and state and local authorities should continue to consider the selective construction of protection projects only where protecting an area of greater than local significance, where the cost is less than acquisition of the flood plain area, or where non-structural solutions are no longer available. Recreation, fish and wildlife, water supply, and water quality considerations should continue to be taken into account in the formulation and selection of each project.**

Maintenance of existing structures is also a part of an overall flood plain management program. Growing interest in and support of rehabilitating mill dams is being expressed by municipal officials and citizen groups. Dam maintenance together with coordinated operation would help to keep the limited flood retention capacity of mill ponds intact, as well as offer recreation opportunities and, in some cases, small scale power generation.

Protective structures can provide direct protection against loss of property along the coastline, and can help increase property values and tax revenues. Individual project and engineering costs may be high, thereby reinforcing the requirement that such structures can be proposed only where the area to be protected is of high value. Further, future or ongoing studies should be required to include a comparison of the cost of proposed flood control works with the cost of purchasing or acquiring easements on flood hazardous lands. Where it is shown that such acquisitions are in the public interest, federal and/or state funds should be made available for the purchase of land and/or easements in flood hazardous areas, and for making relocation and flood proofing of existing structures viable alternatives to structural measures. Application of Section 73 of the Water Resources Development Act of 1974 will be an important factor in making non-structural measures more competitive than they have been.

Implications

In sum, the policy of applying non-structural measures wherever possible in the context of comprehensive flood plain management programs is expected to minimize future flood damages. This approach is designed to work with, not against, the natural roles that flood plains and wetlands play in accommodating the forces of nature. This policy also deals with the reality that in many instances in this region structural solutions are not feasible. Such a policy will also be a significant step toward protecting the physical beauty of the region's landscape which, as was discussed in *Chapter 2*, is expected to be in the long-term economic interest of the SENE region.

INLAND EROSION

The Situation

Inland erosion and sedimentation are generally not major problems in the SENE region, compared to non-glaciated areas such as in Maryland and Virginia. However, localized problem areas are associated with the development of open and forest lands. The Soil Conservation Service has identified the Narragansett Bay planning area as having the most serious erosion problems in SENE. These problems apply both to agricultural lands and to lands undergoing development.

The Solutions

Alternatives

Conservation land treatment practices have proved effective in reducing erosion on agricultural and forest lands and on urban fringe lands. Land treatment practices such as contour farming, cover cropping, terracing, critical area planting, diversions, pasture and hayland management, proper logging road location, and stabilization could be used. Technical assistance is available from the local Conservation Districts and the Departments of Natural Resources in the Executive Office of Environmental Affairs in Massachusetts, Rhode Island, and Connecticut, through the cooperative Federal-State Forestry Program, and through Resource, Conservation and Development Projects.

Provisions should be made for the retention of optimum amounts of vegetative cover for watershed protection on all areas undergoing residential, highway, and industrial development and construction. Developers should prepare and follow plans designed to minimize the deterioration of the hydrologic balance and the resulting erosion by maintenance of vegetative cover during development. They should utilize the natural landscape in their planning for environmental purposes. Where necessary, developers and contractors should apply erosion control measures such as

temporary debris basins, desilting basins, seeding and mulching of exposed areas, temporary diversions, and forest buffer zones during construction. Adequate planning prior to construction and close supervision of construction operations are needed to control sources of sediment.

Alternative Plans

Alternatives considered for protecting inland erosion areas will now be discussed. (a) Establish municipal sediment and erosion control ordinances. Such ordinances, added to existing building codes and subdivision regulations and adequately enforced, would be sufficient to control the problem. (b) Establish appropriate forest buffer zones within 200 feet of streams and lakes through public acquisition of land and municipal shoreline ordinances. This alternative also applies to protection of water bodies which are included in SENE resource category B *(see Chapter 3, Guiding Growth)*. (c) Control forest road erosion by proper road location and stabilization activities such as seeding and ditching.

Recommendations

The intensity of the problem will vary with the amount of development expected. To control erosion from construction sites throughout the region, it is recommended to:

13. Establish local sediment and erosion control ordinances. Municipalities, assisted by the U. S. Department of Agriculture, the Executive Office of Environmental Affairs in Massachusetts and the state Department of Natural Resources in Rhode Island, should establish local sediment and erosion control ordinances.

A model of such ordinances is included in the more detailed information available through the Study. Cities and towns with existing high and medium development pressure *(see Chapter 3, Guiding Growth, in the planning area reports)* should be among the first to implement this recommendation. In municipalities which are almost completely built up, such as Providence, Boston, Newton, and Everett, there is little need for these ordinances.

Alternatives (b) and (c) are also recommended selectively in appropriate planning area reports.

Implications

Local action supported by state and federal technical assistance can control the localized instances of inland erosion and sedimentation throughout the region. Such action should also reduce water quality degradation due to runoff and sedimentation, and should help to protect open space and wildlife habitats.

COASTAL EROSION

The Situation

The most severe storms to hit the coast of the SENE region are hurricanes, making coastal erosion damages particularly serious for the planning areas in the southern portion of the region – the Pawcatuck, Narragansett Bay, Buzzards Bay, and the Cape Cod and Islands planning areas. This section addresses ways to reduce unnaturally increasing rates of critical coastal erosion.

The Corps of Engineers has approximated lengths of critical coastal erosion areas (erosion of about 3 feet or more per year). These are displayed in Table 8.4 and in Figure 8.1. Negligible amounts of coastal erosion were measured for the Taunton, Blackstone (Providence Harbor area), and Pawtuxet planning areas, which have little coastal shoreline. While the extent of erosion is particularly severe along the southern coastline of the region, there are also serious erosion spots along the eastern Massachusetts shoreline such as along Plum Island in the Ipswich-North Shore area and the northern portion of the South Shore planning area.

Much of the critical erosion is occurring along coastal beaches, many of which are currently developed and used to capacity. Increases in beach demand combined with continual erosion of many beaches suggests that existing beaches may not be able to accommodate future patronage. Additional discussion of beaches considered for further study for protection and restoration is contained in *Chapter 6, Outdoor Recreation.*

The National Park Service is currently developing a new resource management policy pertaining to national seashores. The policy is designed both to serve present visitors, and to preserve these areas in an essentially natural state. Such a management strategy reflects a philosophy of living with, and adjusting to, natural events, and acknowledges the vital role natural processes play in the long-term preservation of areas such as the Cape Cod National Seashore.

In Rhode Island, the state Coastal Resources Management Council has adopted, as part of its coastal zone management program, a set of regulations and official

maps for regulating barrier beaches. However, overlapping jurisdictions with municipalities and the Department of Natural Resources, together with continued challenges to the Council's barrier beach authority, have weakened the potential strength of the new barrier beach regulations.

The Solutions

Alternatives

A number of alternative measures were considered for protecting or enchancing the coastal areas. (a) Planting with beach grass and fertilizing areas of the existing dunes, to reduce wind erosion. Dune stabilization with beach grass will reduce loss of sand into lagoons and estuaries and enhance shellfish beds. (b) Restoration and protection of beaches by direct sand placement (artificial nourishment) and construction of back-up dikes of sand and gravel, rock or concrete walls, and rock groins, where required: (c) Protection of erodible bluffs with rock revetments, sea walls, or bulkheads. More recently, the possibility of using floating breakwaters to reduce shoreline erosion has received some attention. Restored beaches and protected dunes would act as a first line of defense for marshes and lagoons and development beyond. Increased beach area would allow greater use by bathers.

Alternative Plans

Within the context of the alternative measures discussed above, several alternative plans were examined. A plan to "do nothing," to allow present patterns of development and steadily increasing rates of erosion to continue, was rejected as being in neither the economic nor environmental interest of the region. A plan stressing restoration and protection of critical shoreline areas through extensive structural controls, thus permitting further development – technically a plan emphasizing future economic development – was considered for the most part an unwise, even futile, investment of public funds, except in those few areas where the area protected was regionally significant. Finally, a plan emphasizing environmental preservation – a rigid coastal zone management program precluding future encroachment on marshes and barrier beaches and encouraging restoration of natural impediments to erosion–formed the backbone of the recommended plan outlined below.

Recommendations

Coastal beaches and critical erosion areas were included along with wetlands in the SENE Critical Environmental Areas as Priority Protection Areas (resource Category A) requiring the greatest degree of protection from development. This approach reflects the fragile nature of these areas and the dynamic role that uninterrupted natural processes play in the long-term evolution of the areas, as described in *Chapter 3*, and is consistent with the proposed National Park Service policy pertaining to national seashores.

Consistent with, and in conjunction with, the preceding recommendations on managing coastal flood prone areas is the following recommendation:

> **14. Manage critical erosion areas through state coastal zone programs. State legislatures should ensure that state coastal zone management program areas of jurisdiction include coastal wetlands, barrier beaches, and the coastal flood prone areas as defined for purposes of the National Flood Insurance Program.**

In the case of Rhode Island, the Coastal Resources Management Council (CRMC) does not have jurisdiction over the entire area subject to coastal flooding, even with the special jurisdiction of coastal wetlands and barrier beaches

TABLE 8.4 DISTRIBUTION OF CRITICAL COASTAL EROSION

Planning Area	Annual Rates of Erosion Feet	Miles
Ipswich-North Shore	12,600	2.4
Boston Harbor area	1,200	0.4
South Shore	25,900	4.9
Cape Cod and Islands	291,850	55.3
Buzzards Bay	1,200	0.9
Narragansett Bay	35,200	6.7
(including Block Island)	(31,000)	(5.9)
Pawcatuck (includes South County shoreline)	8,800	1.7
	376,750	71.4*

Source: These figures represent rough estimates provided by the U.S. Army Corps of Engineers.

* Total does not add due to rounding.

above the high water mark. Extension of the CRMC's area of jurisdiction to include the 100-year flood prone areas would go a long way in integrating the effective application of a number of related programs in areas of coastal influence. In Massachusetts, the area subject to coastal management jurisdiction should include the 100-year flood prone area.

Consistent with a coastal zone management program:

15. **Protect critical erosion areas through local regulations. Coastal municipalities should include, on their flood hazard maps prepared for the National Flood Insurance Program, wetlands and areas subject to critical rates of erosion including barrier beaches and dunes. Town zoning ordinances, building codes, and subdivision regulations should expressly prohibit development in these areas and should include other protective regulations to guard against use which would accelerate natural erosion rates.**

Such regulations should incorporate the protective regulations and restrictions of state wetlands laws, and in the case of Rhode Island, barrier beach regulations. The Rhode Island Supreme Court has ruled that the state and municipalities can limit beach access on a non-discriminatory basis if the shore area was endangered by overutilization. Similarly, in Massachusetts, municipalities have the right to restrict access to lands under their jurisdiction. Broad authority given to Massachusetts conservation commissions would include limitation of access to, and use of, conservation lands held by the town.

The HUD flood insurance program should encourage incorporation of those areas serving as important buffers to storm damages by including wave height and velocity in the guidelines for defining flood hazard areas.

Further, states, municipalities, and conservation commissions should:

16. **Encourage natural stabilization of coastal erosion areas. Municipalities, conservation commissions, and the states, through their coastal zone management programs, should encourage such stabilization measures as vegetative cover, snow fences, discarded Christmas trees, and board walks to to slow the effects of wind and wave erosion, particularly on dunes and barier beaches. Funding support could come through implementation funds for the state coastal zone management programs. Priority should be given to areas experiencing critical rates of coastal erosion (3 feet or more per year).**

Possible studies of the need to artificially nourish eroding beaches with sand are discussed in *Chapter 6, Outdoor Recreation.* Only where beaches have potential for recreation benefits should beach nourishment be considered. It must be kept in mind that beach nourishment, if done at all, must be done carefully so as not to aggravate or transfer erosion problems. Also, it should be recognized that such action will not eliminate the causes of erosion and will therefore require periodic replenishment.

However, in some cases, structural approaches to controlling coastal erosion may be justified:

17. **Construct erosion control projects selectively. Where non-structural techniques are not effective in slowing accelerating rates of erosion, such as for eroding bluffs, the Corps of Engineers, Soil Conservation Service, and state and local authorities should consider the selective construction of erosion control projects.**

Areas other than eroding beaches and unique natural sites can be considered for this type of protection. These projects should apply methods as similar as possible to natural ones, in order to avoid aggravating or transferring erosion problems. Another coastal restoration effort could include:

18. **Build or restore salt marshes. The Corps of Engineers, the Executive Office of Environmental Affairs in Massachusetts, the Department of Natural Resources in Rhode Island, state Departments of Public Works, and coastal zone management programs should follow carefully the ongoing and proposed pilot projects in salt marsh construction or restoration in the neighboring states of New York, Connecticut, and Maine with the view that, if these projects are successful, Massachusetts and Rhode Island should also consider undertaking them.**

Implications

In sum, an approach which seeks to protect fragile coastal areas from critical erosion, using non-structural means, is consistent with maintaining the natural character of the coastal region with benefits both to recreation and open space preservation, and to tourism and other economic activities dependent on maintaining the natural beauty of the region.

Locating Key Facilities

6

CHAPTER 9 LOCATING KEY FACILITIES **9-1**

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CHAPTER 9 LOCATING KEY FACILITIES

The Setting

The production of power, the ready availability of fuel, the extraction of sand and gravel for construction and the disposal of wastes are crucial to the continuing health of the economy of Southeastern New England. And yet there are few uses of the land more controversial.

The extraction of sand and gravel can be noisy, dirty, and bring with it heavy equipment traffic. Power plants, refineries, and solid waste disposal sites are unsightly, and are potential polluters. Considering the generally negative effects such *key facilities* have traditionally had on the physical landscape, a "put them in somebody else's backyard" attitude prevails in most communities. However, from the standpoint of public health, we would be worse off without these facilities than we are with them – at least for the foreseeable future. The objective then, is to determine how badly we need these facilities and then to locate them in a manner which minimizes their effects on our landscape.

The key issue is siting. Where do we site those new facilities we legitimately need? The impacts of a new power plant, a sand and gravel operation, a solid waste processing center are much greater than local. Such strategic facilities not only serve the needs of more than just the town, they affect the daily lives of more than just local townspeople. A brief look at who makes these siting decisions is a good introduction to the key problem in meeting SENE's needs for these vital facilities.

Sand and Gravel. The authority for regulating the extraction of sand and gravel is essentially a **local** one. Town zoning regulations define where extraction is permitted, if at all, but the permit requirements regulating operations and post-operational site restoration vary widely from town to town so that no uniform policy can be said to exist. State interest and responsibility is fragmented among the respective state departments of Public Works and the Rhode Island Department of Natural Resources and Massachusetts Department of Environmental Quality Engineering, and, in Massachusetts, the Office of the State Geologist as well. There is little **federal** involvement.

Electrical Power. Energy shortages, always a problem in New England, have greatly intensified in recent years. This fact, plus an awareness of the broad environmental impacts of energy production, have brought about a gradual increase in **state** control of power plant siting. Massachusetts has established an Energy Facilities Siting Council to control the siting of plants generating 100 megawatts or more in the state. The Council reviews utility forecasts and can either accept, reject, or conditionally approve proposals for new generating facilities. In Rhode Island, the Coastal Resources Management Council has the authority to review, modify, set conditions for, approve or reject proposals for power plants, except those proposed by the state's Port Authority and Economic Development Corporation, which are reviewed by the General Assembly. **Federal** involvement is complex. Reviewing various aspects of each power plant proposal are the U. S. Army Corps of Engineers, the Environmental Protection Agency, the Nuclear Regulatory Commission (formerly AEC) for nuclear plants, the National Oceanic and Atmospheric Administration, the U. S. Fish and Wildlife Service, the Federal Aeronautic Administration, and the Federal Power Commission. This multitude of review authority and the delays which have resulted have prompted requests for a simplified "one-stop" review of power plant proposals.

Petroleum Facilities. In siting petroleum refineries and related facilities the petroleum **industry** generally tries to deal directly with **local** officials. Their economic leverage is, after all, pretty powerful. But, as with the siting of electrical power plants, **state** involvement and control is on the increase. In Rhode Island, the Coastal Resources Management Council can review, accept or reject refinery and related development proposals. Once again, however, if the proposal originates with the Port Authority and Economic Development Corporation, the General Assembly can override the Council's decision. Massachusetts, on the other hand, does not have a central clearinghouse or control agency for petroleum facility proposals. The state's Energy Facilities Siting Council regulates electrical power and natural gas facilities but, as yet, has no authority over petroleum facilities. **Federal** agencies involved in the review process include the Corps of Engineers, U. S. Coast Guard, Environmental Protection Agency, Federal Energy Administration, and the President's Council on Environmental Quality (for the impact statement required).

Solid Waste Management. Recognizing that solid wastes can be an opportunity, instead of a nuisance, both Massachusetts and Rhode Island have begun programs to recover these "resources". Rhode Island has established a Solid Waste Management Corporation. The program, yet to be funded by the legislature, will improve local management and lead to regional recovery of valuable wastes. In Massachusetts, an interagency planning unit has proposed a regional solid waste recovery program which is scheduled for implementation in 1976.

The institutional considerations involved in the siting of each of these key facilities are discussed in detail in this chapter. This chapter addresses, for each activity in turn: assessing the current situation and reviewing projected demands for these services; examining several ways of meeting these demands; and finally suggesting a series of measures to meet the region's legitimate needs most reasonably.

This chapter uses as a framework, several of the fundamental concepts covered in *Chapter 1, Goals and Approach,* and *Chapter 2, The Setting.* These chapters describe, for example, the importance of the environment to enhancing the region's economy, and that existing knowledge, programs, and institutions, with some new additions, can provide tools for achieving results. *Chapter 3, Guiding Growth,* outlines a rationale and policies for protecting Critical Environmental Areas, many of which should be taken into account when dealing with issues related to siting or managing key facilities such as power plants or refineries. The approaches described in this chapter, take these principles into account. Although references are also made in this chapter to several other portions of this report, *Chapter 11, Tying the Recommendations Together*, can be referred to in order to determine the implications of the recommendations in this chapter, or those described in other chapters of this report.

ONSHORE SAND AND GRAVEL EXTRACTION

Sand, gravel, and stone are mined in substantial amounts in Southeastern New England and are a vital component in the growth of the region's economy. It is a SENE Study objective to assure adequate supplies of these materials at the lowest economic and environmental cost. But surprisingly little is known about the location of potential deposits in the region – deposits required if we are to continue to grow. Without them, construction aggregate, now a relatively small portion of total construction cost, will become an increasingly important building restriction. With the construction industry already reeling from the effects of inflation, the result of cost increases and shortages of material could be a further slow down of the region's economy.

The Situation

According to the U. S. Department of the Interior, Bureau of Mines, production of sand and gravel in the region was 15.3 million tons in 1970. The demand projections for the future vary from 23-28 million tons in 1990 and 33-49 million tons in 2020 (Table 9.1). Similarly, production of crushed stone was 6.2 million tons in 1970 and its demand is expected to be 10.5–13.7 and 17.4–27.9 million tons in 1990 and 2020, respectively (Table 9.2).

The demand for sand and gravel and crushed stone is "derived" demand. That is, it is dependent on decisions made in the construction industry which, in turn, are based on the orders of individual firms and government for new construction. Road construction, which accounted for almost 50 percent of the total sand and gravel consumption in Rhode Island and 30 percent in Massachusetts in 1972, is not expected to continue at the same pace as during the 1960's and early 1970's. Indeed, the 1972 figure for Massachusetts cited above represents a 25 percent decrease

TABLE 9.1 PROJECTED POPULATION AND DEMAND FOR SAND AND GRAVEL IN SENE (1980-2020)

		Sand and Gravel Demand			
Year	Population 1/ (thousands)	Low projection 2/ (thousand tons)	Per capita (tons)	Low projection 3/ (thousand tons)	Per capita (tons)
1980	6,833	19,857	2.91	22,001	3.22
1990	7,905	23,196	2.93	28,086	3.55
2000	8,993	26,535	2.95	34,263	3.81
2010	10,228	29,873	2.92	41,274	4.04
2020	11,594	33,212	2.86	49,038	4.23

1/ OBERS projection, Series C.

2/ Straight-line projection of sand and gravel production in the years 1959-70.

3/ Projection based on regression of tons of sand and gravel against population for the years 1959-70.

from 1971. To a somewhat lesser degree, increases in urban industrial and residential demand for construction aggregates is also expected to be lower compared to the peak rates of the sixties. Furthermore, the projections in Tables 9.1 and 9.2 are based on Series C projections, higher than the recently-available Series E. In view of these considerations, the projections cited above may be somewhat over-estimated. Yet even if they are, the general lack of information on the location and availability of sand and gravel deposits complicates the task of providing sufficient construction aggregate to meet future needs.

While sand and gravel deposits were inventoried in Rhode Island in 1964, no accurate survey exists for the Massachusetts portion of Southeastern New England. Even with an accurate survey, however, it is necessary to distinguish between deposits which technically exist and those which are actually available for extraction. Available information is especially weak on the relationships between the stratified drift deposits – the usual source of sand and gravel – and ground water recharge. Finally, preemptive uses of the land and restrictive local ordinances prevent many safe potential deposits from being developed.

It is estimated that, from a regionwide point of view, sufficient sand, gravel, and rock suitable for crushing exists to meet needs for the next fifty years. The supply potential, however, is extremely site-local. While one producer may have, or be negotiating for, holdings which would last another twenty or thirty years, another nearby may have no further possibility for sand and gravel leases, and may have to turn to crushed stone as a source of aggregate, a move which necessitates large capital expenditures for new equipment. And that means higher cost to the consumer.

The depletion of existing sites and the longer distances between new supplies and demand centers has had a sharp effect on price. Price increases from June 1973 through June 1974 ranged from 10 to 50 percent. Moreover, in June 1974, price of washed and screened concrete sand varied from approximately $2.35 per ton in Charles River Basin to $1.10 per ton in the Ten Mile River Basin. While some price differences are undoubtedly caused by variations in operating efficiency, the cost of transportation (10 to 12 cents per ton per mile) between mining sites and points of processing and distribution plays a major role. Commonly, transportation costs double every 8 to 12 truck miles, or 50 railroad miles, or 125 barge miles.

But the distance between supply and demand, and thus the transportation costs, increases as much because of regulations against extraction imposed by the cities and towns as from depletion of existing deposits. Municipal zoning ordinances commonly divide land use into four categories: (1) rural or agricultural; (2) residential; (3) commercial; and (4) industrial. The activities permitted or proscribed for specifically zoned areas are generally well defined, and where sand and gravel extraction is permitted, specific lot sizes, hours of operation, haulage routes, depth of excavation, slope control, and so forth are often indicated. The realization that land suitable for sand and gravel operations may occur in areas not specifically zoned for mining activity has led to the provision in some areas for "special exceptions" to the zoning regulations.

Some towns require that operating plans be filed, but the degree of specificity of these plans is not always spelled out by municipal ordinances. Restoration of a site may be required, but what is meant by "restoration" may be open to a wide range of interpretations. Similarly, some municipalities require performance bonds ranging from $500 to $7,500 an acre to ensure that operational and post-operational requirements are met. Non-compliance can result in fines or cancellation of permits. However, not all municipalities require such bonds, and there is much latitude

TABLE 9.2 PROJECTED POPULATION AND DEMAND FOR CRUSHED STONE IN SENE (1980-2020)

		Estimated crushed and broken stone demand			
Year	Population 1/ (thousands)	Low projection 2/ (thousand tons)	Per capita (tons)	High projection 3/ (thousand tons)	Per Capita (tons)
1980	6,833	8,245	1.21	9,372	1.37
1990	7,905	10,532	1.33	13,762	1.74
2000	8,993	12,819	1.43	17,936	1.99
2010	10,228	15,106	1.48	22,863	2.24
2020	11,594	17,393	1.50	27,928	2.41

Source: Bureau of Mines

1/ OBERS projection, Series C.

2/ Straight-line projection of 11 year historical crushed and broken stone production (1960-70).

3/ Projection based on regression of crushed and broken stone against population for the years 1960-70.

in many of the requirements and in the amount of fines, so that no uniform policy concerning operational or post-operational requirements can be said to exist. Some cities and towns permit extraction, but prohibit export of the finished product outside of the municipal boundaries, thus limiting the availability of the resource to the region.

These factors – restrictive regulation, escalating costs, and diminishing economically feasible sites – have had the effect of directing public attention to the exploitation of alternative sources for meeting the demand at the lowest possible cost.

The Solutions

Alternatives

The Study considered four alternative measures for meeting demand: importation of materials from outside the region; substituting crushed stone for sand and gravel; offshore mining; and identifying, protecting, and sequencing the use of onshore deposits within the region.

Substitution of other materials, using near-shore resources, reducing demands and not meeting the need were not considered to be viable alternatives for satisfying projected needs. Substitute materials, such as marine muds, although technically feasible, were not considered practical sources for meeting the large needs of the construction industry in the region. Near-shore mining was suspected to have some negative environmental and, over the long-term economic effects. Some small demand reduction might be feasible without serious social or economic disruption, but either major reduction in demand, or not meeting that demand, would have major adverse impacts on the economy and, consequently, on the quality of life in the region.

Importing Sand and Gravel from Outside the SENE Region. This alternative is attractive in the sense that residents of the Study area would no longer be concerned with active mining operations, and disturbances to the land from mining would cease. However, there is no guarantee that other areas would supply these needed materials to this region. Aversion to mining operations is by no means unique to the people of this region. Moreover, since transportation is such a large proportion of the price at construction site, such supplies would carry a significantly higher price, and, thus would have a significantly negative impact on the regional economy.

The Substitution of Crushed Stone for Sand and Gravel. This is already a practice in parts of the SENE region – notably northeast of Boston in the Lynn-Saugus area. However, to meet the region's sand and gravel needs, stone production would have to at least triple and it is not known whether available deposits could produce this much. In many cases crushed stone would not be a satisfactory substitute for sand and gravel. Moreover, while sites favorable for crushable stone do not generally have as high a commercial value as do sand and gravel sites (because they are often less favorable for other forms of development), the higher private costs of extraction and of processing equipment, make crushed stone higher priced than naturally occuring sand and gravel. Social costs of stone production and crushing are also higher. Besides having the externalities that are associated with a conventional sand and gravel operation, the noise from blasting and pneumatic drilling makes a crushed stone operation less compatible with densely populated areas. As a result of these factors, crushed stone is not considered an adequate, or acceptable, alternative to naturally occuring sand and gravel.

Offshore Mining of Sand and Gravel. This alternative may offer a very attractive alternative to onshore mining. Large quantities of sand and gravel are known to exist off the shores of the Northeastern United States. These sources could be sufficient to meet the needs of the region for several thousand years. Except for coastal dredge and fill operations and beach restoration programs, there is currently no extensive exploitation of offshore mineral resources in the SENE Study area. Although industrial speculation has been aroused, no leases will be issued by the federal government until present disputes over ownership rights to the outer continental shelf (OCS) adjacent to the individual states are resolved. A detailed discussion of the issues and opportunities for offshore sand and gravel mining is found in *Chapter 7, Marine Management.*

Identifying and Preparing a Plan for Sequential Uses of Onshore Deposit Sites within the Region. This alternative would provide for extraction before the land is preempted for other uses, for post-operation site rehabilitation, and planned final development of the site. This alternative suggests that sand, gravel, and crushed stone production is a legitimate interim use of land which requires uniform protective zoning. It further suggests that extraction sites, if properly reclaimed, can provide open space, recreation areas, and space for commercial and industrial development. The alternative is technically feasible. In recent years the technology of extraction has improved to the point where the industry can operate profitably even under strict standards of performance. The National Sand and Gravel Association has produced detailed standards and guidelines on site utilization and rehabilitation, simultaneous excavation and rehabilitation, and pre-operational site planning.

There are, however, certain legal stumbling blocks to enforcing a sequential land use plan. The power of local zoning is sufficient to require that minerals be extracted before other economic uses of the land are made without being construed as a "taking". Furthermore, the issuance of an extraction permit can make site rehabilitation a

condition for approval. However, it is not within the power of local zoning to require that, once extraction has occurred, the land must be restored and developed to another specific use – such as recreation space, commercial, or residential development. Thus a sequential use "master plan" for mineral sites, if based on regulation through the local police powers, constitutes a "taking without compensation".

Alternative Plans

Three alternative plans were examined for meeting the region's needs for sand, gravel, and stone, each utilizing one or more of the measures described above and emphasizing either an economic development or environmental enhancement objective.

With the first plan, mining would be greatly reduced or eliminated in the Study area. The price of aggregates would rise substantially. However, a more important consideration than price, ultimately, would be that with the heavy dependence upon outside sources this plan entails, there could be no assurance of adequate supplies of aggregate. It is a situation not entirely unlike New England's petroleum predicament. Failure to meet the region's needs could well deter needed construction projects, further depressing the already dismal construction industry. Moreover, to the extent that air, water quality and recreational facilities, mass transportation, power generation and other public services, depend to some degree on the availability of sand, gravel, and stone for construction, even the environmental quality objective would, in the long-term, be threatened.

A second plan, emphasizing short-term economic gains and low price, would stress the exploitation of mineral deposits closest to their point of consumption, with little regard for costly measures for protecting the environment, reclaiming mined-out lands, or regulating operations to reduce the "nuisance" value associated with them.

To a large degree, this has been the industry's approach to the problem in the past. But is has not resulted in low prices. Rather, it has increased the public hostility towards mining operations and has resulted in dwindling availability of the minerals and sharply increasing prices.

Recommendations

A third, and recommended program, is based on the Study's conclusion that, to a large extent, mineral resources in the region can be extracted and used for the public's benefit without causing unacceptable environmental damage, or being a nuisance to the great majority of the region's people. The program takes the view that sand and gravel mining can be the first step in a carefully developed plan for multiple uses of land in areas under heavy development pressure.

The recommendations follow the policy articulated in *Chapter 3, Guiding Growth*, that the identification and protection of sites for regionally significant facilities such as sand and gravel pits, is as important to the future of SENE as protection of Critical Environmental Areas.

The state is the most logical entity to govern and monitor the sequencing of mining and site redevelopment. Under the program, the state would assure uniformity and standardization of operations, provide a level of assistance to municipalities and the industry not available to the towns themselves and, further, can reconcile competing interests between towns. As a political reality the state is the only institution capable of adopting this policy.

The major elements of the program include a comprehensive inventory of extractable minerals in both states, the establishment by state statute of minimum operating and site rehabilitation standards, local permitting of individual operations under state minimum standards and with state technical assistance, and state permitting of operations involving more than one municipality. The implementation of this policy to ensure extraction before preemption, and encourage sequential use should continue to be through local zoning regulation, adopted pursuant to the aforementioned state standards.

Following extraction and restoration, to overcome the legal taking issue and yet guarantee appropriate sequential use of the site, the state should encourage and provide certain incentives (through planning assistance) to the municipality for rezoning the site to commercial, residential, or public use, consistent with the economic needs and environmental aspirations of the community.

In light of the above discussion, the SENE Study makes the following recommendations:

1. **Centralize minerals management authority. Authority for managing mineral resources needs to be centralized in each state. Accordingly, the Massachusetts General Court and Rhode Island General Assembly should designate the Department of Environmental Quality Engineering and the Department of Natural Resources, respectively, as the appropriate agency for mineral resources policy-making, monitoring, and regulation.**

2. **Conduct state mineral resources survey in Massachusetts. *To determine the location*, quantity and quality of sand, gravel, and stone deposits the Massachusetts Department of Environmental Quality Engineering should conduct, with the assistance of the U. S. Geological Survey, a detailed survey of potential extraction sites. The survey could be conducted simultane-**

ously with the survey of ground water and recharge recommended in *Chapter 4, Water Supply*. This study has high priority and should be initiated by 1977.

Once the authority for managing mineral extraction has been centralized, a **minerals management program** should be implemented consisting of, but not limited to, the following:

3. **Create minerals public education program, aimed at encouraging municipalities to protect, through zoning, sites identified in the minerals survey for extraction.**

4. **Promulgate minimum statewide operating and rehabilitation standards for mineral extraction to assist local permitting.**

5. **Provide state guidance to municipalities in establishment of a permit program, regulating mining operations and site reclamation pursuant to the minimum standards.**

6. **Begin staged state reclamation of abandoned extraction sites for recreational use in areas deficient in recreational opportunities as indicated in *Chapter 6, Outdoor Recreation*.**

Implications

Implementation of these recommendations would eliminate the fragmented authority for minerals management in the two states and go a long way toward assuring an adequate supply of reasonably priced construction aggregate for the region. The program serves both the region's needs for continued economic growth and provides a measure of protection from the traditionally negative social and environmental effects of mineral extraction. Moreover, it recognizes that land close to sources of demand for sand and gravel is already under heavy development pressure and provides a system for ensuring that, once extraction is completed, the site is returned to the market place in condition suitable for redevelopment.

ELECTRICAL POWER

It is by no means unanimous, but it is probably safe to say that there are few things which people would rather not have in their back yard than a power plant, whether nuclear or fossil. And yet, like it or not, we are tremendously dependent upon abundant and cheap energy, especially electrical energy. And, by all accounts, to a greater or lesser extent, we will be more so in the future, because electrical power's share of the region's total energy demand is expected to increase steadily in the next several decades. The Study region is technically self-sufficient in power generation today, though it is, of course, linked to other power facilities throughout the Northeast. To meet tomorrow's needs we need to know how much power we need, whether we can generate it without harming ourselves or our surroundings, and to what degree we can, or should, look to others to supply us.

The Situation

To determine power consumption and future peak demands in the SENE region, any utility serving any portion of the Study area was included. As a result, the SENE "service area" is approximately 10 percent larger than the 4,400 square mile Study region.

In 1970, the energy requirement in the SENE service area was about 25 million megawatt hours or about 40% of the total requirements of New England. Consumption increased in SENE to 26.2 million megawatt hours in 1971, and according to the Federal Power Commission's most recent figures, it can be expected to increase to 47.1 million megawatt hours in 1980 and 85.0 million megawatt hours in 1990. These figures represent a steady decrease in the average annual rates of growth from 7.3 percent in the decade from 1960-1970, to 6.8 percent in the period from 1971-1980 and 6.1 percent in the decade from 1980-1990. The Federal Power Commission (FPC) currently estimates that the average annual rate of consumption will decrease to 4 percent or less by 2020.

To serve the public's consumption of 26.2 million megawatt hours in 1971, the utilities in SENE had to provide for a peak market demand of nearly 5,000 megawatts. (Energy consumption = capacity multiplied by the number of operating hours in a year.) In addition to that capacity, they are required to maintain a reserve capacity of approximately 25 percent. By 1990, according to the FPC, the utilities in SENE will have to provide for a peak market demand of almost 16,000 megawatts plus the 25 percent reserve.

The Energy Crisis and Projecting Demand

It is entirely possible that these projected demands will be significantly less than anticipated at present for 1990, particularly if recession, conservation efforts, and inflation continue. Many economists claim that electricity consumption will steadily decrease as increases in costs continue to escalate the cost of electricity. It is true that electricity consumption, especially in the commercial sector, is, at present, slightly price elastic. Realistically, however, demand is responsive to much more than price: personal income, population growth, technology, public policy, conservation programs, changes in style and taste, and the cost and availability of alternative sources of energy. Without other fuels for consumers to switch to, they may have no alternative but to use electricity – whatever the price.

Boston Edison's decision to postpone construction of Plymouth Unit #3 is based in part on a decline in the growth of electrical demand. However, it also reflects the growing financial dilemma of the power industry in the Northeast. The industry's inability to secure the capital needed to meet planned additions to the region's generation capacity, if it continues, will be a serious threat to the reliability of the region's power supply.

Ultimately, however excessive analysts may feel these projected rates of consumption increase may be, one fact is undeniable: consumption of electricity will continue to increase.

Meeting Future Power Needs

Whether the annual growth rate for electricity is 2 percent or 6 percent annually, SENE will need more electricity. Assuming that there are no areas elsewhere in New England willing to accept the burden of providing power to plants to meet SENE's needs, and that SENE does not wish to significantly decrease the reliability of its power by significantly increasing power importation, a considerable increase in generating capacity will be required in the future.

With residual oil as much as 40 percent higher in SENE and the rest of New England than elsewhere in the nation, and coal switching technologically and environmentally nettlesome, large future generating plants are expected to be nuclear powered. Major new generating units proposed in, or near, the SENE region (Plymouth, Mass., Seabrook, N.H.) are all nuclear, as are the Federal Power Commission's long-term (post-1990) suggested additions to the region's generation capacity. Existing power plant sites and those proposed by the utilities or suggested by the FPC are displayed in Figure 9.1.

Cost Implications of Alternative Sites

The cost of new capital and of meeting environmental and safety regulations has become such a difficult problem that a significant amount of slippage is occurring in the schedule for additions to the region's generating capacity.

Among the factors affecting market costs are: land prices; variations in transmission line distances and their associated land costs; the cost of labor material, services and money; changes in the scope of the project; and schedule slippage.

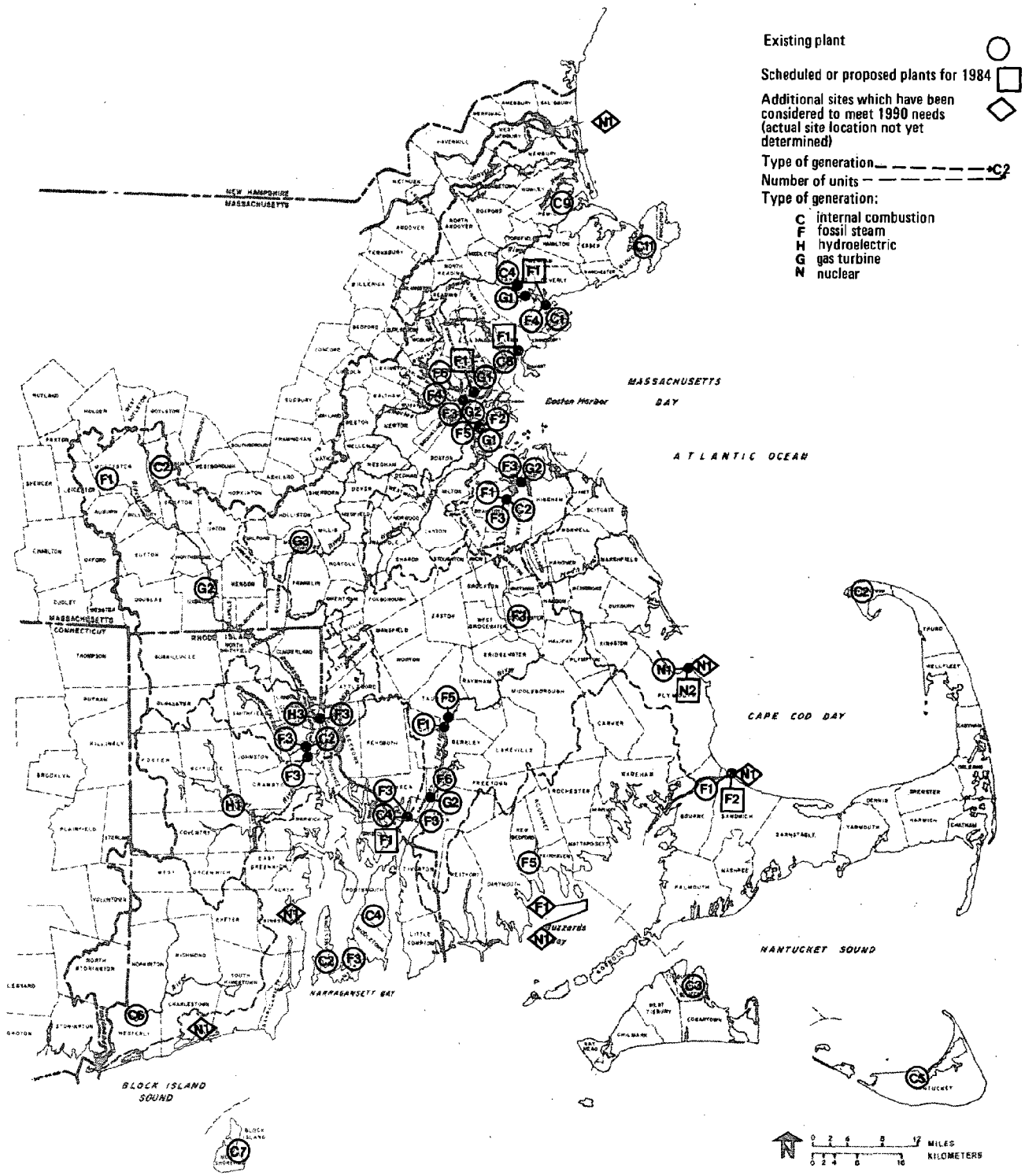
Of the total plant capital (assuming $2,000 per acre and 500 acres per site) approximately 0.3 to 0.4 percent represents investment in land. Moreover, since land is a non-depreciable asset, the final impact of land costs on electricity rates would be even less. Therefore, changes in location are not likely to change the relative weight of land costs in any considerable manner.

Transmission line costs include the costs of land and land rights, towers, poles, cables, construction, and engineering. Excluding land costs, a current rule of thumb for transmission line costs is $160,000 to $200,000 per mile for a 345 kv line. Assuming one 345 kv for each 500 mw of generating capacity, this implies approximately $320,000 to $400,000 per mile of transmission line for a 1,000 mw-generating plant. Adding land costs at 45 acres per mile at $2,000 per acre would raise this total to $410,000 to $490,000 per mile of transmission line. To assess the impact of differences in transmission line costs related to distance, on final cost, consider a range of sites for which the range in distance factors is fifty miles. Depending on the range in land costs and line costs assumed, a 50-mile increase in transmission distances would add 4.5 to 8.5 percent to the total unit cost per kilowatt hour.

Perhaps a more serious cost problem from the point of view of reliability of the existing and planned expansions of the region's generation capacity is the staggering increase in capital costs. Power plant capital costs have risen from an average $119/kilowatt in 1965 to $558/kilowatt in 1974. Plymouth #1 of Boston Edison, a 665 mw nuclear plant completed in 1972, cost $350/kilowatt. This represents an increase of something over 18 percent per year compounded annually.

The cost of labor and materials and the unavailability of capital has caused serious slippage in planned additions to the generation system. The slippages have, in turn, resulted in higher costs due to inflation. It is a vicious circle. To compensate for delays it is likely that plant capacity reserves will be decreased with a resulting decrease in the reliability of the system.

It was not within the scope of this Study to present a detailed discussion of environmental and safety costs. Most of what is known of these effects is familiar. Much remains to be researched. While the precise impacts of ther-



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

EXISTING BULK AND PEAKING POWER PLANTS; PROPOSED BULK POWER PLANT SITES – 1990

FIG. NO. 9.1

mal discharges to the ocean are unclear, we know they are at least locally significant. At the same time the difficulty of disposing of radioactive wastes and the long-term effects of continuous low level emissions build-up in the food chain may be of far greater concern than the thermal loading problem. A collective decision must be reached as to how much risk society will accept in return for the benefits of nuclear energy. One suggestion receiving consideration is that coal be used as an interim fuel source for generating power until the safety of nuclear power is assured. However, whether coal is available in SENE, as currently suspected, or has to be imported from other coal producing areas in the nation, widespread interim use of coal could have significant negative environmental impacts. At the same time the negative social impacts from not meeting the region's power needs could be more serious. This decision must be reached at the highest levels of government and with the fullest possible public debate.

State Institutional Arrangements for Siting. In December 1973, the Massachusetts legislature passed an enabling act creating the Electric Power Facilities Siting Council, renamed the Energy Facilities Siting Council in August 1974. The Council has the authority to control the siting of power plants of 100 mw or more in the state. Under the act, each electric company must file with the Council by December 31, 1975 a ten-year long-range forecast with respect to the electric power needs of its market area. Such forecasts will include proposals for construction of power plants, and the Council will either accept, reject, or conditionally accept the forecast, after public hearings are held. If plans are accepted, electric companies may proceed with their planned construction of a power plant. In the event that any other state agency or department, or any local agencies or departments, attempt to block such construction, the electric company may apply to the Council for a "Certificate of Environmental Impact and Public Need". If granted, the certificate would override the power of all other state agencies and the electric utility would receive permission for the construction of the facility. The Council may also reject or conditionally accept an application for a Certificate. Public hearings must be held in connection with an application. The Council does not, however, have the authority to inventory and secure for future development potential power plant sites in the state.

In Rhode Island, the Coastal Resources Management Council (CRMC) has the authority to review, modify, set conditions for, approve, or reject proposals for power plants. However, should the proposal be made by the state's Port Authority and Economic Development Corporation, the Rhode Island General Assembly has final review and authority over the CRMC. The CRMC does not appear to have the authority to secure sites for future development. A five-person staff is being created under the direction of the Chairman of the Public Utilities Commission (which has responsibilities for rate setting) to act as the primary agency of the executive branch in all energy matters.

The Coastal Resources Center at the University of Rhode Island, which serves as the technical arm of the CRMC, is currently making a study of the most suitable sites for power plants in Rhode Island. The study will take into consideration the basic standards and criteria that apply to all projects, as set forth in the enabling legislation of the CRMC: (a) the need and demand for various activities and their impact upon ecological systems; (b) the degree of compatibility of various activities; (c) the capability of coastal resources to support various activities; (d) water quality standards set by the Department of Health; (e) consideration of plans, studies, surveys, inventories, and so forth, prepared by other public and private sources; (f) consideration of contiguous land uses and transportation facilities; and (g) consistency with the state guide plan.

The Solutions

Perhaps no issue has received greater attention in recent months than production and consumption of power. The following measures appear to be viable alternatives for meeting future needs.

Demand Management Measures

In the face of worldwide concern about the availability of fuel resources, the simultaneous multiplying of safety and environmental risks, and the spiraling cost of providing new technologies, it becomes clear that it is in the national welfare to reduce the rate of consumption growth before counting up the new power plants we need.

Efficient Pricing of Electrical Power to Reflect the Marginal Costs of Supply. In peak power demand periods – November to February and July to August seasonally, as well as during daily peak periods – demand exceeds base load generating capacity. To meet that need, peaking technologies such as gas turbine and pumped storage facilities must be brought "on line" at higher marginal costs.

Placing a premium on peaking power – peak load pricing– would have the effect of discouraging power demand during on-peak periods, smoothing demand peaks, reducing the need for "standby capacity," and reducing the average cost per kilowatt hour to the utility over an annual period. The savings in cost could be passed on to consumers or be used to improve environmental control technologies.

Revising the Rate Structure. Under the present rate structure, the more electricity a heavy user consumes, the less he pays per kilowatt hour. The question of rates is a complex one, complicated by the fact that increases in

fuel adjustment clauses have all but eliminated benefits large users gain from decreasing block rates. It may well be, however, that traditional economic theory – charging less per unit the more the customer buys – may no longer be in the best economic interest of the nation when applied to energy consumption. The subject requires immediate study.

According to the recently released Ford Foundation Energy Policy Project, adoption of these and other measures – stringent fuel performance standards for new cars, encouraging more efficient space heating and cooling, revising building codes and standards – could slow the total energy consumption rate to two percent per year by 1985. And while one may question the target date or quibble over the most realistic percentage, the basic question is clear: to what extent can we reduce our overall energy consumption rate in the Study region, and thus our total demand for electrical power, without crippling the economy? A state program of public education stressing specific measures for reducing power consumption would be the key in any demand management effort.

Alternatives for Power Plant Siting

A number of alternatives to the current system of reviewing power plant proposals exist:

Continue the Present Siting System

One alternative is to continue siting power plants based on existing procedures. The current system, however, is reactive rather than direct, and the approvals process is fragmented. Two problems loom largest. The initiative for finding a site is left to the utility, and recent history has illustrated that the utilities have not always been good judges of either the development capability of the site or the social atmosphere surrounding it. The result has been lengthy delays in bringing new capacity on line, thereby greatly increasing the overall cost and decreasing the overall reliability of the system. Second, the approvals process – getting clearance from all federal and state agencies involved – is maddeningly fragmented, and may not be any safer for being so. Again, the result is increasingly longer lead times and costs, with the added problem of weakness in design and operations control.

Create One-Stop Coordinated Federal-State Permitting. To resolve some of the problems caused by lengthy delays under the existing permitting process, many advocate a "one-stop" permit system, under which proposals would be cleared through a single agency responsible for seeing that all permit requirements have been met. Advocates point to greatly reduced lead times and thus lower cost. Opponents claim that adequate public scrutiny could easily be bypassed and that such an agency's decision would be difficult to overturn.

Establish Program of State Identification and Protection of Potential Power Plant Sites. This step would guarantee the state and its people that sites are chosen with greatest possible attention to development capability, environmental impacts, and the mood of the local community to such development. Such a state planning process would be more costly initially than the existing system but, once sites have been identified and steps taken to secure them for the future, the benefits of decreased litigation and costs to consumers would be far greater.

To facilitate decision making on the siting of such key facilities as power plants, whether nuclear or fossil, *significant guidance can be obtained from the SENE Study's detailed resource capability analysis.* The Study has surveyed and mapped the land resource characteristics of the entire land area in the Study region. As discussed in *Chapter 3, Guiding Growth,* the result of this analysis was the classifying of SENE's lands on the basis of limitations and opportunities for development. While the Development Capability Maps are not sufficient for detailed engineering and design, they are especially useful for *reconnaissance* study to locate sites with the least potential for resource conflicts.

Using the resource capability data, complex and controversial siting decisions can be facilitated and impacts anticipated and minimized. In a hierarchy of land use measures, the Study places the same emphasis on identification and acquisition of sites for such key facilities as power plants as it does on protection of Critical Environmental Areas. Both are important to the continuing economic health of the region.

The Technological Innovations Alternative

Another alternative is to look to new technology to meet future energy needs. The reasoning is attractive, straightforward, and popular: if we can put a man on the moon we can find clean, safe ways to meet our future power needs. There is a good bit of truth in such reasoning, but there are limitations as well. The Study endorses increased funding for research and development in badly needed alternative energy sources: wind, solar, magnetohydrodynamics, use of waste heat, and others. Yet it also recognizes that even were breakthroughs imminent, which they are not, it would take many years to implement them extensively. The purpose of the Study is to recommend economically realistic and environmentally safe measures for meeting SENE's power needs until new technology can take over, probably not before 1990. The Study concludes that nuclear power, supplemented by fossil and solar, developed under the strictest controls available, and sited in the least damaging areas of the region, is the most realistic technology for meeting near- and mid-term needs, but urges caution against heavy long term reliance on nuclear power

until the legitimate questions raised as to its safety have been resolved.

Alternative Plans

In light of the foregoing, the following alternative plans were investigated to meet the region's power needs, one maximizing economic development and another environmental quality.

One, the plan emphasizing economic development, would favor power plant sites and generation technologies with the least cost, the most efficient operation, and making the greatest contribution to the regional economy. Since the Study area is well endowed with saline cooling water, this plan calls for Southeastern New England to become a net exporter of power to New England as a whole. The plan would give special priority to location of power plant sites, would permit thermal loading of coastal waters and a degree of air and water contamination under special variances, and would allow transmission preference over aesthetics.

Another plan, emphasizing environmental quality, replaces economic goals with maximum environmental security and would cause it to be more beneficial for SENE to become a net importer of power from elsewhere in New England. This plan would place fewest demands on the resources of the Study area but would simultaneously reduce the reliability of service, reduce efficiency, and create substantially higher costs.

Recommendations

The recommended program emphasizes energy conservation and demand management with a general goal of base load self-sufficiency, prefers nuclear base load generation for at least the period to 1990, stresses fossil power for peaking generation, provides siting guidance, and emphasizes expansion of existing sites to limit impact and achieve economies of scale. The program includes the following programs and priority actions:

Demand Management and Conservation. While additional generation capacity will be required to meet SENE power demands, much can be done to slow the rate of consumption:

7. **Create state energy conservation education program. Top priority should be given in each state to the creation of a wide ranging public education program aimed less at exhortations of conservation and more on specific measures for reducing consumption.**

8. **Provide state technical assistance on energy consumption rate reduction. In light of the Ford Foundation's Energy Policy Project findings and recent national conservation initiatives, it would be appropriate for each state Energy Office to provide technical assistance to commercial and industrial interests on energy consumption rate reduction as an element in the public awareness program.**

9. **Implement conservation measures. Among the measures which should receive state endorsement and implementation are:**

   - **significant tax credit incentives for energy consumption reduction measures in the residential, commercial, and industrial sectors;**
   - **revision of building codes to include mandatory increases in insulation requirements and standards in new buildings;**
   - **mandatory reductions in lighting, space heating, and cooling levels in all public and commercial buildings;**
   - **labeling and taxing low efficiency, high energy use appliances;**
   - **use of waste heat in the design and operation of all new private and public buildings; and**
   - **utilization of processed refuse as fuel supplement in fossil fuel plants.**

10. **Revise pricing policy. To bring rate schedules more in line with the full marginal costs of supplying power, the Massachusetts and Rhode Island Public Utilities Commissions should encourage state legislation to:**

    - **establish a schedule to encourage substitution of off-peak for peak power consumption, either through premium pricing for peak use or cut-rates for off-peak use; and**
    - **explore the cost-justification for adjusting the energy-inefficient decreasing block rate schedule for heavy power users.**

Siting. To assure the availability of suitable sites for future generation capacity.

11. **Identify and secure power plant sites for the future.** The Rhode Island General Assembly and Massachusetts General Court should expand the authority of the Coastal Resources Management Council and Energy Facilities Siting Council, respectively, to permit those agencies to identify and secure sites for future development, to the extent possible. The goal of the region should be to minimize dependency on external sources of supply.

12. **Avoid Critical Environmental Areas for future sites.** The state siting agencies should avoid areas within SENE resource categories A and B for generation facility siting. Sites in category C should be very carefully reviewed for environmental, economic, aesthetic, and social impact.

13. **Maximize development at existing power plant sites.** Wherever possible the state siting agencies should require full expansion of development capability at existing facility sites and/or redevelopment at abandoned sites.

14. **Upgrade or phase out inefficient plants.** Existing near-urban fossil units should be phased into a peaking program to minimize their use. Units presently violating air quality standards, or operating under variances, should be upgraded immediately or retired.

15. **Put lines underground during urban redevelopment.** A program of selective undergrounding of existing overhead transmission and distribution lines should be established by power companies in concert with large urban renewal programs or new suburban development.

16. **Provide interim recreational use of undeveloped power plant sites.** The state siting agencies under expanded authority should provide interim recreational uses of sites secured for future development of power plants.

17. **Simplify licensing procedures.** To simplify the licensing procedure pursuant to the recommendations of the state-Nuclear Regulatory Commission (NRC) 1975 Workshop on Federal-State Cooperation in the Environmental Review and Hearing Process, both the states and NRC should establish liaison officers to coordinate review, conduct joint hearings, and coordinate in the preparation of impact statements.

Implications

Implementation of these recommendations would recognize both the vital part electrical power plays in the maintenance of public health and welfare, and the potential risks of power plant development. It is felt that the recommendations constitute a realistic program which will provide adequate electrical power under fairly rigorous, yet practical, demand management guidelines to meet the needs of the people of Southeastern New England in a manner which supports continued economic development and assures social well-being. Moreover it provides a mechanism for streamlining the siting and licensing process through efficient and coordinated state and federal action. Finally it places priority on the provision of suitable sites now to meet future generation requirements at the least cost to the environment and social well-being. By recognizing the importance of siting regionally significant facilities such as power plants, while at the same time recognizing the importance of Critical Environmental Areas, both the region's economic and environmental goals will be served.

PETROLEUM FACILITIES

The United States is the most oil hungry nation in the world and New England is the most oil hungry region in the nation. With only six percent of the nation's population, New England accounted for over 20 percent of its oil consumption in 1972 – over 1.1 million barrels per day. Indeed, during the last two months of 1973, the only part of the world more dependent on foreign oil than New England was Japan.

The Study does not attempt to add to studies already underway to determine for the New England Governors the economic and environmental impacts of deepwater

ports or refineries. Rather, the purpose of this section is to provide some insight into the nature of petroleum demands, mechanisms for managing these demands, and guidelines for siting major facilities should that decision be made, in a manner which is economically sensible and environmentally safe.

The Situation

Of the 31.2 million tons of petroleum products received at Southeastern New England's ports in 1972, 27 percent was gasoline, 31 percent was distillate (primarily #2 home heating fuel) and 42 percent was residual oil (used in power plants and industry). Moreover, SENE consumers paid as much as 40 percent more for some of these products than consumers elsewhere in the nation.

It would be logical to assume that anyone with that big a corner on the demand for a product would try to achieve some degree of control over the supply of that product. Yet there are no refineries in SENE, nor in all New England for that matter. New England is so far away from the nearest refinery that pipelines are not feasible and oil products must be shipped by tanker. And SENE's developed ports, as elsewhere in the nation, are so small and shallow they are unable to accommodate today's modern deep draft tankers. The result is numerous small tanker calls, heavy harbor congestion, frequent "nuisance" spills, and a steadily increasing probability for a spill of major proportions. Existing storage facilities, with an average of seven inventory turnovers annually, are nearly used to capacity and are reaching the point of being unable to safely meet demand.

By the second month in 1974 the Arab oil embargo had begun to significantly affect the normal course of economic events in the nation, and SENE's consumers were beginning to realize how dependent on foreign oil they were. In fact, of the 1.1 million barrels per day consumed in New England in 1972, 360,000 barrels, or one-third of the consumption, were directly imported from foreign refineries. In addition, 25 percent of the products which were domestically refined were from foreign crude. As a result New England, and SENE in particular, is directly or indirectly dependent upon foreign imports for almost 50 percent of its needs. This makes the region particularly vulnerable to foreign cutbacks.

The nation's vulnerability to changes in the foreign supply situation has spurred interest in potential oil and gas reserves on Georges Bank, the renowned fishing grounds on the outer continental shelf (OCS) off Cape Cod. The process of exploring and developing these potential reserves has already been set into motion. The Department of the Interior offered nearly 16 million acres, and the oil industry subsequently nominated nearly 11 million acres, of the North Atlantic OCS for exploration. Following the announcement of which of the nominated tracts will be offered for leasing and the completion of environmental impact statements, lease sales are likely to be held in August, 1976.

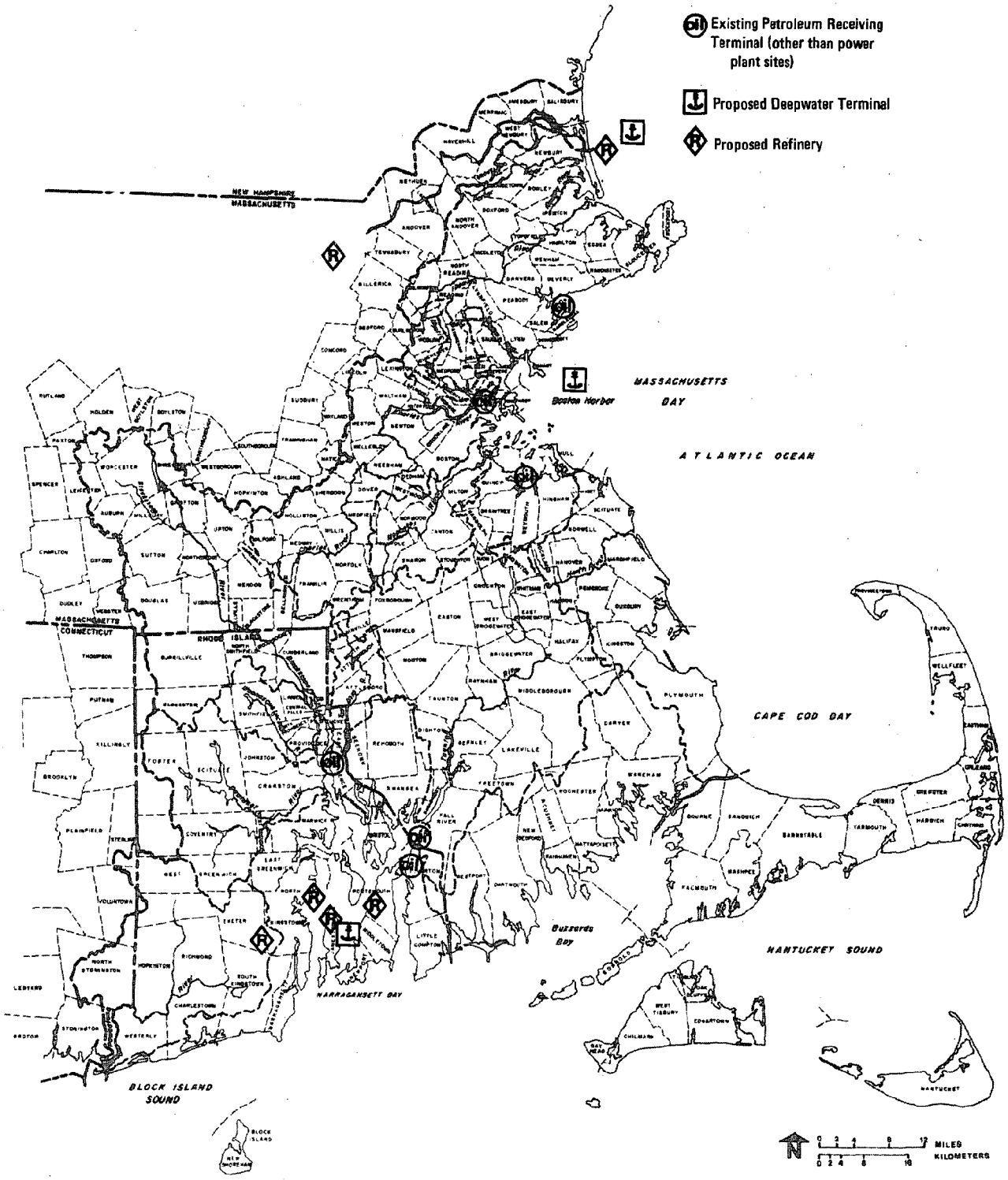
The states are not without resources to help cope with the onshore impacts of OCS oil and gas exploration and development. Both Rhode Island and Massachusetts are developing coastal zone management programs under the 1972 Act, and both are members of NERBC's regional coastal zone and OCS task forces. Also, $6 million are now available nationwide through the Office of Coastal Zone Management for OCS impact planning – $3 million in FY75 supplemental funds and $3 million in FY76 funds. In addition, two bills passed in the Senate – S.586 amending the Coastal Zone Management Act and S.521 amending the Outer Continental Shelf Lands Act – establish "Coastal Energy Facility Impact Funds" and provide annually $100 million nationwide for planning for the impacts from the exploration, development or production of energy resources, and $200 million to ameliorate impacts resulting from exploration and production of energy resources. There are no state matching requirements.

The region's inordinate dependence upon foreign supplies, the potential of Georges Bank, and the nature of increases in demand projected for the future, have made parts of SENE the target of a barrage of proposals for developing petroleum receiving and refining facilities. Proposals have been made by a number of entrepreneurs, including several independent oil companies, at least one state government agency – The Massachusetts Port Authority (Massport) – and other interests as diverse as Greek shipping companies, and a local dairy products company. These proposals are shown on Figure 9.2. Notable in their absence are the major oil companies.

Market, Environmental and Economic Considerations.

A number of factors serve to explain the failure of past refinery development proposals and the industry's lack of interest. According to the recent report "Effects on New England of Petroleum-Related Industrial Development" prepared by consultants for the New England Regional Commission (NERCOM), the major stumbling blocks nationwide, but felt more keenly in New England, include: the political instability of foreign oil supplies; uncertain federal and regional energy policies; high cost of investment; uncertain market conditions; other financial constraints; and environmental opposition.

The NERCOM report asserts that "except for the long-term possibility of extensive Georges Bank production, it is unlikely that extensive petroleum-related industrial development will occur" in New England. From a national perspective, and particularly from the point of view of the



NEW ENGLAND RIVER BASINS COMMISSION
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SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

EXISTING AND PROPOSED
PETROLEUM FACILITIES

FIG. NO. 9.2

major oil companies, this conclusion is, no doubt, accurate. New England, however, is unique in that a major portion of its market is dominated by highly entrepreneurial and independent oil companies – "home based" companies with more to gain from regional refining than the majors, whether their crude originates on Georges Bank or from foreign sources.

Should refinery development occur, Southeastern New England is likely to be the center of activity. SENE consumes over 50 percent of the oil consumed in New England and demand is expected to increase at the rate of 5.3 percent annually to 1985, decreasing to 3.4 percent thereafter. It is strategically close to Georges Bank. Market scale and distribution logistics are favorable. Developable land exists. Consequently, it is useful to examine the requirements and likely effects of petroleum-related development.

By far the greatest physical effects of oil refineries are on land. For example, a 250,000 bbls/day refinery requires 1,000 to 1,500 acres, including necessary 40-day storage capacity and "green belt" treatment. Similarly, expansion of existing tank farms, located near offloading terminals in major product demand centers, may require large tracts of scarce urban and urban/coastal land. Terminal development, whether coastal (as in Narragansett Bay) or offshore (as off Nahant, Massachusetts) may require a degree of dredging, with the potential problem of disposing of partially polluted marine sediments. Distribution of refined products may result in significant disruption during construction in the case of pipelines and a higher probability of oil spill occurrences in the case of coastal tankers.

Water is also a major limiting factor. Under current technology a 250,000 bbls/day refinery will use roughly 10.5 million gallons per day for cooling and processing. According to the NERCOM report, only three rivers in the market area – the Merrimack, Androscoggin, and Connecticut – could meet this demand. Alternatively, an air-cooled plant would require only 3.4 mgd., primarily for process water.

The air pollution effects of refinery operation are also significant. Again, according to the NERCOM report, unless significant advances are made in hydrocarbon emission control technology, air quality standards will be exceeded regularly in normal refinery operations.

With lease sales for the North Atlantic OCS expected within a year, the impact of exploration-related development is already being felt in SENE. Among the requirements of exploration are: a small amount of land, primarily office and warehouse space; harbor and pier facilities for roughly 30 boats; a twenty foot channel; highway, air, and rail transportation access; and helicopter facilities closest to the drilling sites (Nantucket has already received inquiries). The industry apparently sees three areas in SENE as meeting most or all of their exploration requirements: Boston, the Fall River-New Bedford area, and Narragansett Bay.

To help the New England states cope with the complexities of OCS-related industrial development, NERBC has begun a study on the "Development and Application of a Methodology for Siting Onshore Facilities Associated with OCS Development". The program is funded through the Resources and Land Investigations (RALI) program of Interior's U. S. Geological Survey.

Several recent studies indicate that the economic benefits of petroleum-related industrial development are not especially significant from a regional perspective. The NERCOM study has found that:

(1) Georges Bank production and local refining will not lower the price of oil products for the consumer;

(2) It is unlikely that any find on Georges Bank would be large enough to make New England an exporter of petroleum products;

(3) Potential direct and indirect employment from a 250,000 bbls/day refinery would total roughly 1,500 people. Depending on the nature of a find on Georges Bank, total related employment could reach 10-12,000 people, most of them local. The induced employment would be regionally insignificant but could have dramatic local impacts;

(4) Local tax benefits could well be offset by the cost of required municipal services; and,

(5) Regional refining, even with Georges Bank development, would not appreciably increase the security of oil product supplies in SENE or the rest of New England.

Despite this somewhat gloomy forecast, some industrial development will occur in SENE during the OCS exploration and development stages, and it is clear that the states will need to establish systems for reviewing development proposals and, perhaps, for identifying and securing potential development sites able to meet the needs of the industry with a minimum of environmental disruption. As indicated in *Chapter 3, Guiding Growth,* it is a policy assumption of the Study that protection of potential sites for key facilities is as important to the future of the region as the protection of Critical Environmental Areas.

Institutional Considerations

While the siting and operation of a refinery, for example, have been shown to have little effect on the region as a whole, the local effects are considerable. With this kind

of leverage the industry's best bet for siting is to bring a proposal directly to the locale. The very nature of the petroleum industry's intensely competitive production, refining, distribution, and marketing activities, combined with local economic leverage, appears to minimize coordination with state or regional siting agencies and plans. Nevertheless, both states are taking steps to handle industry proposals.

In Rhode Island, a potential conflict in power plant and refinery siting authority between the Coastal Resources Management Council (CRMC) and the Port Authority and Economic Development Corporation (PA-EDC) appears to have been resolved. It has been determined that CRMC has authority over PA-EDC for such siting decisions. According to an "observation" by the Rhode Island Attorney General, the State General Assembly can review, accept, or reject a PA-EDC proposed power plant or refinery over CRMC's opposition. However, CRMC has final authority over proposals not originating with the PA-EDC. And, in addition to its utility regulatory functions, the Public Utilities Commission will also have responsibility for developing a comprehensive state energy program.

In Massachusetts, the state's Electric Power Facilities Siting Council, created in December, 1973, had its authority extended by amendment in August 1974. Under the amendment, the renamed Energy Facilities Siting Council has additional authority over natural gas facilities. In September 1975 the Council's authority was further extended to include review of siting proposals for major petroleum-related facilities. The Massachusetts General Court, however, has failed to date to provide the Council with the funds to permit it to adequately perform its duties.

The Solutions

Demand Management

While the majority of recommendations described below deal with facilities siting and configuration, much can be done to significantly decrease the rate at which we consume petroleum and other energy sources. As described in the section of this chapter dealing with electrical power, a recent Ford Foundation study claims that we can reduce the rate of growth of petroleum consumption to two percent per year. Indeed, the oil shortage in New England depressed demand, according to the Massachusetts Port Authority, from 4.3 percent in 1972 to 2.4 in 1973. Whether that level could have been continued longer, without causing major disruption to the region's economy, is unclear. In 1973 the incentive for demand reduction was price. In the future we will have to develop more imaginative incentives. Insulation standards for new construction can be upgraded, tax deductions can be made available for voluntary measures to decrease consumption, the states can establish and promote demand management goals in every economic sector through public awareness programs. Setting a percent goal for slowing the rate of consumption of energy may be unrealistic. Yet much "fat" remains to be trimmed – the potential for reducing petroleum demands exists. Indeed, after the tight winter of 1973, we are already accelerating consumption today.

Facilities Alternatives

The following discussion presents several alternative steps under each of the major facilities in the petroleum system.

Delivery. Alternative measures for delivering crude oil include pipelines, coastal tankers, and deepwater terminals. **Delivery by pipeline** of either crude or refined product to SENE from the nearest petroleum facilities center (New Jersey) would be extremely costly and is commonly discounted. Harbors now receiving **coastal tankers** – Boston, Providence, Fall River, Weymouth, Salem, and Cape Cod Canal – are expected to experience heavy traffic congestion in the next decade. Based upon anticipated petroleum receipts, vessel trips would increase from 1,000 trips in 1972, to 2,200 trips in 1990, and 5,400 trips in 2020. And, as stated earlier, the greater the small tanker traffic, the greater the likelihood of collision and spills. Recognizing the limitations, then, of pipelines and tankers for delivering product to New England, planners in the region have begun to turn to **deepwater terminals** – coastal, as in the case of Narragansett Bay, and far offshore, as in the case of Massport's proposal off Nahant, Massachusetts. Technology is well developed and several options exist. Immobile facilities include: artificial islands, sea island berths, and marginal piers; mooring facilities include conventional buoy, single point buoy, single anchor leg, and single point swivel pier. The advantages, explained earlier, include among others, reduction of traffic, and ability to tranship or offload the largest vessels with speed and relative safety.

Refining. To preclude preemption of valuable coastal, and especially coastal/urban lands, from other uses and to protect critical or environmental resources generally more prevalent in such areas, potential refinery sites are preferred inland, close to existing labor and demand centers, and in areas already served by transportation, communication, water supply, and wastewater infrastructure.

Distribution. Again, **coastal tankers** are a possibility. Yet if the region's goal is to lessen coastal tanker trips and the probability of accident, then clearly **pipeline distribution** systems are preferred. Though it is unlikely that any refinery within SENE would have a solely SENE market, distribution by pipeline in the Study area would be preferable from an economic as well as strictly environmental point of view.

Alternative Plans

Three alternative plans were examined, each maximizing to a greater or lesser extent economic development and environmental quality objectives.

A plan emphasizing national and regional economic development was investigated which would capitalize on the region's deepwater near-shore and offshore port potential and abundant coastal land close to major marketing and distribution areas. Under this plan, priority for land allocation is given to refinery and related heavy industrial development at sites closest to delivery and market areas. With SENE developing as a net exporter of refined products to New England and the nation, significant national economic benefits could be attained. Regional short and mid-term economic benefits, in terms of additional employment and growth of regional income, would be considerable. Under such a plan, however, no significant degree of supply assurance or cost savings would be gained. Even with federal air and water pollution control standards, degradation of the Study area's environment would occur. The emphasis on allocating land to industrial development would have important opportunity costs to other users of land.

In contrast, another plan emphasizing environmental quality would eliminate SENE and New England as a whole from further consideration for refinery and related heavy development. Under this alternative, SENE would continue to be a 100 percent importer of refined oil products, and an extremely high degree of state controlled demand management would be essential. Petroleum consumption quotas would have to be established for all uses, special tax deductions would be granted for insulation improvements, building specifications would undergo marked revision for insulation standards, strict transportation, particularly automobile, restrictions would be established (and petroleum pricing would increase markedly to stifle demand). The program would also include the development of one deepwater terminal for receiving refined products to eliminate the threat of spills within existing and crowded harbors. Distribution would be exclusively by underground pipelines. Environmental quality would be preserved but the economy could suffer. Likewise, no contribution to national economic efficiency could be made under the plan. The escalation of cost would be felt most keenly by lower income groups and a steady decrease of social well-being of a significant sector of the region's population would be inevitable.

Recommendations

Between these two extremes, a significant number of options remain. The recommended program involves demand reduction, strict control over development if it should occur, deepwater port development, pipeline distribution, and maximum feasible environmental control. The program assumes that the environment would be best served by a deepwater port and pipeline distribution system and strict controls over refinery operations. It further assumes that a significant degree of reduction in the rate of growth of demand can be attained by innovative state action.

An important limitation of this program should be noted. The New England Regional Commission, working with other agencies throughout the region, is developing a study of the regional energy and facilities siting situation in New England. The results of this study will not be available until later in 1975. Further, the specific regional policy implications will not be decided by the New England governors until some time later. The following recommended program was developed without the benefits of detailed regional analysis, but nevertheless presents a course of action designed to balance certain national economic efficiency objectives and environmental quality goals within the best interests of regional economic efficiency and social well-being. The following programs and actions are recommended, *generally in order of priority:*

Demand Management. While a number of options of varying severity are available – and more often than not untested – the following appear most socially feasible:

18. **Revise building standards. The Massachusetts Department of Community Affairs, and the Rhode Island Statewide Planning Program and Department of Community Affairs, should promulgate revised standards for new buildings with a view to improving upon heating and cooling system efficiencies. The building code provisions in each municipality in the Study area should be revised to meet these standards. Care should be taken, however, that such standards do not serve to discourage efforts to rehabilitate existing old buildings.**

19. **Provide tax incentives for conservation. Liberal state tax deductions should be established for voluntary domestic, commercial, and industrial energy conservation improvements, whether to heating and cooling systems or insulation. State excise taxes could, for example, be set so as to encourage purchase of small cars.**

20. **Provide energy consumption reduction technical assistance. Both states should establish energy conservation technical assistance and energy aware-**

ness public education programs to bring consumption in line with conservation goals.

21. **Fund mass transit systems.** Both states should tap state highway funds (the general fund in Rhode Island) to provide significant expansion of rail, bus, and rapid transit systems in order to effect substantial reductions in commuter automobile use and attendant gasoline demands. (A 1974 referendum in Massachusetts has already approved this concept.)

Facilities Siting. To improve the existing system for siting major petroleum facilities, the following steps are recommended:

22. **Establish state siting authority in Rhode Island.** The legislature should authorize Rhode Island Statewide Planning Program to approve or reject refinery proposals and survey and protect potentially feasible sites for future development.

23. **Strengthen state siting authority in Massachusetts.** The Massachusetts Energy Facilities Siting Council should be funded and staffed immediately to permit it to perform its legislatively-mandated review authority over energy facilities. The Council should also be authorized, funded and staffed to permit it to inventory and secure potential development sites for the future.

24. **Consider regionwide implications of siting decisions.** Both states should evaluate specific siting decisions in the context of the policy implications of the New England Regional Commission and the New England River Basins Commission's regional energy facility siting studies. Regional policy issues should be resolved by the New England Governors. Moreover, future siting decisions of the above mentioned agencies should be made in consideration of both the statewide and regionwide implications of petroleum facilities siting.

25. **Establish standards and criteria for refinery siting and operation.** With guidance from the Environmental Protection Agency, the Corps of Engineers, NERCOM, NERBC, and the Federal Regional Council, the states should establish standards and criteria for petroleum facilities siting and operation, maximizing environmental protection.

26. **Use SENE development capability analyses in siting decisions.** As a general rule no key facility should be considered on resources mapped by the SENE Study under Critical Environmental Area Categories A or B (SENE Plates 1, 2, and 3). Very careful investigation of environmental effects should be undertaken before any facilities are constructed on Developable Areas Category C. *[Categories described in Chapter 3 of this report.]*

Facilities Configuration. The Study believes that the fact that many decision makers view the development of petroleum facilities as inevitable to some degree is not a reason for resigning the decision making authority to the industry, but for strengthening state policy guidelines to assure that such decisions are made in the best interests of SENE and New England as a whole. Consequently, basic policies concurred in by the SENE Study are:

27. **Establish deepwater port(s); evaluate each individually.** As a matter of state policy, deepwater port(s) should be the preferred method of petroleum delivery, eclipsing coastal tankers wherever feasible, with the distance offshore determined individually, based on the technical and environmental considerations of each site. Blanket statements on distance from shore for such facilities should be avoided. Any decision as to the advisability or inadvisability of individual deepwater port siting proposals should await the completion of the regional port study recommended elsewhere in this report.

28. **Locate refineries inland near infrastructure.** Should their need be determined, refineries, storage facilities, and related industrial development should be located inland by the state siting agencies in areas already served by necessary transportation, water supply, and wastewater services.

29. **Distribute refined products by pipeline.** Distribution of refined products should

be via underground pipeline wherever practicable and along well identified corridors.

30. **Use most advanced technologies. State siting agencies should ensure that operation of any and all facilities use the most advanced environmentol control technologies available.**

Implications

In view of the complexity of the problem and the broad regional implications of siting decisions, an exact assessment of the economic, social, and environmental costs and benefits of petroleum-related industrial development was not within the scope of this Study. Like it or not, we must admit that, for at least the reasonably near future, SENE and the rest of New England will continue to be dependent on oil – oil which we neither produce nor refine. Should the region's decision makers, upon reviewing the results of these and other impact studies, determine it to be in the best interests of the region to provide regional refining capacity, it is felt that the recommendations above provide a practical framework for policy making, one which provides a modest response to national pressures while minimizing negative social and environmental effects within the region.

SOLID WASTE MANAGEMENT

Finding a way to dispose of the tremendous amount of solid waste we generate daily is one of the most perplexing problems facing a region as populous as Southeastern New England. And while the Study was not intended to be a definitive investigation of how these wastes are managed in the region, the consequences of improper solid waste disposal on water resources requires that at least some investigation be made. The solid waste disposal problem is both a nuisance and an opportunity, and both states in the SENE area have begun to recognize that the objective in solid waste management is not so much getting rid of waste as it is recovering and using wastes to meet some of our needs.

The Situation

Solid waste disposal sites throughout Massachusetts and Rhode Island handled 7.5 million tons and roughly 590,000 tons respectively in 1973. By 1980 those figures are expected to climb to 8.7 million and 717,000 tons, respectively. Despite these demands, disposal sites are disappearing. In the SENE portion of Massachusetts, for example, 51 out of the 147 municipal disposal sites have a life expenctancy of only five years. To the vast majority of the people of the region, solid waste disposal is a non-issue. You put your waste in bags, set them out on the street and they are taken away. Yet the trends are quite clear. With more wastes and fewer sites SENE is running out of places to dispose of its refuse and garbage.

In the last decade open dumps have largely been replaced by what are nominally, at least, sanitary landfills. Both Massachusetts and Rhode Island have regulations for the maintenance of disposal sites under the enforcement of each state health department. Regulations were revised in Rhode Island as recently as November 1974.

Yet in spite of improvements, neither state can claim complete success in regulation enforcement. In Rhode Island, 71 percent of the 35 municipal sites do not meet sanitary landfill standards. In Massachusetts, 80 percent are deficient.

The major problem at unacceptable disposal sites is water pollution. Because they are "unwelcome neighbors", many of the landfills are located on land no one wants, such as marshes and flood plains. Water flowing through the material in these sites picks up phosphates, chlorides, and other pollutants, producing a leachate which can be highly contaminating to streams and ground water aquifers.

Recently, however, both states have devised new statewide solid waste management plans in an effort to better handle the problem. In Massachusetts, an interagency planning unit has proposed a statewide solid waste recovery system on a regional basis. Implementation is scheduled to begin in 1976 and full statewide operations are to be in swing in 10 or 15 years.

The state plan proposes a joint venture of state, municipal, and regional governments with private enterprise. Through their combined efforts the system provides for the collection, hauling, transfer, processing, and disposal of all solid waste material generated within Massachusetts. Provisions will be made in the system for the handling of special and hazardous wastes.

Local governments will be responsible for collecting municipal solid wastes at their sources, transporting solid wastes to either a municipal or district transfer station, and processing waste at municipal transfer stations. The state's responsibilities will include transport of waste from district to regional facilities, administration of district and regional fa-

cilities, and the regulation, inspection, and enforcement of all aspects of waste handling.

Private responsibilities will include collection and transportation of wastes, processing and reclamation of solid waste, operation of municipal, district or regional facilities, and secondary materials industry development.

Rhode Island has established a Solid Waste Management Corporation and although a bond issue was defeated in the 1974 elections, the Corporation recently received funding to proceed to the next phase of planning. The Rhode Island program is publicly managed with the state contracting with private operators for services. Municipalities must dispose of wastes at a licensed disposal facility within their boundaries or use a facility made available by the Corporation. The Department of Health continues to monitor the programs.

Resource recovery is key to both systems. Material which can be recovered includes ferrous metals, aluminum, other non-ferrous metals, and glass. The largest and most valuable resource, however, is that portion which can be converted to fuel that can be used to produce electricity. It is estimated that 15 percent of the energy consumed by Massachusetts utilities in the process of generating electricity could be recovered by burning processed wastes with coal or oil.

The Solutions

Land Disposal Sites Should be Selected to Minimize the Infiltration of Leachate into Surface and Ground Water. Selection and operation of solid waste disposal sites in accordance with existing sanitary landfill regulations of both states could prevent future degradation of water resources. Physical barriers such as clay layers, polyethylene sheets, and asphalt liners could also be used to minimize the ground water contact by trapping the leachate.

Besides keeping leachate from reaching any aquifers or streams, other provisions which should be incorporated include daily coverage to prevent rodent and insect problems, spreading and compaction of incoming refuse, and venting for methane gas.

Established Landfills Should be Operated Under the Appropriate State Regulations to Minimize Impact. Proper management can make sanitary landfill operations both an acceptable and effective means of solid waste disposal as recovery technologies are refined. Where land is available, a sanitary landfill is usually the most economical method of solid waste disposal, and the initial investment is low compared with other disposal methods. Furthermore, a sanitary landfill can receive all types of solid wastes, eliminating the necessity of separate collections. It is also a complete disposal method, as opposed to incineration or composting which require additional treatment or disposal operations.

Encourage Community Participation in State Solid Waste Recovery Programs. Clearly sanitary landfills are, like dumps before them, only a stopgap solution. As non-renewable resources become more and more scarce, solid waste recovery becomes more and more appealing.

Resource recovery has the potential to generate revenues which will reduce the cost of disposal in the future, as well as the potential to reduce the amount of land that would otherwise be required for landfilling.

Recommendations

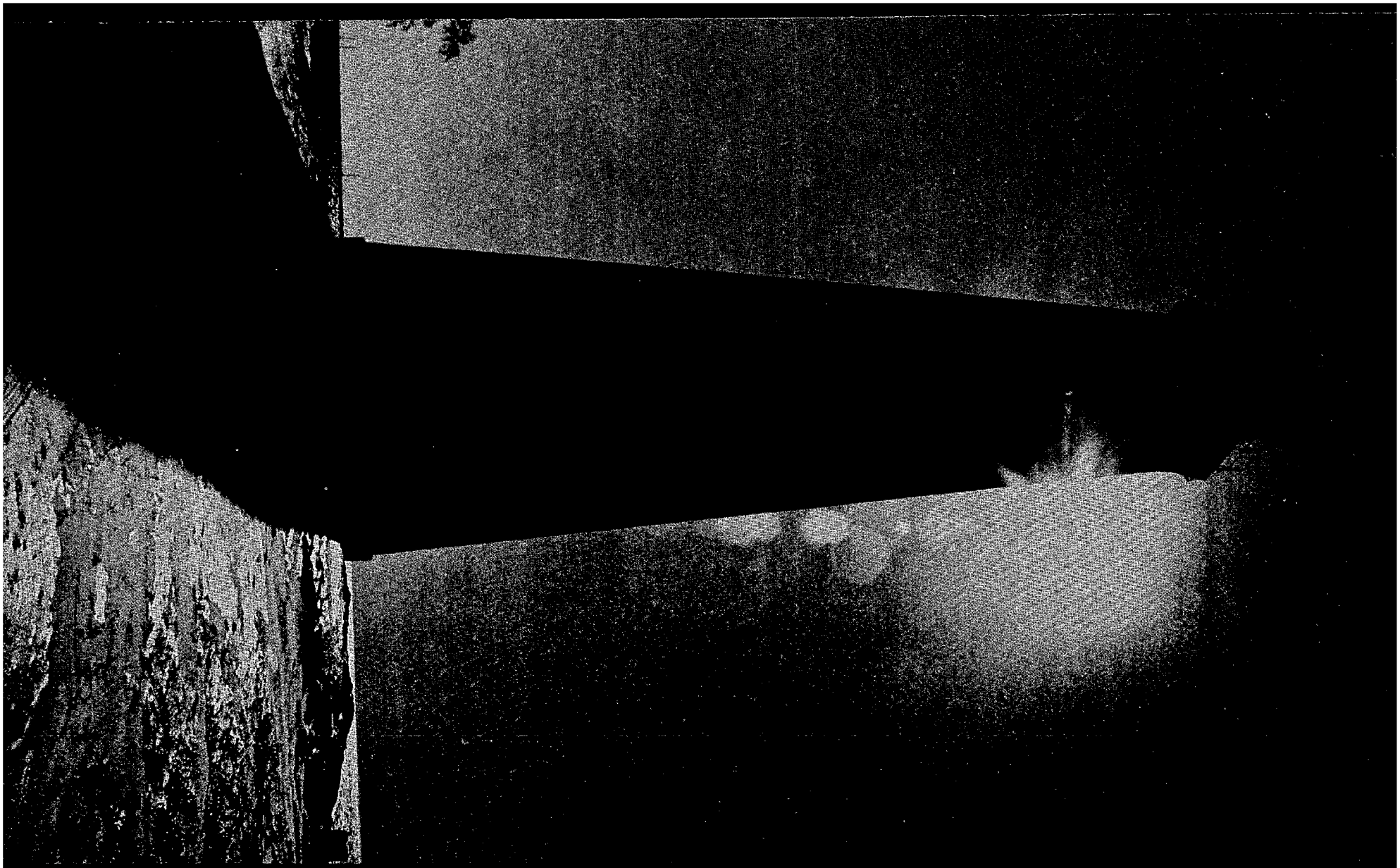
31. **Enforce existing sanitary landfill regulations. Whenever alternative solutions exist, each state health department should strictly enforce existing sanitary landfill regulations.**

32. **Fund the Rhode Island Solid Waste Management Corporation. The General Assembly should move at once to provide at least partial funding to the Solid Waste Management Corporation for staff and continuing planning.**

33. **Accelerate local participation in recovery programs. The Study strongly endorses each state recovery program and urges speedy participation by municipalities.**

Implications

The existing management programs, with the above slight adjustments to detail, will be adequate for meeting the needs of SENE's growing population and refuse problem. At the same time, the new programs will contribute significantly to the improvement of the region's environment and, as a result, to the quality of life of the people of the region.



Strengthening the Management System for Natural Resources

10

CHAPTER 10 STRENGTHENING THE MANAGEMENT SYSTEM FOR NATURAL RESOURCES 10-1

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CHAPTER 10 STRENGTHENING THE MANAGEMENT SYSTEM FOR NATURAL RESOURCES

The Setting

How Natural Resources Policy is Made and Implemented

The Legislature and Governors of both Massachusetts and Rhode Island are responsible for setting a broad policy framework for the state. Within that context, the Executive, through various administrative departments, refines those policies and develops programs to implement them.

The **federal** government too, sets broad environmental policies. But by and large, its role has been limited to the administration of grants, guidance and review of state programs, technical assistance, and in some cases, performing direct, substantive resource management activities. Interstate regional agencies, such as the New England River Basins Commission, the New England Regional Commission, and the New England Governors' Conference, provide coordination between states and reinforce their efforts to develop integrated programs.

State agencies directly concerned with the formulation and implementation of natural resource policy and the delivery of programs include, in Massachusetts, the Cabinet, the Secretary of Environmental Affairs with the Coastal Zone Management Program and the Department of Natural Resources, and the Secretary for Communities and Development with its Department of Community Affairs; and in Rhode Island, the State Planning Council and Statewide Planning Program, the Department of Natural Resources, the Coastal Resources Management Council, and the Water Resources Board.

It is the **local** level at which many specific resource decisions are made. Local governments prepare land use and resource plans, make primary decisions with regard to land use, and construct water and wastewater facilities. **Substate regional** planning agencies in Massachusetts ensure the coordination between towns of local plans and policies.

Most of the specific recommendations of the SENE Study presented in the preceding chapters can be implemented promptly under existing laws and by existing local, state, and federal government agencies, and the private sector. In other cases, modifications in the authority of individual agencies may be required; these are discussed in earlier chapters and are presented in *"An Index for Decision Makers"* in the concluding section of this chapter.

The purpose of this chapter is to outline, in the context of public institutional and governmental arrangements, suggestions for securing the *integration* of policies and major programs so that the conflicting array of human wants and needs – for a decent environment in which to live and a productive and stable economy – are served.

A STRATEGY FOR NATURAL RESOURCES MANAGEMENT

Some Key Assumptions

This discussion of ways to implement the SENE Study recommendations is based on several key assumptions:

(1) Natural resource policies must be developed in coordination with economic and social policies;

(2) Encouraging growth patterns based, in part, on natural resource development capability, and water resources in particular, is desirable. The process by which land is consumed can be guided so as to protect Critical Environmental Areas and maximize the efficiency of public investment in infrastructure, without diminishing the opportunities for choice and variety in lifestyle;

(3) Governmental action to achieve these ends is necessary and desirable. Guiding growth effectively depends on the integration of private actions and the authority and responsibility of all levels of government; and,

(4) The state is the appropriate level of government to provide leadership in pursuit of that integration. It can regulate private actions, guide, assist, and review efforts of local government; coordinate state government

actions; and guide federal actions except where overriding questions of national interest are involved.

Elements of a Strategy for State Leadership

The vast majority of the recommendations in the SENE Study are directed to agencies of the two states. This emphasis on state leadership is consistent with traditional constitutional principles of the role of the states in the federal system. Moreover, it is consistent with the policy of the current Administration and Congress to strengthen the state role in resource decision making. This is clearly the intent of much recent federal legislation, from Revenue Sharing programs to the Water Pollution Control Act Amendments of 1972 and the Coastal Zone Management Act of 1972. The latter, in fact, declares that "the key to more effective protection and use of the land and water resources of the coastal zones is to encourage the states to exercise their full authority over [those] lands and waters. . ." (§302(H)).

Finally, the Study's emphasis on state leadership is consistent with policies established by the states themselves. Both the New England Governors' Conference and the New England River Basins Commission have explicitly recognized and adopted a policy for natural resources management emphasizing the states as the integrating level of government. In its resolution of December 15, 1972, the Governors' Conference recommended that:

> "Each state should review and, as necessary, strengthen its organizational structure and planning processes to secure integration of land use, coastal zone, water quality, and related natural resource management programs consistent with the environmental, social, and economic goals of the state, and should support and participate in cooperative programs to solve interstate and multistate resource problems through appropriate regional mechanisms."

The New England River Basins Commission recognized the pivotal role of the state in its report "Strategies for Natural Resource Decision Making" approved December 6, 1972. According to that report "The Commission recognizes and endorses the evolution of a rational strategy for natural resource decision making. The strategy recognizes the state as the dominant level of government, acting within the framework of national policies and with assistance from the federal government."

The State Role. The steps the Commission recommended the states take included the following:

(1) Design overall natural resource strategies in the context of economic, social, and environmental goals of the state;

(2) Formulate and execute natural resources plans and programs as elements of an overall strategy for effective management of the total natural resource base of the state. The state structure should be capable of identifying relationships among functional programs (water resources, fish and wildlife, outdoor recreation, etc.) and of relating these to the overall strategy;

(3) Develop a focal point within state government capable of: (a) assessing relationships among natural resource programs, securing their integration, and monitoring performance against overall natural resources strategy; (b) stimulating, guiding, and assisting political subdivisions of the state in natural resources decision making;

(4) Assure access for effective participation by local governments and private citizens, and interests in formulation and execution of state programs; and

(5) Support and participate in cooperative programs to secure effective natural resource management in interstate and regionwide contexts.

The Federal Role. To reinforce these efforts the Commission also recommended that "the federal agencies administering programs of assistance to states for natural resources planning and management activities. . . should offer positive assistance to integration of natural resources decision making at the state level," and suggested a number of ways in which that could be done. These included: integrated grants, consolidated grants, and block grants; placing greater responsibility on the federal regional administrators and regional field offices; performing specific tasks for the states as consultants; and operating through the Governor in establishing patterns of federal-state cooperation, or through the state in establishing relationships with its political subdivisions.

The Role of Regional Agencies. At the regional level, it was recognized that agencies such as the New England Regional Commission, the Federal Regional Council and the New England River Basins Commission should design their programs to strengthen state integration and leadership in natural resources management and to assure that the interests of the region are taken into account. To do this, it was suggested that communications be strengthened

with respect to specific natural resource programs – among the states, and between federal and state administering agencies – to exchange information, technical assistance, and to resolve interstate problems.

Thus the SENE Study's heavy emphasis on state leadership in resource management is not really novel. It has already been agreed upon at several levels of government. The key to that leadership is coordination among the three tiers of government – coordination in planning, state agency program review, budget review, project review (environmental impact statements), direct regulation and provision of information and technical assistance. What kind of mechanism is needed to achieve this level of coordination; how can resource management programs be integrated with other state programs?

The Ideal: A State Resource Policy Mechanism

A state mechanism for coordinating resource management policy would ideally consist of the following:

(1) It must be responsive to strong policy direction and leadership by the state and be consistent with, and supportive of, ongoing state programs;

(2) It must have the capability to assimilate information, analyze problems, provide coordination, and specify actions to be taken by or on behalf of the state;

(3) While it ought to be established under existing legislative authority and within an existing institutional framework, such a program should be sufficiently flexible to allow it to evolve and develop greater management responsibilities at some future date;

(4) It must provide the opportunity to involve all levels of government and interests: federal, interstate, state, substate regional, local, and private citizens;

(5) It ought to take advantage of the extensive public and scientific involvement in resource planning developed during the course of the SENE Study;

(6) It should have adequate ties to, and relationship with, the forthcoming state resource programs and the work of the SENE Study;

(7) It should have a small professional staff, responsible for planning, public information and education activities; and

(8) Although it must have adequate resources, it should be funded within the financial capabilities of the federal and state governments.

The effectiveness of such a mechanism is hinged upon the tools available to it to coordinate and implement its policies. Probably the most encompassing of these "tools" is the planning function although budgetary and program review capability is also important. The SENE Study too, is important here, because it provides the frame of reference within which those planning and review acitvities can be conducted by such a mechanism.

Because of the scatteration of functional planning activities, securing integrated management responsive to state policy is difficult. While each state has existing mechanisms to supply planning coordination (in Rhode Island the State Planning Council; in Massachusetts the State Planning Office in the Department of Administration and Finance and the Cabinet serve this function), the question of the degree of consolidation of planning responsibility under the Governor is a perennial issue. Although that issue is not addressed in detail here, it is sufficient to note the importance of planning at the state level and to the Governor's Office to ensure uniform planning assumptions. The Executive, as the state's chief policy maker must be provided with the capacity to monitor, review, modify, or develop planning elements to avoid having to reconcile results hardened in concrete.

One of the oldest of the various planning programs is the '701' Program administered by the Department of Housing and Urban Development (HUD). '701' Funds support the development of management capability for the state's decision making system, including state planning offices with administrative and budgetary functions. HUD's '701' funds are also used for substate physical planning programs. The State Comprehensive Outdoor Recreation Plan (SCORP) funded by the Bureau of Outdoor Recreation in the Department of the Interior, is another planning program which leans more heavily to providing a resource perspective in the planning process. State water and related land resource planning programs are funded under Title III of the Water Resources Planning Act of 1965. Water quality planning programs are funded under the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), administered by the Environmental Protection Agency. Other plans are being prepared for transportation and energy facilities.

The Coastal Zone Management (CZM) program is one of the few planning programs which does provide funds for an integrated approach to resource planning, at least with respect to the area defined as the Coastal Zone. Adminis-

tered by the National Oceanic and Atmospheric Administration, the CZM program links not only water and land planning but provides a means to integrate management activities as well.

Although the states nationally have been looking to federal land use legislation as a source of money and as an impetus to coordinate various functional planning activities, the defeat of this legislation has forced the states to look elsewhere to meet this need. The existence of the Section 208 program under the FWPCA of 1972, designed to integrate land use and water supply with water quality planning, does much to provide the necessary structure to integrate resource planning activities.

The '208' program provides for areawide wastewater management planning in areas which, as a result of urban industrial concentrations and other factors, have substantial water quality control programs. Funding will be for planning and management of a comprehensive program controlling local government and industrial wastewater, storm and sewer runoff, non-point source pollutants, and land use and water supply as it relates to water quality. An important requirement of the plan is the establishment of a management program to ensure that the plan is implemented. Both Massachusetts and Rhode Island have taken steps to enter the program and some regional bodies have already been approved for funding.

With adequate funding assured by the 208 grants, the question of coordination between areawide programs remains. In Rhode Island, because the entire state is expected to be designated as a single 208 area this will not be a problem. In Massachusetts however, where there are to be 15 areas receiving 208 funds, there is a need to ensure uniform planning bases and to coordinate between 208 planning agencies. The Commonwealth has recognized this and is working closely with individual 208 agencies to ensure provisions for appropriate state participation. Input at the policy level, such as review by the Cabinet and subgroups such as its Technical Committee, is necessary to ensure integrated implementation of state policy.

Various review procedures are also capable of giving policy bodies the ability to keep abreast of programs and projects and thereby coordinate the implementation of policy. Any mechanism which is to integrate social, economic, and environmental policies must have the capacity to participate in such review procedures.

At the program level, this review would include the program budget review process, which involves a review of the projected allocation of funds by programs, rather than the traditional allocation by object classification. For the policy maker, knowing the level of funding by program can clearly show priorities and level of effort to be devoted to the various programs.

The review capability would also include the A-95 Project Notification and Review System, which sets up specific requirements for the review by "planning and development clearinghouses" of certain proposals or projects in which the federal government is to be involved. This review attempts to evaluate grant applications in terms of other plans, projects, or policies, and to obtain comments from other interested parties.

Particularly in Rhode Island, the capital budgeting process or the programming of the expenditures of capital over time, and the "A-95" review process in which the state Director of Administration must review and approve an application for federal funds in the state, are appropriate vehicles to help secure program integration.

The process of obtaining funds, including planning grants, from multiple federal sources through a single application to the Federal Regional Council, under the Integrated Grant Administration program and as adopted under the Joint Funding Simplification Act (P. L. 93-510) is another vehicle to assist state coordination.

Finally, the review capability should also include project review. Notable examples of this type of review are the National Environmental Policy Act and the Massachusetts Environmental Policy Act which require environmental impact analysis of major public projects prior to project approval.

The Real: Significant Opportunities in Current Ongoing Programs

Existing government agencies already have some of the tools needed to carry out many of the recommendations made in the SENE study. Both states have already established a mechanism for overall environmental, social, and economic policy coordination. Moreover, the ongoing natural resource planning and management programs in each state provide a significant degree of interagency coordination. A general description of approaches to state resource management follows.

In Massachusetts, as in Rhode Island, responsibility for establishing a broad policy framework and for leadership rests with the respective state Governors. The Governor being the state's chief elected official, plays the central role in formulating substantive resource management policy within that framework.

The two other branches of state government also play important roles in the formulation of resource management policy. The Massachusetts General Court and the Rhode Island General Assembly through their legislative, budgetary, and other ancillary activities often develop and articulate state policies in conjunction with, or in response to, those expressed by the Governor. One example of this

capability is in the work of the Massachusetts Special Commission on the Effects of Growth Patterns on the Quality of Life in the Commonwealth, commonly known as the Wetmore Commission. In examining alternative state strategies, the Commission's views will have a substantial impact on the passage of any comprehensive land use law in Massachusetts. While the judiciary is less able to directly pronounce policy, its role is important too, because it may ultimately decide the legality of various elements of state policy and programs.

Massachusetts. Until recently, Massachusetts relied on an executive office, cabinet-level, Resources Management Policy Council (RMPC) to refine and coordinate policy. It was created by Executive Order Number 103, in 1974, to formulate policy and to make certain that resource policies are made with reference to other social and economic concerns. The RMPC was composed of the Secretaries of Administration and Finance, Communities and Development, Consumer Affairs, Educational Affairs, Transportation and Construction, Human Services, Manpower Affairs, and Environmental Affairs. It directed the Commonwealth's participation in coastal zone, air quality, water quality, land use, and rural development programs. Working through inter-agency task forces, the RMPC coordinated the preparation and submission of the State's water quality management program under the Federal Water Pollution Control Act Amendments of 1972. In addition, the RMPC developed a set of uniform substate administrative districts for agency field operations, and submitted its proposals on this subject for legislative and executive approval. RMPC's Land Use Task Force formulated plans for various state approaches to managing critical areas and controlling developments of greater than local concern.

Under the current Administration however, the full Cabinet, as it is organized to deal with resource management issues, performs the functions previously assumed by the RMPC. At this level, resource management policy can be effectively formulated and evaluated in relation to state social and economic development policy. Moreover, it provides a forum for the evaluation of economic and social programs within the context of state resource management programs.

While resource policies are formulated by the Cabinet, they are carried out through programs of the Executive Office of Environmental Affairs (EOEA). Under reorganization currently in progress, the EOEA will combine the present Department of Natural Resources, the environmental functions of the Department of Public Health, the solid waste programs of the Department of Public Works, the Department of Agriculture, and the Metropolitan District Commission. In addition to the Office of the Secretary, EOEA includes five departments: (1) the Department of Environmental Quality Engineering, responsible for environmental health, pollution control, water supply, water quality, and sanitation programs; (2) the Department of Environmental Management including natural resources and solid waste programs; (3) the Department of Fisheries, Wildlife, and Recreational Vehicles; (4) the Department of Food and Agriculture; and (5) the Metropolitan District Commission. In addition, a system to decentralize the EOEA's activities through substate administrative field offices, coordinated with the state's substate district efforts, is pending legislative action.

One of the most important programs of EOEA, and one which demonstrates the degree of integration necessary for effective resource management, is the Coastal Zone Management Program (CZMP). The program has received initial federal planning funds, is in the beginning stages of plan and program formulations, and has established a citizen participation structure. A Coastal Review Center has been established in the interim to identify significant activities to review major projects and to formulate action recommendations within the coastal zone, pending completion of an approved Coastal Zone Management Plan for the state. The Center serves as a forum for the development of information relating to the coastal zone, and facilitates the decisions of those now performing governmental functions.

The Executive Office for Communities and Development (EOCD), through the Department of Community Affairs (DCA), acts as liaison between the state, the federal government and regional planning agencies. The DCA is also authorized to provide guidance to the state's political subdivisions in the development of land use plans. EOCD's Department of Commerce and Development (DCD) is authorized to prepare a comprehensive plan for the economic development of the state.

Other state level programs have been developed protecting wetlands, requiring environmental impact reports on public projects and activities, and establishing an Energy Facilities Siting Council, authorized to review utility companies' long-range plans and proposed site locations for power plants. The Martha's Vineyard Law, recently enacted, sets up a process to designate areas of "critical planning concern" and to screen "developments of regional impact". These efforts represent concerted attempts to execute resource plans and programs as elements of an overall state strategy.

At the substate level, the advisory regional planning agencies, eight of which exist in SENE, provide a link to local governments by overseeing local planning programs and in the A-95 review process. In addition to the regional planning agencies, the state is currently in the process of standardizing its substate administrative districts to provide a

uniform geographic framework not only for planning, but also for coordination and, most important, the delivery of state programs. Not only will this decentralize state activities, it will allow local governments to meet federal requirements and opportunities for "cooperative regionalism."

Through these programs, policies set in a coordinated state context are translated through administrative and regional agencies into action. The Coastal Zone Management Program provides a focal point capable of "assessing relationships among natural resource programs, securing their integration, and monitoring performance against overall natural resources strategy," as well as providing the means by which local, state, and federal governments can interrelate. For that portion of the State not in the coastal zone, EOEA serves this function. Both could use the SENE Study to provide the substantive link between resource capability analysis, demand analysis, and management recommendations.

Rhode Island. Long-range resource management policy set by the Governor in Rhode Island is integrated and coordinated through the State Planning Council (SPC) and its planning arm, the Statewide Planning Program (SPP). Coordination of agency activities and preparation of the State Guide Plan are the two major vehicles through which policy integration occurs. The SPC is composed of the Director of Administration, as chairman, and nine other heads of state departments and agencies, five officials of local government, and non-voting representatives of federal agencies. Subsequent to Executive Order Number 23, the SPC's membership was expanded to include ten citizen representatives. Through its Technical Committee, which monitors work in progress, and reviews all major studies and development projects, the SPC can coordinate planning and development activities of governmental agencies at all levels and of the private sector. Should the SPC be given greater review responsibilities, such as those described earlier, the services it might perform as a mechanism to coordinate and implement state policy would be greatly enhanced.

The State Guide Plan is composed of framework functional plans for land use, water quality management, transportation, recreation, economic development, historic preservation, and water and sewer service. The State Land Use Policies and Plan has been completed, reviewed by the public and officially adopted by the SPC . Statewide Planning Program activities are assisted by federal grants through the integrated grant administration program; for example, the SPP proposed the State's application for coastal zone planning funds, though the Coastal Resources Management Council will develop the management program. SPP also coordinates as the A-95 review agency for the State.

Implementation of policies developed by the State Planning Council is left to specific administrative departments of the State. The Department of Natural Resources oversees a wide variety of programs for parks and recreation areas, forests, fish and wildlife, agriculture, land acquisition, and wetlands. Water quality control, air quality control, and solid waste are regulated by the Department of Health. The Port Authority and Economic Development Corporation (PAEDC) of the Department of Economic Development constructs and develops utility facilities and port projects to further the State's economic growth. PAEDC projects must conform, however, to requirements of the Coastal Resources Management Countil and the State Guide Plan.

A limited vehicle for interagency coordination is the Water Resources Board (WRB), which is presently responsible for long-range water resource planning in the State. In some cases, the Board's responsibility for long-range water planning conflicts with the role of the SPC as the final arbiter of long-range policy. The WRB approves water supply distribution systems, and within certain statutory limitations, is authorized to acquire sites and construct facilities for water supply.

The Coastal Resources Management Council (CRMC) also serves to integrate state resource management policies. It has authority to plan, manage, and regulate the State's resources in the coastal region through the formulation, implementation, and operation of various programs consistent with the State Guide Plan as well as with water quality standards set by the Department of Health. The CRMC issues permits for alteration of intertidal salt marshes and any work in, above, or beneath, the water areas under its jurisdiction. Its activities extend as well to certain land uses and activities where there is a reasonable probability of conflict with the coastal environment, including, but not limited to: power generating and desalination plants; chemicals or petroleum processing, transfer, or storage; minerals extraction; wastewater treatment and disposal; and solid waste disposal facilities. It is also the State's coastal zone management agency under the federal coastal zone program.

One problem for the state is the dispersion of the environmental functions among some twelve state administrative agencies. The overlap in regulatory responsibility for water quality maintenance for example, is a potential area of conflict. However, mutual interests can be served without duplication if there is sufficient cooperation and coordination among the agencies concerned. Greater coordination is possible by combining environmental functions under the responsibility of one agency as is being done in Massachusetts, or by strengthening the coordination function which SPC serves to enable it to act as the State's environmental "clearinghouse."

The State Planning Council also can provide the necessary leadership to coordinate overall resource policies within

the context of other state social and economic programs. The SPC role could be strengthened by incorporating long-range water resource policy making, and by improving coordination with the CRMC and with other departments, where that is necessary. The State has recognized the need to guide growth based on resource capabilities and has expressed that need through the preparation of the State Land Use Plan and Policies. The Statewide Planning Program is capable of assessing and directing relationships among various functional resource programs, and its role should be strengthened in this regard.

By using resource capability information developed by SENE, the State Planning Council and the Statewide Planning Program could ensure a consistent starting point for agency program development and provide additional resource management program guidance.

Federal and Interstate. The role of the federal government in environmental management reinforces state resource management integration efforts. An example is the administration of the coastal zone management programs. Integrated grant administration and greater delegation of authority to regional field offices also demonstrates greater federal emphasis on state control. The existence of the Federal Regional Council (FRC) too, offers the states better access to federal funds and services. In fact, the FRC was established to develop closer working relationships between federal grant-making agencies and state and local governments, and to approve federal coordination of the grant system. Since federal agencies are participants with the relevant states, the New England River Basins Commission is also available to help accomplish objectives of specific state programs through the federal system. In addition to this coordination, the federal government also provides technical assistance, funding, or direct resource management activities. These include: flood control, navigation improvement, erosion protection (Corps of Engineers, Soil Conservation Service), water quality improvement (EPA), fish and wildlife enhancement (USFWS), land acquisition programs (BOR, NPS), and regulation of power facilities (FPC), to name a few.

Cooperation between the states and with the federal agencies can be even more effective through other regional New England institutions. Through the New England Regional Commission, programs are formulated to strengthen regional economic development. The New England River Basins Commission provides a vehicle to contribute directly to the development of regional and interstate aspects of natural resource programs undertaking analysis of regional needs and issues, providing information, developing comprehensive management programs for the region, and assisting in development and review of state programs with special reference to regional and interstate water and related land aspects. Finally, the New England Governors' Conference, composed of the six New England governors, also can coordinate state policies with regard to natural resources.

While there is no one mechanism which can look at the SENE region as a whole, a new SENE-wide institution is both unrealistic and unnecessary. Rather, it is necessary to reinforce and strengthen current linkages, capabilities, and activities. Existing institutional arrangements must provide the process by which integration of state activities can occur.

RECOMMENDED STRATEGY

Given the institutional framework set forth above, and given the role of the state interagency policy councils, it is the current responsibility of the Cabinet in Massachusetts and the State Planning Council in Rhode Island to review and adopt in whole, or in part, the resource management policies and programs of the SENE Study, and to guide program development for specific functional recommendations by State administrative agencies within the context of the State's overall social and economic, as well as environmental goals.

1. **Maximize use of existing resource policy institutions. The resource management policies and programs recommended by the SENE Study should be reviewed and, based on that review, policies the states feel appropriate should be adopted by such institutions in Massachusetts as the Cabinet and in Rhode Island, the State Planning Council.**

As the agents through which management strategies are devised, these bodies can ensure coordination between the state and other levels of government. They have staff and coordinative capabilities, as well as access to resource information and data, and with some modifications could include public and scientific input. Federal linkages exist to various degrees and program coordination, where necessary, between states would be most effective if carried out at this level.

After considering these policies, the state interagency councils should implement major policy recommendation of the SENE Study by adopting and endorsing as appropriate, specific policy positions.

Even with these organizations, which have a broad mandate to coordinate and implement resource management policies and programs, modifications to the institutions which have more specific responsibilities may be necessary to guide growth effectively.

New legislation will be necessary to do this. At the very least, guiding an area's growth requires a degree of control by, and direction from, a level of government which can balance the needs of more than one community, beyond the traditional relationship between the state, the region, and the municipality.

Guiding principles. The following general principles ought to form the basis of any effort to realign the balance of powers between the state and its political subdivisions:

(1) Municipalities should carry out, through existing legal powers, their traditional role in making land and water resource use decisions of local significance and should be able to increase their effect on land and water resources decisions having regional or state impact;

(2) There should be a regional perspective with respect to greater than local land and water resource use decisions, with the state coordinating and setting general policy and standards; and,

(3) More effective use of present and potential direct state planning regulatory functions should be made with respect to land and water resource use decisions of overall state interest.

The precise institutional form that will embody these principles ought to be determined by each state, acting through its legislative process. The Study finds however, after extensive public review, that the general institutional framework should be premised on a system of decision-making which moves up one level of government if performance at the next lower level does not meet prescribed criteria. Planning and regulatory decisions should be made at the most decentralized level appropriate, without sacrificing the necessary perspective of the decision to be made. Approach 1D of the following alternatives, most nearly embodies these concepts.

Active involvement of municipalities in the bulk of land use and development decisions of local significance, is at the foundation of this structure. An increase in technical and financial assistance or changes in enabling authority may be necessary to allow localities to be more responsive to local needs.

Regional bodies, consisting of politically responsive appointees of member municipalities, and supported by adequate staff, ought to arbitrate conflicts between neighboring local governments and review and regulate developments of regional impact in those situations where a regional perspective is essential. The regional regulatory authority ought to be accompanied by comprehensive, longer range planning responsibilities, even if limited to reviewing and making various local plans compatible. Because existing regional institutions as presently structured are incapable of performing most of the functions which such a system would allocate to them, they must be modified or new institutions must be developed, to make them more visible and politically accountable.

The state role would involve the formulation of a basic policy, based on local and regional input and the integration of land use and development policy within the context of social, economic, and environmental policies. The state should administer the policy through regional instrumentalities and local government to the maximum feasible extent and should provide technical and financial assistance to the regions and municipalities.

The following approaches offer alternative ways of striking this balance. It should be remembered that they are not mutually exclusive, and that desirable features of one may be used in combination to form entirely new alternatives.

Alternative Approaches to Key Elements of a Comprehensive Resources Management Program

A wide array of more specific approaches to translating state policy into action programs could be devised as elements of a management program. To recommend any definitive set of approaches would certainly be premature in advance of thorough public debate over alternatives. However, the Study has investigated, and presents here, a number of approaches to stimulate this discussion, to illustrate certain considerations in one approach or another, and to characterize the comprehensive management approach suggested by this report. The approaches are summarized in Table 10.1.

Two common threads run through the approaches proposed. The first is that growth must be guided based on resource capabilities, and second, that there must be greater involvement on the part of all governments in formulating policy, developing plans, setting standards, and reviewing lower level decisions with respect to environmentally and economically sensitive issues.

In this era of frequent government reorganization, the utility of the following approaches should not be tied to specific named agencies. Rather, such references should be taken to imply an institution or agency with the func-

TABLE 10.1 ALTERNATIVE APPROACHES TO KEY ELEMENTS OF A COMPREHENSIVE RESOURCE MANAGEMENT PROGRAM

MASSACHUSETTS	CONCEPT	RHODE ISLAND
State: Cabinet promulgates development guidelines; reviews state agency proposals under expanded Mass. Environmental Policy Act. **Region:** Screens municipal permits for consistency with the guide. **Local:** Issues development permits consistent with the guide.	**STATE DEVELOPMENT GUIDELINES FOR USE BY LOCAL GOVERNMENTS** • Identifies requirements of developments of regional impact, and matches them with site criteria • Public and private development consistent with guidelines are facilitated • Directs public and private development	**State:** SPC promulgates development guidelines; reviews local permits and state agency proposals. **Local:** Issues development permits consistent with the guide.
State: State law making mandatory local planning and controls in accord with state criteria. **Region:** RPA review of municipal program. **Local:** Municipalities formulate and administer plans; regulate development.	**MANDATORY LOCAL PLANNING AND ZONING** • State legislation requiring municipalities to designate and regulate critical environmental areas and developments of regional impact • State and regional actions guided by local plans.	**State:** State law making mandatory local planning and controls in accord with state criteria. State review of municipal program **Local:** Municipalities formulate and administer plans; regulate development.
State: Cabinet establishes standards and designates areas. **Region:** RPA acts if municipality in default. **Local:** Municipal administration of consistent development controls.	**STATE DESIGNATION AND LOCAL REGULATION OF CRITICAL ENVIRONMENTAL AREAS OR AREAS OF CRITICAL CONCERN TO THE STATE** • Critical areas include: critical environmental areas; areas of importance to the public welfare; areas affecting or affected by key facilities.	**State:** SPC establishes standards and designates areas. Critical areas to include: areas for social or economic development. **Local:** Municipal administration of consistent development controls.
State: Cabinet designates, establishes standards and regulations for uses in critical areas. **Region:** RPA regulates if designated by Cabinet; (RPA might designate and establish standards for areas, as an alternative to the state.) **Local:** Municipal administration of state regulations; if fails to do so, state through RPA would assume regulatory control.	**STATE OR REGIONAL REGULATION OF CRITICAL AREAS WITH MUNICIPAL ADMINISTRATION** • State designations, standards and regulations for protecting, managing and developing critical areas. • Critical areas include: critical environmental areas.	**State:** Newly created Resources Management Council designates, establishes standards and regulations for uses in critical areas (RMC would be similar to the CRMC). The RMC and CRMC would grant permits for development in these areas. **Local:** Development would continue to be regulated by municipalities as well.
State: Cabinet establishes policies and guidelines possibly through WRC. **Region:** Prepares water management plan; provides technical assistance; carries out operations or construction of facilities. **Local:** Negotiates formation of regional authorities.	**REGIONAL MANAGEMENT OF WATER AND RELATED LAND RESOURCES** • Critical areas include: water and water related land. • Water supply coordinated with waste water management. • Substate regional management.	(No substate regional governments in Rhode Island, therefore concept not applicable.)
State: State planning, management, and permit granting through a series of state-level regional agencies (like MDC). **Region:** Advisory role. **Local:** Continues present function where conforms to state plans.	**STATE PLANNING AND MANAGEMENT OF RELATED LAND RESOURCES** • Pervasive state role. • Critical areas include: Water and water related land.	**State:** State (SPP - SPC) plans the integrated management of water and related land resources, including long range planning for the water resource. WRB and Solid Waste Management Corporation would construct, operate and carry out management activities to implement state plans and policies. **Local:** Advisory role.

Notes:
RPA - Regional Planning Agency
WRC - Water Resources Commission
MDC - Metropolitan District Comm.

SPC - R.I. State Planning Council
SPP - R.I. Statewide Planning Program
RMC - Resources Management Council
CRMC - R.I. Coastal Resources Management Council
WRB - R.I. Water Resources Board

tional capabilities suggested in the context of a particular approach. In Massachusetts, for example, most functions formerly carried out by the Resource Management Policy Council have now been assumed by the full Cabinet. References thereto in the following approaches should be taken to mean the Cabinet as it is organized to deal with resource management issues.

Finally, one of the most important limitations on any management scheme is how it distributes its costs and benefits. Windfall gains may accrue to some, windfall losses to others, as a result of government decisions, unless mechanisms exist for redistributing, or at least integrating, such results. This may be true for entire communities, no less than for individuals, as when, for example, one municipality bears the burden of regional open space requirements and thereby incurs a disproportionately heavy loss of property tax revenues. There also is constant pressure on municipalities, given the present property tax structure, to increase development or "ratables" at the expense of protection for critical environmental areas. Land values, too, may be pushed up or down as a result of official actions and policies. Institutions should take full cognizance of such impacts and ameliorate their inequities. The right of a private owner to secure compensation when his property is taken by eminent domain, the right of public access to publicly subsidized amenities, Vermont's recently enacted capital gains tax on land sales, and proposals for property tax-base revenue sharing are examples of equitable methods by which this issue has been resolved. The role that fiscal policy plays must be considered in any of the following approaches, and mechanisms should be designed to reconcile such inequities.

Massachusetts. The Massachusetts approaches presented demonstrate two major themes of a management program: (1) the balance of resource management powers between the state and its municipalities; and (2) the possibility of indirectly guiding growth through comprehensive programs for protecting the water resource. By comparing the various approaches, the essential elements of conflict or complementarity between arrangements can be characterized. The various approaches are not mutually exclusive. They do illustrate, however, different starting points from which one might proceed to construct institutional arrangements.

1A. State development guidelines for use by local government. Under the first approach, a development guide would be prepared which would direct certain kinds of development to possible sites identified, based on stated criteria, as being suitable for such development from the standpoint of resource capability. Proposals contrary to the guide would have to undergo extensive impact analysis before approval.

Using the SENE Study as a data base and applying its methodologies to develop guidelines and to identify areas, the Cabinet could coordinate the identification and designation of areas suitable for various kinds of developments of regional impact (e.g. power plants, highways, and waste disposal facilities) and other categories of developments which, because of their size or nature, are likely to have environmental, economic, or other impacts of greater than local consequence. Areas, which because of their regional significance, are not to be developed, could also be designated.

These studies will be conducted on the basis of inputs from state and regional agencies concerned with economic development and environmental protection, as well as from representatives of local government and interested public and private sector sources. These studies will include consideration of the range of site characteristics that may be relevant in deciding the location of categories of facilities or developments. Access to, and impact upon, water resources are further variables that would be considered as relevant to such decisions. Based on data generated by these surveys, the Cabinet could prepare, promulgate, and, as the need arises, revise, a "development guide ". This guide could be used by all agencies and developers, both public and private, in initiating, evaluating, permitting, funding, or undertaking particular future development proposals. Proposals for the development of key facilities or developments of extra-local impact that are advanced consistently with the criteria and procedures set forth in the guide, could be expedited by streamlined permit procedures, and with a minimum of additional impact analysis. Conversely, development proposals lacking such consistency would have to be justified by full impact analysis, and might have to run the gamut of multiple reviews by different agencies. For this purpose, the Massachusetts Environmental Policy Act (MEPA) would be extended to cover municipal and private developments of more than local concern that were advanced inconsistently with the "development guide". In short, a stronger burden of proof would fall upon a developer with respect to any proposal that appeared to lack such consistency. Regional planning agencies (RPA's) could conduct the initial screening to determine if pending municipal development permits were consistent with the guide; the Cabinet itself, or its designee, would conduct a similar screening with respect to development proposals advanced by state agencies. If the reviewing agency determined that the proposed project was inconsistent in the guide, it could so certify to the permitting agency, and a full-scale impact analysis would then have to be prepared and reviewed for adequacy before the development could proceed.

The advantages of this approach are several. This approach would be premised upon the adoption of SENE Study policy recommendations for development and protecting

Critical Environmental Areas. It would build upon the criteria for guiding development that are advanced in earlier chapters of the Study. The guide could, for example, refine and extend the Study's analysis of criteria to identify future power plant sites to maintain regional self-sufficiency. This approach would not impose an authoritative site-sufficiency. master plan on the state, but would provide a flexible set of criteria for evaluating proposed development in terms of its environmental, economic, and other impacts. In conjunction with an extended MEPA, the guide could have substantial persuasive force. The development guide prepared by the Cabinet would be a definitive expression of state policy and norms for evaluating the efficacy of certain stated development types. As new development types are identified, or as additional data regarding land use capabilities becomes known, the development guide could be revised and updated.

Since the guide would not attempt to select sites for specific development projects, but would instead create a process for matching sites with needs as basic economic supply and demand factors interact, it is more likely to be acceptable than more authoritative regulations.

The disadvantages of this alternative are as follows: impressive resources and expertise would be required to prepare a useful and persuasive development guide along the lines here envisaged. Some types of relevant information will be impossible, or prohibitively costly, to obtain. As a practical matter, many aspects of the guide may be only tentative or advisory, and frequent revisions may undermine the justification for using it to impose heavier burdens of proof and administrative procedures on some developers and not on others. Moreover, to effect the revisions of administrative procedure articulated in this approach may require controversial modifications of statutory authority of existing institutions.

The second approach in this set relies primarily on local initiative.

1B. Mandatory local planning and zoning. Under this approach every municipality could be directed by statute to adopt a plan designating (1) areas requiring protection and those requiring management for development, and establishing procedures for regulating developments in, or affecting such areas; and (2) developments of regional impact according to criteria specified in the statute; and (3) setting forth a program of long-range capital development that will serve to channel residential and economic growth in accordance with the time-phased provision of municipal services. The statute could specify criteria to be applied by municipalities in formulating and administering such plans, especially criteria for incorporating consideration of state and regional interests in the local decision making process. Full public participation in both planning and regulatory decisions at the local level could also be required.

State and regional agencies would be expected to nominate some areas for critical designation, to make inputs to local plans, and to furnish technical assistance to localities in performing the foregoing tasks. In addition, the concerned RPA could review the consistency of proposed municipal plans with the statutory criteria and with any established state or regional plans for development of capital infrastructure (e.g. transportation networks, waste management facilities). Such plans will have been formulated so as to reflect the maximum possible degree of consensus among municipalities and RPAs. If the RPA objected to a municipal plan on grounds of inconsistency with the statute or with a larger state or regional plan, and the municipality failed to correct it, either party could appeal the matter to the courts for final determination under normal judicial procedures. If the municipality failed to adopt an acceptable plan within the time prescribed by statute or judicial decree, the RPA would be authorized to prepare such a plan, which the municipality would then have to administer until such time as it developed an acceptable plan of its own.

Until a municipal plan was adopted, developments of regional impact and developments affecting areas of critical environmental concern, as defined by the statute, would have to be preceded by submission of environmental impact reports to local permit-issuing agencies, and by public hearings thereupon which would include required participation by any relevant state or regional agency. This review process could be streamlined and shortened, however, once an acceptable municipal plan was in effect. At any time, judicial review of a municipal grant or denial of a development permit could be obtained by an adversely affected person on grounds that the municipal action was inconsistent, either with the statute itself, or with an applicable plan developed pursuant to the statute.

Municipalities would be expected to exercise, where appropriate, any or all of their existing powers over land use in discharging the responsibilities here envisaged for them. Those powers include master planning, flood plain cluster, and environmental impact zoning, as well as the more traditional forms of zoning and subdivision controls; administration of wetlands protection laws; enforcement of health codes relating to land disposal of wastes; prescription of performance standards for the conduct of land-based or land-disturbing activities; and acquisition of properties for purposes of public recreation or conservation.

In subsidizing, permitting, or undertaking activities of various kinds and in exercising other powers already granted to the state by law (e.g., with respect to wetlands and scenic or recreational rivers), the state will be guided by locally formulated plans to the maximum extent feasible. Exceptions to this rule would be recognized only for overriding reasons of state policy (e.g., equitable distribution of low-

income housing) expressed through formal action of the Legislature.

The advantages of this alternative are several. This approach (which largely reflects the new Colorado law) comes closest to continuing the tradition of primary local responsibility for land use control, and assumes that municipalities can do the job under pressure from the Legislature, with help and guidance from state and regional agencies. This approach would take advantage of existing local authority to regulate and manage use of critical areas such as flood plains, and would restrict state and regional planning initiatives to inherently extra-local interests.

Comprehensive planning at the local level through an open planning process, such as here envisaged, along with local regulation of development in accordance with statutory criteria, may well be worth a try before attempting any substantial shift of power over land use from local to state or regional levels. It is assumed that localities would be able to strike the best balance between developmental and environmental objectives, taking into account the desires of the citizenry whose voices are most clearly heard in local councils. At the same time, through consultations, technical assistance, planning for capital improvements of regional, or statewide significance and judicial review, state and regional agencies with broader perspectives would still be able to exert substantial influence over local performance.

The disadvantage of this approach is that it is likely to prove cumbersome, time-consuming, and inefficient. Unless consistent standards are developed such as those of the SENE Study, this approach would run the risk that decisions of numerous municipalities may be inconsistent with one another and contrary to state or regional needs.

The next approach gives the state a greater role in designating areas to be protected.

1C. State designation and local regulation of Critical Environmental Areas. In an alternative approach, the Cabinet could supervise a process for the identification and protection of areas deemed to be of critical environmental concern from state, regional, and local perspectives. This would be done on the basis of inputs from all interested state agencies, and the public, to ensure interagency and interdisciplinary coordination.

The Cabinet could initiate this process by designating areas of critical concern to the state, such as important resource sites, based on work already done by the Department of Community Affairs and the SENE Study on identifying Critical Environmental Areas. The Cabinet could then suggest how they might be protected and promulgate guidelines for the RPAs and municipalities to follow in designating areas of regional and local concern. Critical areas qualifying for designation under this model would basically be of three kinds:

(1) Priority Protection Areas (Category A): highly fragile resources, which have the lowest tolerance for development and highest value for water resource protection;

(2) Other Protection Areas (Category B): resources relatively tolerant to specific types and densities of development and having high value for water and related resource management; and

(3) Developable Areas Requiring Management (Categories C, F, & G): resources capable of absorbing varying degrees of development.

The above categories, which include "water related lands" as defined in *Chapter 3,* fall within what the Study has defined as Critical Environmental Areas requiring protection and Developable Areas requiring management.

Simultaneously with the identification of areas of statewide concern and the promulgation of guidelines for the successive identification of areas of regional and local concern, the Cabinet could promulgate standards for the protection or development of designated areas, and for the regulation of activities therein. Municipalities could then be required to formulate special zoning and subdivision ordinances, selective restrictions or prohibitions on development and waste disposal, and other protective regulations, consistent with the state standards, for all designated critical areas lying within their respective boundaries. Upon approval by the Cabinet, each set of proposed municipal controls would have the force of law, and would thereafter be administered by the municipality. If a municipality fails to submit to the Cabinet a set of controls responsive to the state Standards, the Cabinet could order the appropriate RPA to prepare the necessary controls for the municipality to administer. Only in the event that neither the concerned municipality nor the RPA developed a satisfactory set of controls within a reasonable period of time, would the Cabinet itself prepare them for the municipality to administer in those critical areas.

Once areas of critical concern had been identified and a local regulatory program was in effect, the issuance or denial of any development or use permit affecting such an area would be appealable by any interested person to the RPA. Upon such appeal, the RPA could be empowered to review, reject, or modify any permit determination it deemed to have been made inconsistently with the applicable set of controls. Further, the RPA could itself be empowered to initiate, on its own motion and on similar grounds, the review of any local permit determination. In its discretion, the Cabinet could designate an appropriate state entity to provide a further level of review of RPA determinations, upon petition by any interested or aggrieved party showing the importance of the issues at stake. Moreover, all public development would be subject to the same

set of approved standards, and proposed projects could be reviewable by the Cabinet upon petition of any interested party.

The advantages of this alternative are as follows. Because of the broad jurisdictional scope of its composition, the Cabinet is the most appropriate entity to oversee and resolve interdisciplinary and interagency disputes occasioned by the implementation of this critical area program. For the staff capabilities needed to carry out the program, the Cabinet could utilize the diverse manpower talents of its several constituent state agencies, or expand the technical capabilities of its own staff.

Again, this alternative would take maximum advantage of the work identifying Critical Environmental Areas already done by the SENE Study. Under this alternative, every level of government – state, local, and sub-state regional – is given a role in the designation of areas to be preserved; the level of government most appropriately concerned with a potential problem area does the designation for that area. The alternative also preserves municipal initiative in determining what development controls will be applied to critical areas, in line with traditional concepts of local control over land use.

By confining the state's role to the designation of critical areas of state concern, to the establishment of flexible standards for regulating land use in such areas, and to the limited review of actions taken or not taken, pursuant to such directives, this alternative avoids the objections that would be raised to any more pervasive state role in determining patterns of development or in indirectly regulating land use.

The disadvantages of this alternative are as follows. The procedures for producing critical area designations and for achieving implementation of the envisaged regulatory format are complex and time consuming. Unless interim development controls are implemented, it is likely that many areas that would otherwise fall within the critical catalogue will be developed before designations are made and ongoing controls are adopted and approved. Even the limited roles envisaged for the Cabinet and RPA's under this alternative are likely to be opposed by municiplaities and developers on traditional grounds or as a matter of public policy, it may be necessary to provide a state fund for compensating owners and municipalities whose property is made subject to development restrictions that impair its market value or revenue generating capacity.

The last approach gives the state regulatory authority over critical areas.

1D. State or Regional regulation of critical areas with municipal administration. On the basis of consultations with all interested agencies and the public, the Cabinet could be statutorily empowered to list particular areas for proposed designation as areas of critical environmental concern in accordance with guidelines or criteria to be set forth in the enabling law and based on the designations and management recommendations for "priority protection areas," "other protection areas", and "developable areas requiring management" already developed by the SENE Study. Such areas might be confined at first to the coastal zone, bearing in mind the Federal Coastal Zone Management Act (CZMA) of 1972 and the state coastal zone program; later, inland areas could be added in consistent ways to the list. The Cabinet could directly zone each designated area for particular uses and propose regulation for restricting or controlling development therein (responsively to the management program specifications set forth in section 305(a) of the CZMA). A further set of regulations could be proposed for controlling developments of regional impact, wherever located within the state. These sets of proposals could be submitted to the Legislature for review and, if not disapproved within ninety days by the relevant committee of either branch, could override any inconsistent municipal ordinances and could be binding upon all state, regional, and local agencies. In the course of preparing the state zoning scheme, the Cabinet would review municipal ordinances for the required consistency, and, if found to be adequate, the municipality would continue to administer them.

With some adaptations, this design could be modified to emphasize a regional or areawide approach to protecting critical areas. In this variation, regional planning agencies could identify areas of critical planning concern and adopt standards for their protection, management, or development. RPAs, with additional authority granted by the Legislature could then administer consistent controls or could ensure that localities administer such controls. Under this variation, provision should be made for an appeals procedure from decisions of the regional or local body to a state-level administrative body or to a court of law, and to grant standing to affected RPAs or neighboring communities.

An areawide approach to critical areas is in line with some current directions in the state, the Martha's Vineyard Law and the Franklin County Bill being the most notable examples. The Martha's Vineyard Law establishes a twenty-one member regional commission which passes on all applications to construct developments of regional impact (defined, in part, as "the types of development which because of their magnitude or the magnitude of their effect on the surrounding environment, are likely to present development issues significant to more than one community of the island of Martha's Vineyard"). The Commission also designates "districts of critical planning concern" and oversees local regulation of these districts. Such arrangements appear to be more responsive to local conditions, would provide a means only one step removed

from municipalities to reconcile local and regional objectives, and would leave the majority of land use decisions to the authority of local government.

Municipalities would be charged in the first instance with administering the state-set controls in designated areas falling within their respective jurisdictions. In case of repeated failure by a municipality to apply the state regulations, the Cabinet could assume direct regulatory control of a designated area or class of developments, or designate the relevant RPA to assume such control.

The advantages of this alternative are as follows. This alternative (for which a rough precedent exists in Hawaii law) outlines a direct, efficient, and expeditious way of asserting the state's interest in the protection of critical areas and in the guidance of significant development. The responsibility would be shared between the Executive Branch, through the Cabinet and the Legislature, which adequately represents local interests. Localities would also be given a prime opportunity to implement state strategy.

Although some restructuring of RPAs may be necessary, which would be resolved politically by the Legislature, the reform suggested here may be far less than other options presented. As a practical matter, the RPAs' experience, staff, resources and familiarity with their areas make them likely candidates to assume greater responsibilities.

The disadvantages of this alternative follow. State intervention of this magnitude, even if confined to carefully chosen areas and developments of critical concern to the state itself, departs severely from the tradition of primary local control over land use. Objections might be raised to dictation from the top down, without having sufficiently resorted to processes of accommodation and consensus-formation among all concerned agencies and the public. In particular, the absence of local participation in the development of the envisaged controls might well eliminate this alternative as politically unfeasible.

The second set of approaches demonstrates an indirect approach to guiding growth through comprehensive programs for the protection of the water resource. The first offers a regional emphasis; the second illustrates centralized state management. Both are based on the development of integrated long-range policies for management of water resources in all phases of the hydrologic cycle.

2A. Regional management of water and related land resources. Under this approach, a state interagency body, representing all agencies concerned with the protection and use of the state's waters, would plan and set standards with respect to: (1) the quality, quantity, and the availability (timing and placement) of the water resource; (2) coordination of water resource development with demographic and economic growth, consistently with any applicable state policies respecting growth and land use; (3) allocation of the resource among competing or conflicting instream and withdrawal uses, whenever and wherever it is not sufficient to satisfy all demands simultaneously; and (4) regulation of activities on the land through performance standards designed to protect the water resource, in all phases of the hydrologic cycle, against degradation or excessive depletion. In all cases, the most sensitive question of interbasin resource allocation could be resolved by legislative action. Such plans and policies could be proposed after consultation with all interested agencies, including the RPAs and the public.

With these objectives in view, an interagency body would prepare a program guide for water resources management throughout the state, which would acquire authoritative status upon review and approval by the Cabinet. Such an interagency body might be the Massachusetts Water Resources Commission (WRC), if it were given adequate authority and staff. The guide could include: (1) identification of water and related land resource projects proposed for development, expansion, or management by state agencies within the foreseeable future, together with environmental and economic impact analysis of the alternatives considered and institutional and fiscal strategies for implementing the preferred alternatives; (2) guidelines and regulations that the WRC and the Department of Health would follow (the latter to retain its regulatory power over the purity and safety of public water supplies) in reviewing application from regional or local agencies for approval to develop or expand their own sources of supply; (3) guidelines and regulations for allowing multiple use of water bodies and adjacent lands, and for protecting water quality against adverse impacts of land use, including land disposal of wastes; (4) integration of basin plans for water quality control into larger basin plans for protecting and managing the entire water resource; and (5) designation of particular water resources as of critical state concern, based on those identified by the SENE Study including fragile or non-renewable resources that are in jeopardy of depletion, or degradation or salt water intrusion (e.g., the Cape Cod aquifer) and waters subject to competing or conflicting demands that cannot be simultaneously accommodated.

Substate regional or areawide entities would be the primary vehicles for implementing state-set policies and would prepare specific water management plans consistently with the guide to allocate and protect the waters of a region. By legislative mandate, ground waters would be included, in whole or in part, within the definition of waters subject to public regulation. The regional plan would establish and allocate intrabasin water uses in harmony with other functional plans developed regionally; identify needed facilities for water resource management; establish regulations to be observed by local authorities in permitting ground and surface water use, subsurface disposal, sewering and sewer connections; and articulate performance standards for conserv-

ing water and controlling polluted runoff from land developments and land disturbing activities, especially as these may affect water resources of critical state concern.

A key agency for assisting in the implementation of regional flow management plans could be a regionally based environmental service authority, RESA, which would perform the following functions: (1) render technical assistance to operators of water management and wastewater management facilities; (2) monitor such operations for conformance with applicable state or federal standards; and (3) on request, contact with any public or private entity to plan, finance, construct, or operate any water supply or waste management facility. As discussed in an earlier *Chapter 4, Water Supply,* such authorities could be created through intermunicipal negotiation and agreement. The managing board of each RESA would include technically qualified personnel as well as representatives of the region, the localities within it, and the public. Responsibility for taking enforcement action against violators would continue to reside primarily in other state agencies.

The advantages of this approach are many. As pointed out in earlier chapters on water supply and water quality, there is a need to integrate management of all phases of the water resource. This approach, and the one following, could be used as the means by which such integration could occur.

Development of regional capabilities for overall water resource planning and management is a natural extension of the planning roles that may be assigned to regional agencies pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972. This approach recognizes the advanced state of water quality planning and management. Moreover, most, if not all, of the existing regional planning agencies have already gained exposure through their water and sewer planning and their A-95 review roles, to many of the water-related technical and political issues within their regions.

This approach envisages only a partial centralization of power over water resources at the state level. Specific planning for use of the resource could mainly be done by the regional agencies which may be in the best position to harmonize multiple environmental and developmental objectives, and to mediate between state, federal, and local interests in resource management. The RESA, working in close cooperation with both state and regional agencies, should be able to promote economies of scale, administrative coordination, and technical expertise in the management of water resources. Local initiative in the development of water and related land resources would be preserved, to the maximum extent consistent with the recognition of legitimate state and regional interests in the extra-local consequences of resource use.

The disadvantages of the approach are that RPAs, which appear to be the leading candidates for regional resource planning activities in Massachusetts, continue to be organized on an essentially one-town, one-vote basis. Political parochialism may prevent them from developing and implementing regional plans of the caliber contemplated by this approach. It may be necessary to reform the RPAs which may be politically difficult to achieve, if it means any loss of individual municipal autonomy to the regional entity. Similar objections may be raised to the concept of the RESA, and owners of land above ground water can be expected to resist any attempts to compromise their claims to unrestricted control over this resource.

The second approach in this pair involves greater state management.

2B. State planning and management of water and related land resources. In a variation of the above approach, an interagency council, such as the Massachusetts Water Resources Commission (WRC), after consultation with other interested state, regional, local agencies, and the general public, would prepare an integrated master plan for water resource management and protection of lands critical to the protection of water in the Commonwealth. This plan would contain all the elements described in the previous option. However, in this approach, the WRC would administer a use-permit system over water and related land resources. No person could make use of such a resource, nor conduct any land development or activity that might degrade it, without obtaining a permit from the WRC. The plan, together with programs, and regulations for implementing it, would be reviewed and approved by the Cabinet.

A statewide Massachusetts environmental service agency (MESA), or a series of regionally-oriented state agencies like the Metropolitan District Commission (MDC), would be primarily responsible for implementing the approved state plan. The MESA (or MDCs) would exercise functions, powers, and duties similar to those described for the RESA under the previous option. This means that the state itself would become heavily involved in undertaking management measures, and in administering regulatory controls over both the quality and quantity of the resource.

The RPAs would continue to play advisory roles in water resource planning. Municipal agencies and intermunicipal districts for wastewater management and water quality control could continue to function, but only in accordance with the WRC's plans and under supervision of the MESA. Local initiatives and municipal controls over water related land use would be left intact, but would be subject to supervening state powers to protect, allocate, and manage the water resource.

The advantages of this approach, like the preceding one, are that it would provide an opportunity to integrate long-

range water quality management and water supply development as conceived in earlier chapters of the Study. Location of water reservoirs, for example, could be coordinated with the development of treatment facilities. Moreover, this approach could provide efficiency in realizing the state's legitimate interest in the quality and allocation of the water resource. Given the maze and geographic scale of interrelated problems, including some highly technical ones, there are those involved in the management of the state's waters who believe that the state itself must protect and control this resource with a firm hand. At the same time, accountability to a variety of private and public interests can be built into the design by requiring interagency consultations and public participation at key stages of the planning and implementing process.

The vesting of primary planning and support functions on the state level will achieve greater uniformity than that attainable through use of the regional institution described in the previous approach.

The disadvantages are that a powerful state agency in the field of water resource management may be perceived as too great an affront to the tradition of local autonomy. Such an agency would, moreover, require an enlarged bureaucracy. The fact that state decisions regarding water pollution control, water supply, and critical area management would have profound influence on growth and land use is also likely to engender substantial political opposition.

Some of the state powers suggested here, for example, to allocate water supply and multiple use of the water resource – may encounter constitutional challenges based upon established riparian rights. Constitutional challenge may also be expected to any wholesale declaration that ground waters belong to, and are subject to allocation by, the Commonwealth. These issues may require lengthy litigation before the state can proceed with any master water resources plan.

Rhode Island. Unlike Massachusetts, Rhode Island is a small state with little tradition of regional government existing between the state and its municipalities, with the exception of regional councils of government such as that which exists in Blackstone Valley, created under R.I. Gen. Laws Ann. § 45–43. Moreover, the relevant institutions particularly the Statewide Planning Program (SPP), the State Planning Council (SPC), the Coastal Resources Management Council (CRMC), and the Water Resources Board (WRB) – have no precise counterparts in Massachusetts. For these reasons, a different array of institutional possibilities must be tailored to Rhode Island. As set forth below, they are organized under two major categories: (1) the control of land uses of critical planning concern, with varying degrees of state and local responsibility; and (2) the centralized management of water and related land resources.

1A. State development guidelines for use by local government. Similar to the Massachusetts approach 1A, state development guidelines would be prepared to address specific types of development which cannot be adequately controlled at the local level. Guidelines would be promulgated to direct certain kinds of development to possible sites, identified on the basis of resource capability criteria. The location, criteria and requirements of particular kinds of development would represent an expression of state development policies as set forth in the State Guide Plan and the State Land Use Policies and Plan.

The State Planning Council (SPC) would adopt and promulgate the guidelines, which would be prepared by the Statewide Planning Program (SPP), based on work already done by the state and the work of the SENE Study in identifying critical areas and criteria for categories of development, and any further studies which may be necessary. The guidelines developed by the SPP would assess the impacts and resource requirements of various kinds of developments of regional impact and compare them with the range of site characteristics which may be relevant in deciding their location. The guidelines would be based on inputs from state agencies concerned with economic development and environmental protection, as well as from representatives of local government and interested members of the public and private sector.

The guidelines would be used by all agencies and developers, both public and private, in initiating, evaluating, permitting, funding or undertaking particular development proposals. Development proposals advanced consistently with the guidelines could be facilitated by streamlined permit procedures. Proposals which are not consistent with the guidelines would be more carefully scrutinized for potential adverse effects. Possibly other incentives such as funding or technical assistance would be withheld from those proposals which were inconsistent with the guidelines.

Municipalities would retain their authority for development permits, although they would be expected to apply the guidelines developed by the State. Consistent with its role in the A-95 review process and the integrated grant administration program, the Statewide Planning Program would conduct screenings to determine if pending municipal development permits as well as development proposals advanced by state agencies were consistent with the guidelines.

The advantages of this approach are as follows. Insofar as the State Land Use Policies and Plan including State development policies and general statewide guidelines has been adopted by the SPC, this approach would reflect current state efforts. Moreover, this approach would build on the criteria for guiding development that are advanced in earlier chapters of the Study, such as the criteria to identify future power plant sites in ways consistent with water and related land resource characteristics. The guidelines

would also provide uniformity of approach to developments of regional impact or in special problem areas which have common characteristics, even though located in different political jurisdictions. Further, the guidelines adopted by the SPC would be a definitive expression of state policy and norms for evaluating the efficacy of certain development types.

Finally, since the guideline would not select specific development sites but would create instead an advisory process for matching sites with needs, is not likely to be seen as a great affront to the tradition of home rule.

The disadvantages of the approach are as follows. By the same token, the fact that the guidelines may only be tentative or advisory may undermine effective implementation of state development policy. Considerable resources and expertise may be necessary to prepare a useful and persuasive set of guidelines. Finally, although this approach could be used as an entire state program, it would appear to be more useful as a component of a broader program. Guidelines alone might leave the state without adequate authority to regulate some matters of clearly state concern.

The second alternative vests primary responsibilities with localities.

1B. Mandatory local planning and zoning. A contrasting approach based on local controls under state initiative would apply to Rhode Island the framework outlined in approach 1B for Massachusetts. *(See 1B above under Massachusetts.)*

The distinguishing features of this approach in the Rhode Island setting would be the absence of a regional intermediary between the state and its municipalities, and the performance by SPP-SPC of those functions which in Massachusetts would be assumed by the RPAs. The advantages and disadvantages enumerated there would also hold true for Rhode Island.

The next approach poses a more influential state role in critical areas management.

1C. State designation and local regulation of areas of critical concern to the state. This approach would charge a state agency with the responsibility to designate areas of critical concern and to establish standards for protecting, managing, and developing those areas. The most likely agency for the role of designating these areas and establishing standards for their protection or development would be the Statewide Planning Program, subject to guidance, review, modification, and approval by the State Planning Council. Municipalities would then formulate zoning and other development controls, pursuant to the state standards for designated areas within their respective jurisdictions.

Areas of critical concern to the state would be legislatively defined but might include: (1) Priority Protection Areas (category A): highly fragile resources which have the lowest tolerance for development and the highest value for water resource protection; (2) Other Protection Areas (category B): resources relatively tolerant to specific types and densities of development and having high value for water and related resource management; (3) Developable Areas Requiring Management (categories C, F, and G): resources capable of absorbing varying degrees of development; (all of which are included in the Study's definition of areas requiring protection and those capable of development), as well as (4) areas directly affecting, or affected by, major existing or planned key facilities or developments of regional impact (e.g., those described in *Chapter 9);* and (5) areas which, for reasons of state economic or social policy, have been accorded a high priority for development or redevelopment. The state standard-setting agency or agencies would review the mandated local controls for such areas and, where proposed controls were deemed to be inadequate, would make recommendations for their improvement. If the state recommendations were not complied with within a specified time, or local ordinances were inconsistent, the state would prescribe the required controls for the municipality. Developments located in, or affecting, the designated areas would be regulated by permit systems administered by the concerned municipalities, consistently with the approved set of controls. The state would stand prepared to acquire, or to assist a municipality in acquiring, the appropriate rights to any area designated for maintenance in a natural state with little or no development.

Issuance of use or development permits by municipalities pursuant to this scheme would be appealable by interested or aggrieved parties to the appropriate state agency for review. Upon such appeal, the state agency would be empowered to veto or to modify any permit it determined to have been issued inconsistently with applicable standards. Further, the state agency would itself be empowered to initiate, on its own motion, the review of the issuance of any local permit which it suspected of being in derogation of applicable standards. The denial of a development permit by a municipality would not be appealable to, or reviewable by, the state agency. All local and state agency determination would, however, be subject to judicial review after all administrative remedies had been exhausted.

The advantages of the approach are that it would provide a direct and efficient method by which state interest in environmental protection and economic development can be expressed through a unified state planning process. This approach would retain initiative for guiding local develop-

ment at the municipal level, while promoting the state's broad interest in protecting critical environmental areas. The state and the towns would each exercise controls at a scale, and through mechanisms, consistent with their interests.

Because the review patterns contained herein (e.g., double veto) are familiar elements of existing programs for coastal and inland wetlands protection, this approach has an institutional precedent and a major redistribution of power at, or between, state and local government levels would not be necessary. State-set standards for protecting critical areas could be flexible and sufficiently general for towns to readily tailor them to particular local circumstances.

This approach is consistent with some of the organizational precepts expressed in the Rhode Island State Land Use Policies and Plan, in the 1972 Coastal Zone Management Act, and in some of the national land use control proposals.

The disadvantages of this approach are that it would necessitate significant statutory revisions to empower SPP-SPC to set and enforce standards, and well might encounter opposition to the degree of state control it envisages over local determinations.

The last alternative would vest the state with greater regulatory authority.

1D. State regulation of critical areas with municipal administration. In a variation of the above alternative, a Resources Management Council (RMC) would be created to formulate plans consisting of designations, standards, and regulations for protecting, managing, and developing inland areas of critical environmental concern based on designations presented in the SENE Study, and would implement these through appropriate regulatory controls. The Coastal Resources Management Council's (CRMC) mandate would continue in a parallel role with respect to a defined coastal zone. Both sets of plans would be reviewed by the State Planning Council for consistency with state policy as expressed in the State Guide Plan and would be binding upon municipalities, overriding inconsistent municipal ordinances or actions.

The RMC would be newly established by legislative authorization with the regulatory powers suggested here. Powers of the CRMC would also be strengthened to equip it for a similar role. CRMC's staff would be removed from the DNR and brought under the direct control of the CRMC itself. In addition to any required municipal permit, a development falling within the regulated categories would also have to be approved by the issuance of a permit from either the RMC or CRMC. The grant or denial of such a permit would hinge upon the consistency of the proposed development with applicable sets of plans and guidelines, and would be appealable to the courts upon petition of any interested party.

The advantages of this approach are that with an adequate definition of the jurisdictional zones to be regulated by these two agencies, and with a viable mechanism (namely, the SPC) for resolving conflicts occasioned by regulatory activities affecting both zones, this approach offers a comprehensive, statewide strategy for accommodating developmental and environmental issues. This approach further respects the existence of CRMC as a functional agency and would preserve or strengthen its role. Municipalities would continue to regulate land use outside of areas of critical environmental concern, and would share the regulatory responsibilities with RMC or CRMC within such areas. Moreover, a substantial portion of the planning that must guide CRMC and RMC activity has already been done by the Statewide Planning Program. CRMC and RMC could take over from SPP the further development of such planning pertaining specifically to coastal and inland areas, respectively. This approach is also consistent with the Coastal Zone Management Act and other federal land use related legislation.

The disadvantages of this approach are that RMC would impose an additional administrative burden on the state and could complicate existing interagency relationships. It could also be perceived as inconsistent with traditional local prerogatives in matters of land use allocation and, possibly, would not be responsive to local needs and priorities.

The final approach demonstrates an option to integrate planning and management of water and related land resources with other resource policies, as the State is presently attempting to do. (Since no regional government exists in Rhode Island the regional management alternative applied in Massachussetts is not applicable to the State.)

2A. State planning and management of water and related land resources. Under this approach, greater emphasis would be placed upon the State Planning Council (SPC) to formulate overall policies and plans for protecting the environment, and for integrating the management of the water and related land resources of the state. The Statewide Planning Program would be responsible for the preparation of an integrated, long-range water resources plan, including water supply, wastewater management, solid waste disposal, and the prevention of improper land activities to protect the water resources of the entire state. This plan might contain all of the elements proposed above in Approach 3A for Massachusetts. This plan would be incorporated into the comprehensive State Guide Plan, for which the SPC is already responsible. The SPC would ensure that all plans for environmental resource management are consistent with one another and with other components of the State Guide Plan.

As a first step to bringing this about and consistent with

current efforts in the state to integrate long-range functional policy making in the State Planning Council, the responsibility for long-range water resources planning would be transferred to SPP-SPC from the Water Resources Board (WRB). The WRB would retain its existing responsibility for project planning in the field of water supply, and would acquire a parallel responsibility with respect to wastewater management. The Solid Waste Corporation (SWC) would carry out responsibilities for solid waste and sludge disposal as they bear on the protection of water resources. All project plans of the WRB and the SWC would be reviewed by the SPC for consistency with the State Guide Plan, guaranteeing the implementation of the water resource plans. Monitoring wastewater management facilities operated by the WRB or municipal agencies would continue to be the responsibility of the Department of Health (DOH). The Public Utilities Commission would regulate waste treatment rates as it now does supply rates.

As at present, acquisition, construction, and management of water supply sources and water resource projects would only be done by or with the approval of, the WRB. The WRB would acquire additional responsibility for wastewater management facilities. The WRB might itself construct water supply facilities in advance of demand. And, where a municipality or group of municipalities proved unwilling or unable to provide needed water supply or wastewater management facilities in accordance with the state plan, the WRB would be authorized to construct, operate, maintain, and/or lease them as necessary for that municipality or region. Similarly, with appropriate funding the SWC could operate a solid waste disposal program in the state, and could coordinate its efforts with the WRB through the SPC. Establishment of specific water quality standards and administration of regulatory programs to achieve and maintain them would still be carried out by DOH. Moreover, DOH's input would be decisive on all aspects of the long-range water resources plan affecting the purity and safety of the resource.

To the extent that the development of water resources would influence other growth, assuring that water resource operations are carried out consistently with state policy will also assist the implementation of other elements of the State Guide Plan. However, if the state is to assume a comprehensive role in the management of natural resources, greater decision making authority would have to be vested in a particular agency to ensure implementation. In this case, for example, the SPC could be given responsibility to coordinate programs, to resolve conflict, to compel appropriate agency activities and to veto inconsistent ones, subject to final approval by the Governor. If the SPC is to accept these responsibilities, then the membership of the SPC should be enlarged to include other state agencies. In this way, the state will not only formulate natural resource policy, but also implement it.

The advantages of this approach are as follows. Again as in approach 3A and 3B for Massachusetts, this approach would integrate management of the water resource in all phases of the hydrologic cycle, as suggested earlier in *Chapters 4 and 5 on Water Supply and Water Quality.*

By articulating a structure for strong state direction of environmental and economic affairs, conducted consistently with the State Guide Plan, this option suggests a strategy for meeting objections stated by some in the State that the State's existing efforts in the field of environmental protection and water resource management are uncoordinated and in some cases, internally inconsistent.

Since the WRB would construct wastewater management facilities for a municipality or group of municipalities only when the latter proved unwilling or unable to do so, as required by the water resources plan or by the DOH water quality standards, direct state intervention in local matters would also be kept to a minimum.

Since the planning and implementation of water management for all municipalities within the state would derive from a comprehensive state planning perspective, a more coherent approach to management of the resource would be achieved than under any less centralized approach. On this basis, the WRB would be able to encourage and/or effect regional solutions to management problems where a proliferation of local responses is not deemed desirable.

This approach would require only moderate adjustment of jurisdictional interests of existing agencies. The extension of the WRB's present mandate over water supply into the wastewater management field provides a degree of coordination unaddressed in current institutional structures. Consolidation of long-range policy planning in the State Planning Council would provide greater integration between land use, water supply, and water quality policy making.

This approach reflects, with some limitations, the recommendations of the Governor's Environmental Task Force.

The disadvantages of this approach are as follows. To the extent that this alternative is perceived as an intrusion into local matters and prerogatives, the role of the State Planning Council and the extension of the WRB's power to wastewater management may encounter legislative opposition. Further, a state master plan for management of the entire water resource may appear too rigid and too centralized an exercise of state power.

Difficulties may be encountered, on the other hand, in defining the respective roles of the WRB and the DOH, and in coordinating their roles, with respect to activities or developments that affect both the quality and quantity of the water resource.

AN INDEX FOR DECISION MAKERS

The last part of this chapter sets forth some of the major recommendations of the SENE Study and the actions necessary to carry them out. It is organized by level of government charged with particular responsibilities and will serve as means by which implementation activities can be graphically portrayed. Implementing actions are set forth in specific terms but, by and large, include such things as administrative tasks, changes in policy, additional funding, or modifications in existing authority. The public and its elected officials will find this a useful tool to specify the things which particular agencies can do to move the SENE program into action as well as to monitor the degree to which specific recommendations are being implemented (See Table 10.2).

TABLE 10.2 AN INDEX FOR DECISION-MAKERS OF MAJOR ACTIONS (Priorities listed next to recommendations: • highest priority; o high priority; * other priority)

RECOMMENDATION / ACTOR	• Increase and integrate protection of Critical Environmental Areas: priority, and other protection areas.	• Improve management of Developable Areas.	• Prefer local ground water to intermunicipal surface water to interbasin transfers as sources of water supply.	• Protect existing water sources.
Congress	Appropriate funds for acquisition under existing programs.			
Federal Agencies	DOT, USDA (SCS, FS); EPA; ACOE; DOI (NPS, BOR); HUD: Provide technical and financial assistance to state and local government through existing programs, (including runoff and sediment standards, flood hazard and soil studies, the flood insurance program, acquisition programs, and through the regulation of dredged or fill material in navigable waters under P.L. 92-500).	HUD; EPA; DOC (NOAA); USDA (SCS, FS): Provide technical and financial assistance to states and municipalities for planning and management.		ACOE: Identify potential supplies in need of protection as part of ongoing NEWS activities, and recommend appropriate means of protection.
State Legislatures	Appropriate funds for acquisition; clarify authority for innovative land use controls; reform tax law to create incentives to preserve agricultural land; establish a program of "agricultural districts" if appropriate.	Enact legislation to create a management system to establish state growth and development policies, to identify critical areas, to establish criteria for location of key facilities, and to review significant developments.		
State Agencies	MA DEM; RI DNR: Acquire significant critical areas; use permits and regulations to the maximum feasible extent to protect critical areas. MA DEQE; RI DOH: Protect reservoir sites through existing regulations; review plans to ensure the location of sewer outfalls away from swimmable areas.	MA Cabinet; RI SPC: Adopt state policies for growth and development formulated by MA OSP and RI SPP; Promulgate policies for the location of key facilities, and for the acquisition of sites for preservation or development. MA EOEA; RI DNR: Adopt development policies and standards for activities hazardous to water resources, (including sanitary landfill, salt storage, industrial wastes, agricultural runoff, and sand and gravel mining below the aquifer level.)	MA WRC; RI WRB: Adopt policy which encourages municipalities to supply future water using in-basin ground water and regional in-basin surface water before considering interbasin transfers of water by requiring use of in-basin water before granting approval of any interbasin transfers.	MA WRC, DEM; RI WRB: Establish a program to encourage municipalities to maintain existing sources by acquiring key sites, limiting water consumption through pricing and education, investigating advanced technology and administering existing protective regulations.
Local Government	Adopt appropriate land use controls to protect critical areas based on regional and state standards; Join flood insurance program; acquire, in fee or easement, designated significant critical areas.	Adopt ordinances which permit land development according to resource capability; Plan infrastructure to guide growth and development.	Use ground water and intertown surface water, before using interbasin transfer as sources of water supply.	Develop, adopt, and enforce land use regulations consistent with state policy to protect water sources.
Other	MA RPA's; RI SPP; Develop and promulgate protective policies and development standards for critical areas; Identify significant sites to be protected.	MA RPA's; RI SPP: Plan and review the location of infrastructure to guide growth; Review developments of regional impact.		MA RPA's; RI SPP; Assist state and local government in identifying potential water supply sources for protection and in developing protective measures.

TABLE 10.2 (Cont'd.)

RECOMMENDATION / ACTOR	• Expand MDC sources by completing the Northfield Mountain facility. Carry out conservation measures. Plan the Millers River facility.	• Encourage substate regionalization of water supply systems.	• Continue non-degradation in areas now swimmable-fishable.	• Emphasize treatment of urban stormwater overflows. • Accelerate federal grants for municipal wastewater treatment.
Congress	Appropriate federal cost-share, consistent with the recommendations previously adopted by the New England River Basins Commission in the *1980 Connecticut River Basin Plan.*			Appropriate additional funds under Section 201 of P.L. 92-500 for federal cost-sharing of most cost efficient means in individual situations.
Federal Agencies	ACOE: Evaluate environmental impact of diversion facilities; Construct diversion facilities once project approved, consistent with the recommendations previously adopted by NERBC in the *1980 Connecticut River Basin Plan.*		EPA: Develop and adopt national guidelines on non-degradation under P.L. 92-500, Section 304.	EPA: Provide technical and financial assistance to state and local government to administer program; Review project proposals to ensure public access at facilities and new rights-of-way. ACOE: Participate in wastewater management studies (Eastern Mass., Merrimack, PNB).
State Legislatures	Appropriate state cost-share through issuance of bonds; Enact law to create a mechanism with Connecticut to resolve riparian conflicts, consistent with the recommendations previously adopted by NERBC in the *1980 Connecticut River Basin Plan.*	Enact legislation to encourage regional water systems through intertown cooperation; Review and approve non-local regional supply development proposals.		Appropriate additional funds as required to provide state cost-share.
State Agencies	MA EOEA: Examine the technical feasibility (economic and environmental) and timing of other alternatives for meeting the long-range water resource needs of MDC, within the context of state policy, and prepare a plan before a final decision on the Millers River diversion is made. MA MDC: Acquire water from the Northfield Mountain diversions; Immediately institute water conservation measures and improve maintenance of the distribution system; Monitor quality of diverted water, especially for radioactive contamination.	MA WRC; RI WRB: Adopt policy to encourage regionalization among municipalities. MA WRC, DEQE; RI WRC, DOH: Coordinate regionalization of local supply system development; Review and approve establishment of regional systems.	MA DEQE; RI DOH: Regulate discharges through "NPDES" program to prevent deterioration of the quality of stream water above the most upstream municipal discharges. MA EOEA; RI DNR & DOH: Encourage downstream negotiation for low flow regime; Encourage protection of steambank buffer strips.	MA DEQE; RI DOH: Designate areas for treatment of urban stormwater runoff; process grants and provide financial assistance to localities for construction of facilities; ensure public access and provision of rights-of-way.
Local Government	Continue to protect and conserve developed and potential municipal supplies.	Towns to negotiate and cooperate with one another; Petition legislature and state agencies to approve system; Establish system by agreement.	Identify candidate areas; Adjust adjacent zoning; Adopt erosion controls.	Design, construct, and operate treatment plants; Appropriate local share of construction costs. Provide appropriate public access and rights-of-way to facilities.
Other		Proposed Regional Systems: Develop water supply cooperatively.	MA RPA's; RI SPP; Identify and evaluate candidate zones as part of '208' studies, under P.L. 92-500, Section 208.	

TABLE 10.2 (Cont'd.)

RECOMMENDATION / ACTOR	o Continue current industrial permits program.	o Begin regionwide stormwater and wet-weather stream sampling.	o Make towns responsible for scavenger waste disposal.	• Expand facilities at existing state beaches and parks.
Congress				Appropriate funds for federal share of costs.
Federal Agencies	EPA: Continue monitoring and approving state programs under section 402, P.L. 92-500.	EPA: Provide funds to states for water quality monitoring programs under Section 106 of P.L. 92-500.		BOR: Provide technical and financial assistance to states and towns; DOT: Provide financial and technical assistance to state to study transportation access to public facilities.
State Legislatures			Appropriate additional funds to enforce existing legislation.	Appropriate funds for state share of costs.
State Agencies	MA DEQE; RI DPH: Continue industrial pollution permits program (National Pollutant Discharge Elimination System).	MA DEQE; RI DOH: Begin year round stream sampling as first step to develop a plan for non-point source abatement program.	MA DEQE; RI DOH: Enforce existing legislation requiring towns to be responsible for proper disposal of septic tank wastes with additional funds and staff.	MA DEM; RI DNR: Provide increased capacity at existing beaches, and acquire additional undeveloped beach areas for recreation; with state DOTs: Study feasibility of increased public transportation to, and expansion of parking facilities at, public beach areas.
Local Government			Establish and enforce regulations to dispose of waste within state guidelines.	Appropriate local share of costs to acquire undeveloped areas to expand existing beaches and parks.
Other				

TABLE 10.2 (Cont'd.)

RECOMMENDATION / ACTOR	o Form state Boating Advisory Committee.	o Construct public boat ramps and fish piers.	• Develop Boston Harbor Island and Narragansett Bay Island Parks. o Make multiple use of urban lands for recreation.	• Declare interim offshore 200-mile economic zone. * Adopt national fisheries management policy and program.
Congress		Appropriate funds for federal share of costs under existing programs.	Appropriate funds for federal share of costs under existing programs.	Enact law to extend nation's jurisdiction to 200-mile offshore by legislative action. Establish national fisheries management policy including: limited foreign entry; quotas; seasonal or species controls; fishing gear specifications.
Federal Agencies		BOR: Provide technical and financial assistance to states and towns.	BOR: Provide financial and technical assistance.	DOT (USCG): Enforce fishing limits law; monitor program. DOC (NMFS): Administer program implementing policy.
State Legislatures	Appropriate funds to support creation of committee.	Appropriate funds for state share of costs.	Appropriate funds for state share of costs.	
State Agencies	MA DOC; RI DED; (with public works, coastal zone and natural resource agencies and private citizens): form a Boating Advisory Committee to advance the orderly development of boating, to identify marinas near centers of high demand for expansion and to encourage utilities, private industries, and private recreational businesses to take actions consistent with the boating policies developed by the Committee.	MA Public Access Board; RI DNR: Construct boat ramps and fishing piers to productive salt water fishing areas for use by the general public.	MA DEM, MDC; RI DNR: Implement current plans to develop Harbor Islands and Bay Island Parks; Provide funds for acquisition of multiple purpose recreation land.	
Local Government		Appropriate local share of costs and construct ramps and piers at local beaches or facilities.	Participate in implementation of plans; Increase recreation opportunities in urban areas by acquiring parks and recreation areas, and allowing multiple use of public lands.	
Other	Citizens: Encourage formation of and join Boating Advisory Committee as described in state agencies above.			

TABLE 10.2 (Cont'd.)

RECOMMENDATION / ACTOR	• Carry out study to develop a region-wide port development	o Coordinate local waterfront planning and development.	o Prepare flood plain programs with non-structural emphasis.	* Adopt zoning to regulate new flood plain construction.
Congress	Appropriate funds for Study.	Appropriate funds to state CZM programs.	Appropriate funds for implementation of non-structural flood management programs.	
Federal Agencies	ACOE; DOC (MARAD); DOT (USCG): Participate in joint study with state, NERCOM & NERBC, and local governments.	OCZM: Approve funding of waterfront renewal programs as part of State Coastal Zone Management Programs under P.L. 92-583.	ACOE; USDA (SCS); DOI (USGS, F&WS, BOR); NWS; HUD: Provide technical and financial assistance to communities for flood plain management.	HUD; Administer National Flood Insurance Program. WRC; ACOE; USDA (SCS); HUD: Accelerate delineation of flood hazard areas.
State Legislatures	Authorize state participation in study and appropriate funds for state share of costs.	Enact legislation creating management structure for coastal zone management; Appropriate state share of funds.	Appropriate funds for state share of costs of programs.	Enact legislation providing that the state would enforce regulations upon failure of the locality to adopt regulations.
State Agencies	MASSPORT; MA DPW; RI DED: Participate in Study.	Coastal Zone Planning Programs in MA & RI: Develop urban waterfront planning and management guidelines and criteria.	MA EOEA; RI SPP: Prepare flood plain management (non-structural) programs; provide technical assistance to municipalities. Coastal zone planning programs: Prepare plans for coastal flood areas.	MA OSP, EOEA; RI SPP: Provide guidelines and technical assistance to localities; review delineation of flood hazard areas; issue permits for flood plain development under current legislation.
Local Government	Participate in Study.	Plan and develop urban waterfront renewal programs with funds available from the Community Development Act (P.L. 93-383).	Develop and implement non-structural flood plain management programs consistent with state and federal guidelines; Qualify for, and participate in, National Flood Insurance Program.	Adopt flood plain zoning to prevent further flood plain development; Qualify for, and participate in, National Flood Insurance Program.
Other	NERCOM, NERBC: Undertake joint port planning study, for the region: (See Chapter 7 for scope of study).	MA RPAs; RI SPP: Review and revise local plans where impact may be of greater than local concern.	MA RPA's; RI SPP; Assist communities in qualifying for the flood insurance programs; Provide assistance in developing non-structural programs.	MA RPA's; RI SPP: Delineate flood hazard areas.

TABLE 10.2 (Cont'd.)

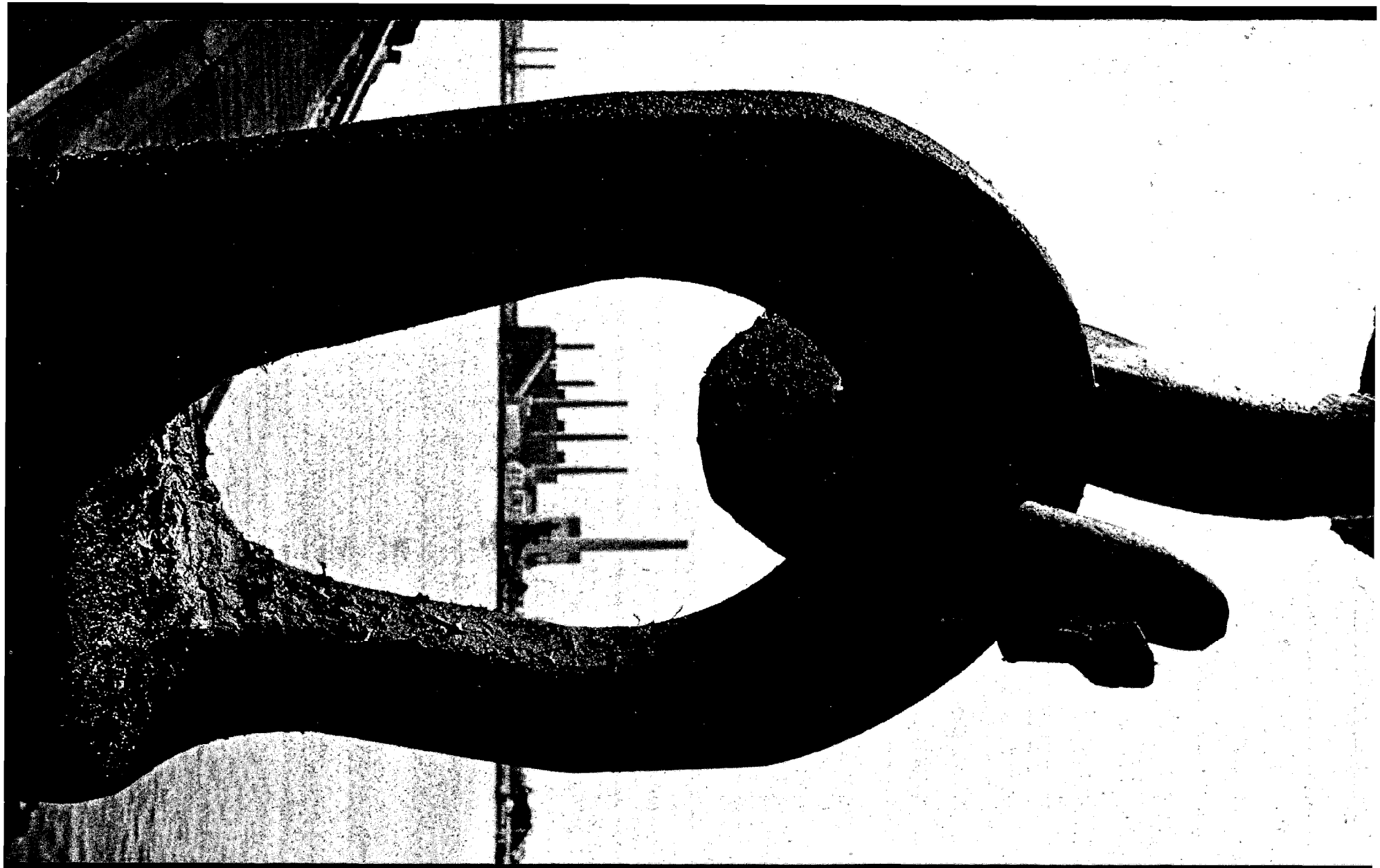
RECOMMENDATION / ACTOR	* Establish regulations to control runoff, erosion, and sedimentation.	o Manage critical erosion areas through state coastal zone programs.	o Centralize minerals management authority in state.	o Create state energy conservation education programs; set state energy goals.
Congress				Enact legislation establishing tax incentives for private conversion to new energy sources.
Federal Agencies	USDA (SCS, FS): Provide technical assistance to state and local governments; control agricultural and forest soil losses through structural and non-structural methods.	DOC (OCZM): Approve and fund state coastal zone plans and management programs. USDA (SCS): Provide technical and financial assistance to states and municipalities.	DOI (USGS, BOM): Provide technical assistance to states in developing or strengthening state minerals extraction policies.	FEA: Initiate an energy conservation program; establish regional energy conservation goals; develop public education programs.
State Legislatures		Ensure coastal zone management agency of state (MA CZMP; RI CRMC) has adequate jurisdiction to include critical areas in the coastal zone.	Adopt state minerals extraction policies; designate appropriate state agency for mineral resources policymaking, monitoring, and regulation. (Possibly the MA DEQE, and the RI DNR.)	Enact legislation establishing tax incentives for private conversion to new energy sources.
State Agencies	MA EOEA; RI DNR: Develop guidelines for local control of erosion, sedimentation and runoff; inspect and maintain beach control structures.	MA DPW; RI DNR: Encourage stabilization of coastal erosion areas; inspect and maintain existing beach control structures; MA CZMP; RI CRMC: Prepare coastal zone plan and recommend management program.	Designated state agency: create minerals public education program; provide guidance to municipalities to establish a permit program; promulgate statewide operating and rehabilitation standards; begin staged reclamation of abandoned extraction sites.	MA & RI EPO: Establish public education programs; set energy consumption rate reduction goals. Other Agencies: begin implementation of energy conservation policies.
Local Government	Adopt local land use controls consistent with state guidelines to prevent erosion and sedimentation.	Encourage stabilization of, and establish regulations for, coastal erosion areas.	Adopt local regulations which conform to state standards to allow mineral extraction.	Develop municipal energy conservation goals.
Other				NERCOM: Continue development of energy awareness program.

TABLE 10.2 (Cont'd.)

RECOMMENDATION / ACTOR	• Identify and secure power plant sites for future use; avoid critical environmental areas for future sites; maximize existing site capabilities.	o Establish petroleum facilities siting authority in Rhode Island and strengthen the one in Massachusetts. o Establish deepwater port(s), evaluate sites individually, locate refineries inland near infrastructure.	o Revise building standards to improve heating-cooling efficiency.	o Fund Rhode Island solid waste management program.
Congress				
Federal Agencies	FEA: assist in the identification of appropriate sites.	DOT (Coast Guard): Administer Deepwater Port Act of 1974 (P.L. 93-627).	FEA: Provide technical assistance to states and municipalities.	EPA; USDA (SCS): Provide technical assistance for locating and reclaiming dumps and landfills.
State Legislatures	Expand authority of MA Energy Facilities Siting Council and RI Statewide Planning Program to identify and secure future power plant sites.	Expand authority of MA Energy Facilities Siting Council and RI Statewide Planning Program to enable them to survey and secure potential sites for petroleum facilities.		(RI) Provide funding.
State Agencies	State siting agencies: Avoid Critical Environmental Areas for future sites; wherever possible, require expansion of existing facilities; Identify and secure future power plant sites.	State siting agencies (MA EFSC; RI SPP): Identify potential sites for petroleum facilities; Locate refineries, storage facilities, and related development inland, in areas served by transportation, water supply, and wastewater services; Secure sites for development through acquisition or regulatory measures. MA's RI EPOS: Adopt and implement policy of deepwater ports as preferred method of petroleum distribution.	MA DCA; RI SPP: Promulgate revised standards for buildings to improve heating-cooling efficiencies; MA & RI EPOs: Set energy consumption reduction goals; establish implementation strategy.	RI SW Corp: Prepare budget; select disposal sites using SENE resource criteria; inventory landfill operations; reclaim abandoned landfills.
Local Government			Adopt building codes consistent with state guidelines.	Develop land use controls to restrict landfill operations.
Other	NERCOM; NERBC: Assist in the identification of appropriate sites.	Oil Industry: Develop deepwater ports and refinery facilities in accord with public policy.	State Home Builders Association: develop improved construction methods for heating-cooling efficiency.	

TABLE 10.2 (Cont'd.)

RECOMMENDATION / ACTOR	• **Maximize use of existing resource policy institutions to strengthen the management system for natural resources.**			
Congress				
Federal Agencies	Support state efforts to integrate resource management policy-making with social and economic policy of the state by providing appropriate technical and financial assistance.			
State Legislatures	Adopt legislation to establish or modify the existing natural resources management system, to allocate responsibilities to sub-state regional or state bodies while relying on municipalities to make the bulk of land use decisions.			
State Agencies	MA Cabinet; RI SPC: Review resource management policies and programs recommended by the SENE Study and adopt appropriate state policies to implement them; provide guidance to program administrators to ensure consistent implementation; consider and recommend for adoption by the legislature one of the alternative management approaches proposed by the Study (See Chapter 10 text).			
Local Government	Continue to administer current legal powers over land use.			
Other	NERBC; NERCOM; Gov. Conf.; FRC: Support state efforts; provide interstate regional cooperation. Substate RPAs: Exercise regional perspective over greater than local resource decisions.			



Tying the Recommendations Together

11

CHAPTER 11 TYING THE RECOMMENDATIONS TOGETHER 11-1

The Relationships of Objectives, Goals, Recommendations, Activities 11-1, How Planning Objectives Achieve the Goal 11-1, How Recommendations Satisfy the Planning Objectives 11-1, How Activities Satisfy the Recommendations 11-9, How Agencies Carry Out the Activities 11-11, **The Relationship of Study Objectives to National Criteria 11-11**, How The SENE Study Objectives Relate to National Criteria 11-11, **The Major Conclusions and the Study Goal 11-17**, How the Major Conclusions for SENE Were Reached 11-17.

CHAPTER 11 TYING THE RECOMMENDATIONS TOGETHER

This chapter has several purposes. First, it describes how the SENE program is systematically tied together in a hierarchy of goals, planning objectives, and responsible agencies.

- The overall Study goal is achieved by satisfying its component planning objectives;
- The planning objectives, in turn, are satisfied by implementing their supporting recommendations;
- The recommendations are implemented by carrying out certain activities; and,
- The activities are carried out by designated agencies, some to oversee programs, some to carry them out.

Second, the chapter evaluates the SENE program in terms of broad national criteria.

Last, the chapter observes the entire program and reflects on how the three major conclusions, that run like master themes through the recommendations, evolved from the Study.

THE RELATIONSHIPS OF OBJECTIVES, GOALS, RECOMMENDATIONS, ACTIVITIES

How Planning Objectives Achieve the Goal

As stated in *Chapter 1,* the principal goal* of the SENE program was taken from the Plan of Study, prepared before the Study began. It was approved by the U. S. Water Resources Council and reads:

> "To identify and recommend actions to be taken by all levels of government and by private interests to secure for the people of the region the full range of uses and benefits which may be provided by balanced conservation and development of the region's water and related land resources."

To achieve this goal, the Study was broken down into the seven broad functions which *Chapters 3 through 9* of this report describe. The functions generally correspond to the principal traditional subdivisions of comprehensive planning for water and related land resources. To give them focus, each function (Chapter in this report) is described in terms of a single broad "planning objective". The seven planning objectives have been stated in their appropriate chapters. They are repeated in the left column of Table 11.1. In general, each planning objective attempts to satisfy a need (solve a problem), subject to the constraint that solutions must be environmentally, economically, and socially acceptable. Satisfying the planning objectives achieves the overall study goal.

How Recommendations Satisfy the Planning Objectives

To satisfy the planning objectives, the SENE Study proposes 128 recommendations. They are listed in the left column of Table 11.1 under the planning objective they satisfy. Each recommendation is given in its short form as listed on the back of the Overview. The full text of the recommendations can be found in the appropriate chapters. As explained further in the legend at the end of Table 11.1, the symbols on the left of the recommendations indicate their relative importance in the SENE program.

The first set of columns in Table 11.1 indicates the relationship between recommendations and planning objectives. For example, the recommendation number 1 (GG-1) under *Guiding Growth (Chapter 3)* is "Protect critical environmental areas, priority protection (Category A), and other protection areas (Category B)." Reading horizontally, the symbols (explained at the end of the table) show that this recommendation has a direct beneficial effect on the planning objectives of five of the seven chapters. Recommendation GG-1 was designed to guide growth, of course, but it also directly benefits *Chapter 4, Water Supply,* by protecting well sites and wetlands, *Chapter 6, Outdoor Recreation,* by protecting beaches and wetlands, *Chapter 7, Marine Management* by protecting wetlands and shellfish areas, and *Chapter 8, Flooding and Erosion,* by protecting wetlands, beaches, and critical coastal erosion areas. Recommendation GG-1 also indirectly benefits water quality by protecting wetlands, which can be effective buffers for the protection of water quality. The recommendation is shown as having little or no net effect, however, on the objective of *Chapter 9, Locating Key Facilities.* Protecting Category A and B areas makes it even more difficult to locate these facilities. On the

* As also indicated in *Chapter 1,* a second goal was to produce a compilation of base data. The first goal is met by the SENE Study recommendations which are being discussed here in *Chapter 11.* The second goal is satisfied primarily by the SENE Study files described in *Chapter 1.*

TABLE 11.1 INTERRELATIONSHIPS AND SELECTED CHARACTERISTICS OF SENE STUDY RECOMMENDATIONS*

Note: Explanation of symbols used is described on the last page of this table.	Planning Objectives ##							Major Activity Types								Principal Agencies	
Planning Objectives and Numbered Recommendations	3. Guiding Growth	4. Water Supply	5. Water Quality	6. Outdoor Recreation	7. Marine Management	8. Flooding & Erosion	9. Locating Key Facilities	Further Planning	Management & Control	Acquisition	Legislation	Regionalization	Research & Development	Private Investment	Project Development	### Overseeing	### Carrying Out
GUIDING GROWTH (Chapter 3)																	
Planning Objective: To suggest strategies for protecting the critical water and related land resources of SENE while acommodating economic activities and guiding growth.																	
Recommendations																	
● 1. Increase protection of critical environmental areas, priority protection (Category A) and other protection areas (Category B)	●	●	o	●	●	●		*	*	*		*				Mass. Cabinet and R.I. SPP	S, M
● 2. Improve management of developable areas (Categories C, F, and G) by resource capability, judicious use and expansion of infrastructure, and regulation of large development.	●	●	●	●	o	●	●	*	*			*	*			Mass. Cabinet and R.I. SPP	S, M
WATER SUPPLY (Chapter 4)																	
Planning Objective; To meet municipal needs for adaquate supplies of fresh water in the most economically feasible and environmentally sound manner.																	
Recommendations																	
Everywhere																	
o 1. Maintain and protect existing water resources	●	●	●						*							DNRs, WRB	S, M
● 2. Prefer local ground water to intermunicipal surface water to interbasin transfer.	o	●						*	*							DNRs, WRB	R, M
o 3. Limit water consumption through education and water saving technology.		●							*							DNRs, WRB	S, M
* 4. Acquire key watersheds and potential well sites.	●	●	●							*		*				DNRs, WRB	S, M
5. Establish regional water management agencies.		●	o					*	*		*	*				DNRs, WRB	F, M
6. Study advanced technologies leading to new sources of water.		●											*			DOI, EPA. DNR	R, M
Ground Water dependent areas																	
o 7. Survey ground water location, quantity, and availability.	o	●											*			USGS, WRC,WRB	F, S
* 8. Restrict activities shown to be hazardous to ground water quality.	●	●	●				o	*								DNRs, WRB,	
* 9. Limit ground water withdrawl to maintain stream levels.		●	o	o	o	●			*							DNRs, WRB	S, M
10. Monitor salt water encroachment in coastal aquifers.	o	●	●										*			DNRs, WRB	S, M
11. Provide recharge basins to capture storm runoff.	o	●	●												*	DNRs, WRB	S, M
12. Establish state ground water boards.		●	o					*	*		*	*				MGC, RIGA	S
Surface water dependent areas																DPH, DOH	S, M
● 13. Expand MDC sources by completing the Northfield Mountain facility. Carry out conservation measures. Plan the Miller's River facility.	o	●													*	MDC, COE	S, I
* 14. Encourage regionalization of water supply systems.		●	o					*	*		*	*				DNRs, WRB	S, R

* The responsibilities of the Massachusetts Department of Natural Resources have been re-organized to several new departments, including Departments of Environmental Quality Engineering, Environmental Management, and Fisheries, Wildlife, and Recreational Vehicles within the Executive Office of Environmental Affairs. Since the distribution of responsibilities is still evolving, the former reference to DNR has been retained for ease in reading Table 11.1.

TABLE 11.1 INTERRELATIONSHIPS AND SELECTED CHARACTERISTICS OF SENE STUDY RECOMMENDATIONS (CONTINUED)

Planning Objectives and Numbered Recommendations	Planning Objectives ##							Major Activity Types								Principal Agencies	
	3. Guiding Growth	4. Water Supply	5. Water Quality	6. Outdoor Recreation	7. Marine Management	8. Flooding & Erosion	9. Locating Key Facilities	Further Planning	Management & Control	Acquisition	Legislation	Regionalization	Research & Development	Private Investment	Project Development	### Overseeing	### Carrying Out
WATER QUALITY (Chapter 5)																	
Planning Objective: To achieve swimmable-fishable waters by 1983 wherever realistically attainable economically, socially and technically.																	
Recommendations																	
Preservation																	
● 1. Stress anti-degradation in areas now swimmable-fishable.	●	●	●	o	o			*	*			*				Congress	F, S, M
o 2. Carry out current state non-degradation policies.	●	●	●	o	o				*			*				DNRs, DOH	S
* 3. Alleviate runoff from new urban developments.	o	o	●		o	o			*					*	*	DNRs	S, M
* 4. Negotiate acceptable low-flow regimes with upstream communities.			●	o	o	o			*							DPH, DNRs, DOH	S, M
5. Provide streambank buffer strips.	o	o	●	●	o	●		*	*			*				DNR, SPP	S, M
Restoration																	
● 6. Emphasize treatment of combined sewer overflows.	o		●	o	o				*						*	EPA, DNRs, DOH	F, S
● 7. Accelerate federal grants for municipal wastewater treatment.			●	o	o				*						*	EPA	F
● 8. Continue current industrial permits program.	o	o	●	o	●									*	*	EPA, DNRs, DOH	F, S
o 9. Begin regionwide stormwater and wet-weather stream sampling.	o	o	●	o	o								*			DNRs, DOH	S
o 10. Make towns responsible for scavenger waste disposal.			●						*							DPH, DOH	S
* 11. Determine municipal sludge disposal policy on plant-by-plant basis.			●		o			*								DNRs, DOH	S
* 12. Place burden on industry for disposing of hazardous wastes.			●		o				*			*		*		DNRs, DOH	S
13. Study and define the landfill leachate problem.	o	o	●				●						*			DPH, DOH	S
14. Provide pumpout facilities and treatment for watercraft wastes.			●	o	o									*	*	DNRs, DOH	S
Area priorities																	
o 15. Give priority to Cape Cod, New Bedford, Providence, and Boston.	o	o	●	o				*	*			*			*		F, S
OUTDOOR RECREATION (Chapter 6)																	
Planning Objective: To meet 1990 recreation needs in economically, environmentally, and socially acceptable ways.																	
Recommendations																	
Swimming																	
● 1. Expand facilities at existing state beaches and parks.	o			●								*			*	DOT, DOT(State) DNRs, MDC	S
2. Study beach erosion control.				●		●						*	*			DNRs, CRMC COE, CZMP	F, S, M

TABLE 11.1 INTERRELATIONSHIPS AND SELECTED CHARACTERISTICS OF SENE STUDY RECOMMENDATIONS (CONTINUED)

Planning Objectives and Numbered Recommendations	Planning Objectives##							Major Activity Types								Principal Agencies	
	3. Guiding Growth	4. Water Supply	5. Water Quality	6. Outdoor Recreation	7. Marine Management	8. Flooding & Erosion	9. Locating Key Facilities	Further Planning	Management & Control	Acquisition	Legislation	Regionalization	Research & Development	Private Investment	Project Development	### Overseeing	### Carrying Out
OUTDOOR RECREATION (Chapter 6) (Con't)																	
3. Study beach expansion.				●		○		*				*	*		*	DNRs, CRMC COE, CZMP	F, S, M
○ 4. Secure public access to shoreline.				●				*		*						DNRs, PAB ROWC	S
Boating																	
○ 5. Form state boating advisory committees.				●				*	*							CZMP, CRMC	S, M, P
6. Undertake authorized channel and anchorage improvements.				●								*			*	DNRs, DCD	F
7. Investigate regional marina basins.				●								*		*	*	DED, DPW COE	F, S, M
Saltwater fishing																COE, CRMC CZMP	
○ 8. Construct public boat ramps and fish piers.				●				*		*					*	PAB, DNRs	S, M
9. Encourage private construction of boat ramps and fish piers.				●					*					*	*	BAdC	S, M
Camping and picnicking																	
* 10. Form state recreational advisory committees.				●				*	*	*					*	DNRs DCD, DED	S
○ 11. Expand state parks near tourist centers.				●				*	*							DNRs, SPP	S, M, P
Hunting and fishing																	
* 12. Acquire SENE's most important wildlife habitats.	●		○	●						*		*				DNRs	S, P
13. Acquire SENE's most important streambanks.	●		○	●		○				*		*				DNRs	S
14. Acquire public access to ponds.				●						*						DNRs	S
15. Enforce wetlands legislation and local zoning regulations.	●			●	○	○			*							DNRs	S, M
Passive outdoor recreation																	
● 16. Develop Boston Harbor Islands and Narragansett Bay Island Park.	○			●				*	*			*			*	MDC, DNRs DNRs, DPH	S
○ 17. Develop guidelines for limited recreation on selected storage reservoir lands.				●					*							DOW, SPP, EDA	F, S, M
○ 18. Make multiple use of urban lands.	●			●				*	*							Municipal	M
○ 19. Implement or develop scenic rivers legislation.	○		○	●		○		*	*			*				DNRs	S
* 20. Expand existing parks near urban centers.	○			●				*	*	*					*	DNRs	S, R, M
21. Develop a regional trail system.				●				*	*		*	*				MDC, DNRs	S
MARINE MANAGEMENT (Chapter 7)																	
Planning Objective: To maintain the region's renewable marine resources at a level sufficient for sustained future use, and to develop the region's nonrenewable marine resources in an environmentally sensitive manner.																	

TABLE 11.1 INTERRELATIONSHIPS AND SELECTED CHARACTERISTICS OF SENE STUDY RECOMMENDATIONS (CONTINUED)

Planning Objectives and Numbered Recommendations	Planning Objectives##							Major Activity Types								Principal Agencies	
	3. Guiding Growth	4. Water Supply	5. Water Quality	6. Outdoor Recreation	7. Marine Management	8. Flooding & Erosion	9. Locating Key Facilities	Further Planning	Management & Control	Acquisition	Legislation	Regionalization	Research & Development	Private Investment	Project Development	### Overseeing	### Carrying Out
MARINE MANAGEMENT (Chapter 7) (Con't)																	
Recommendations																	
Offshore fisheries																	
● 1. Declare interim offshore 200-mile Economic Zone.					●											Congress	
* 2. Adopt national fisheries management policy and program.					●				*		*	*				Congress NMFS	F
3. Increase tariffs on imported fish products.					●						*					Congress NMFS	F
4. Allow privately financed purchase of foreign-built fishing boats.					●									*		Congress NMFS	F
5. Improve market for underutilized fish species.					●								*	*		NMFS	F
6. Accommodate coastal fishing facilities through improved planning.	○				●			*								DNRs, DCAs	F, P
Shellfish and aquaculture																RPA, SPP	S, M
7. Increase Mass. technical assistance for local shellfish management.				○	●								*			DNRs	S
8. Increase shellfish licensing fees in Massachusetts and require recreational licenses in Rhode Island.					●									*		DNRs	S, M
9. Develop underutilized shellfish market.					●								*	*		DNRs	S
* 10. Research removal of viral bacteria to enhance shellfish habitats.			○		●								*			EPA, DPH, DOH	F, S
* 11. Site sewage discharges away from estuaries.	○		●	●	●			*	*						*	EPA	F, S
12. Enact aquaculture legislation in Rhode Island.					●						*					RIGA	S
13. Identify potential aquaculture sites.					●			*					*			DNRs	S, M
14. Increase technical assistance to towns for aquaculture.					●								*			DNRs	S, M
15. Increase research on use of wastewater for aquaculture.			○		●								*			EPA, DPH DOH, DNRs	F, S, M, P
Port development																COE, DOC	
● 16. Create a regionwide port development strategy.	○				●		●		*							DNRs, NERBC NERCOM	F, S
17 Continue interim dredge material disposal procedure.					●		○		*							BLM, CRMC CZMP	F, S
Offshore sand and gravel																	
* 18. Develop policy and program regulating mineral extraction activities in coastal waters.					●	○	●		*							CZMP, CRMC BLM, CRMC	S
19. Coordinate future federal offshore leasing with adjacent states.					●		○		*							CZMP,	
* 20. Develop predictive modeling techniques.					●		○						*			DNRs	S
Urban waterfronts																	
21. Coordinate local waterfront planning and development.	○			○	●		○	*	*							DCAs,RPAs,SPP	F, S, R, M
○ 22. Provide guidance and set criteria for priority waterfront uses.	○			○	●		●	*	*				*			DCAs,RPAs,SPP	F, S, R, M
23. Review and coordinate waterfront use at state and RPA level.	○			○	●		○	*	*			*				DCAs,RPAs,SPP	F, S, R, M
* 24. Support state and local waterfront development plans.	○			○	●		○		*			*				DCAs,RPAs,SPP	F, S, R, M

TABLE 11.1 INTERRELATIONSHIPS AND SELECTED CHARACTERISTICS OF SENE STUDY RECOMMENDATIONS (CONTINUED)

Planning Objectives and Numbered Recommendations	Planning Objectives##							Major Activity Types								Principal Agencies	
	3. Guiding Growth	4. Water Supply	5. Water Quality	6. Outdoor Recreation	7. Marine Management	8. Flooding & Erosion	9. Locating Key Facilities	Further Planning	Management & Control	Acquisition	Legislation	Regionalization	Research & Development	Private Investment	Project Development	### Overseeing	### Carrying Out
FLOODING AND EROSION (Chapter 8)																	
Planning Objective: To reduce flood damage in the region, both riverine and coastal; and to reduce critical coastal erosion.																	
Recommendations																	
Flooding																	
○ 1. Prepare flood plain programs with non-structural emphasis.	○			○		●		*	*			*				COE, USDA DNRs	F, S, M
* 2. Adopt zoning to regulate new flood plain construction.	●			○		●			*							Mass. Cab., SPE	S, M
* 3. Establish other local regulations to control runoff erosion.	●		○			●			*							Municipal	S, M
4. Provide technical assistance to local officials.						●			*				*			USDA, DNRs	F, S
5. Acquire key flood plains and wetlands.	●	○	○	●	●	●				*						DNRs	S, M
6. Locate in existing safe buildings in the flood plain.						●			*							Municipal	M
7. Require relocation out of flood plains where appropriate.	○			○		●			*					*		DCAs, DNRs	S, M
* 8. Discourage reconstruction or redevelopment after storm damage.	○			○		●			*					*		Municipal	
9. Update and establish flood warning and evacuation programs.						●			*				*				
10. Improve storm forecasting abilities.						●							*			NOAA, NWS	F
* 11. Amend and strengthen administration of wetland laws.	●	○	○	●	●	●			*							MGL, RIGA DNRs	S
* 12. Construct flood projects selectively.	○					●									*	DPW, DNRs COE, USDA	F, S
Erosion																	
13. Establish inland sediment and erosion control ordinances.	●		○			●		*	*		*					USDA, DNRs	M
○ 14. Manage critical erosion areas through state coastal zone programs.	●			○		●		*	*			*				CZMP, CRMC	S
* 15. Protect critical coastal erosion areas under local regulations.	○					●			*							CZMP, CRMC	M
* 16. Encourage natural stabilization of coastal erosion areas.	●			○		●										CZMP, CRMC	M
17. Construct erosion control projects selectively.	○					●									*	COE, USDA DPWs, DNRs CZMP, CRMC	F, S, M
18. Build or restore salt marshes.	●			●		●							*		*	COE, DNRs CZMP, CRMC	F, S
LOCATING KEY FACILITIES (Chapter 9)																	
Planning objective: To provide certain vital services to society -- power, fuel, construction materials, solid waste disposal -- in a manner which supports continued economic growth and minimizes the negative environmental impacts such facilities have traditionally had.																	

TABLE 11.1 INTERRELATIONSHIPS AND SELECTED CHARACTERISTICS OF SENE STUDY RECOMMENDATIONS (CONTINUED)

Planning Objectives and Numbered Recommendations	Planning Objectives##							Major Activity Types								Principal Agencies	
	3. Guiding Growth	4. Water Supply	5. Water Quality	6. Outdoor Recreation	7. Marine Management	8. Flooding & Erosion	9. Locating Key Facilities	Further Planning	Management & Control	Acquisition	Legislation	Regionalization	Research & Development	Private Investment	Project Development	### Overseeing	### Carrying Out
LOCATING KEY FACILITIES (Chapter 9) (Con't)																	
Recommendations																	
Onshore sand and gravel extraction																RIGA	
o 1. Centralize minerals management authority.	o						●		*		*	*				DNRs, MGC	S
2. Conduct state mineral resources surveys.			o				●					*	*			USGS, DNRs	F, S
3. Create public education program for minerals management.	o						●		*							DNRs	S
* 4. Promulgate minimum state extraction operation and rehabilitation standards.	o						●		*			*				DNRs	S
* 5. Provide state guidance to municipalities on extraction permits.	o						●		*				*			DNRs	S
* 6. Reclaim selected abandoned extraction sites for recreation.				●			●							*	*	DNRs	S
Electrical power																	
o 7. Create energy conservation education program.	o						●						*		*	GOVs. En. Off.	
● 8. Provide state technical assistance on state energy consumption rate reduction goals.			o				●	*	*			*				EPOs	S
			o				●	*	*			*				EPOs	S
9. Implement program of mandatory and voluntary energy saving measures.			o				●		*			*				EPOs	S, M
10. Study electricity rate schedule; encourage off-peak power use.							●		*			*		*		PUCs	S
o 11. Identify and secure power plant sites for future use.	●			o			●	*		*		*	*			EFSC, CRMC	S
● 12. Avoid critical environmental areas for future sites.	●		o	o	o	o	●	*	*		*	*				EFSC, CRMC	S
o 13. Maximize development capabilities at existing power plant sites.	●						●	*	*		*					EFSC, CRMC	S
* 14. Upgrade or phase out inefficient fossil units near cities.							●	*	*					*	*	PUCs	S
* 15. Put transmission and distribution lines underground in urban redevelopment programs.							●	*	*			*		*		PUCs	S
* 16. Provide interim recreational use of undeveloped power plant sites.				●			●	*				*		*		EFSC, CRMC	S
● 17. Simplify procedures for power plant licensing.	●						●					*		*		FPC, PUCs	F, S
Petroleum facilities																	
o 18. Revise new building standards to improve heating-cooling efficiency.							o		*			*				DCAs, SPP	S, M
* 19. Provide tax incentives for voluntary energy conservation measures.							o		*			*				MGC, RIGA	S
● 20. Provide energy consumption rate reduction technical assistance.			o				o		*			*				EPO	S
* 21. Fund mass transit systems.	●			o			o	*		*		*				DOTs	S
o 22. Establish petroleum facilities siting authority in Rhode Island.	●		o		o		o	*	*		*	*				RIGA	S
o 23. Strengthen petroleum facilities siting authority in Massachusetts.	●		o		o		o	*	*		*	*				MGC	S
* 24. Consider New England-wide implications of siting decisions.	●						o	*				*				NERCOM Mass. Cab., SAC	R, F, S
o 25. Establish standards and criteria for refinery siting and operation.	●		o		o		o	*	*			*				EPA, COE, FEC Mass. Cab., SPC	F, S
* 26. Use SENE development capability analysis in siting decisions.	●		o		o		o	*	*			*				EFSC, CRMC, Mass. Cab., SPC	S
o 27. Establish deepwater ports based on a regional port study.	●				●		o	*	*						*	EFSC, CRMC	S

TABLE 11.1 INTERRELATIONSHIPS AND SELECTED CHARACTERISTICS OF SENE STUDY RECOMMENDATIONS* (CONTINUED)

Planning Objectives and Numbered Recommendations	Planning Objectives##							Major Activity Types								Principal Agencies	
	3. Guiding Growth	4. Water Supply	5. Water Quality	6. Outdoor Recreation	7. Marine Management	8. Flooding & Erosion	9. Locating Key Facilities	Further Planning	Management & Control	Acquisition	Legislation	Regionalization	Research & Development	Private Investment	Project Development	### Overseeing	### Carrying Out
LOCATING KEY FACILITIES (Chapter 9) (Cont't)																	
o 28. Locate refineries and related development inland near infrastructure.	o		o				●	*	*			*		*		EFSC, CRMC	S
* 29. Distribute refined products by pipeline wherever feasible.	o		o o				●	*				*		*		EFSC, CRMC	S
* 30. Use most advanced technologies in facilities operation.			o		o		●					*		*		EFSC, CRMC	S
Solid waste management																	
* 31. Enforce existing sanitary land fill regulations.	o	o	o				●		*			*				DPH, DOH	S
o 32. Fund the Rhode Island solid waste management program.							●			*		*				RIGA	S
33. Accelerate participation by municipalities in state program.	o	o	o				●		*			*					
STRENGTHENING THE MANAGEMENT SYSTEM FOR NATURAL RESOURCES (Chapter 10)																	
Planning objective: To ensure appropriate action taken with regard to planning recommendations.																	
Recommendation																	
● 1. Maximize use of existing resource policy institutions.	o	o	o	o	o	o	o	*	*	*		*	*		*	Mass. Cab., SPC	S

The priority of the recommendations is indicated by the symbol preceding it:

- ● Highest priority recommendations (18 each)
- o High priority recommendations (27 each)
- * Other priority recommendations (40 each)
- Blank Remaining priority recommendations (43 each)

Elements of the planning objectives column of the matrix are scored as follows:

- ● The recommendation has a net primary or direct beneficial effect (high positive correlation) on the indicated objective.
- o The recommendation has a net significant but secondary or indirect beneficial effect (low but significant positive correlation).
- Blank The recommendation has little or no net effect on the objective (no significant correlation).
- ō The recommendation has a net significant but secondary or indirect adverse effect (low but significant negative correlation).
- ● The recommendation has a net primary or direct negative effect (high negative correlation).

Abbreviations for agency names are listed in Table 11.3.

* The responsibilities of the Massachusetts Department of Natural Resources have been re-organized to several new departments, including Departments of Environmental Quality Engineering, Environmental Management, and Fisheries, Wildlife and Recreational Vehicles within the Executive Office of Environmental Affairs. Since the distribution of responsibilities is still evolving, the former reference to DNR has been retained for ease in reading Table 11.1.

other hand, defining these critical environmental areas and identifying their general locations on maps increases the probability that these sites will not be considered by industry. On balance, these two effects are judged to offset each other.

In a similar manner, all the other approximately 900 relationships between individual recommendations and planning objectives were characterized.

Reading vertically, the first set of columns, Table 11.1 shows how each planning objective is affected by every recommendation in the SENE program. For example, the planning objective of guiding growth is helped substantially by individual recommendations under every other objective, such as the recommendations under *Locating Key Facilities* (because of their control of growth-inducing infrastructure) and *Flooding and Erosion* (because they discourage development in flood plains).

The pervasiveness of symbols showing primary and secondary beneficial effects in different parts of the matrix point up several broad strategic-level interrelationships between the chapter objectives:

- *Guiding Growth* is by far the most strongly related to other chapters. The intensity of this interrelationship is not surprising, however, because *Guiding Growth* was basically designed to be an organized, integrated response to the land-related needs of the other chapters. That response is the underlying foundation of the strategy for guiding growth suggested in *Chapter 3.*
- The second most interactive chapter, though far behind *Guiding Growth,* is *Water Quality.* That chapter is strongly related to *Guiding Growth* and *Outdoor Recreation* and moderately related to *Water Supply* and *Marine Management.*
- All of the chapters show about the same degree of interrelationship.

One of the recommendations – in *Marine Management* – appears that it could have a net negative effect on a planning objective. The important point is that this conflicting value has been identified, rather than that it reveals a lack of planning consistency. Therefore, it signals the potential for conflicts in the implementation of certain recommendations, signaling the need for further refinement as the recommendation is implemented. Thus, Recommendation 18 for *Chapter 7, Marine Management* ("Develop state policy and program regulating mineral extraction activities in coastal waters") is shown to have a net direct negative effect on the planning objective for key facilities. By denying this close-in source of sand and gravel to a metropolitan area like Boston, other alternative sources, possibly equally undesirable, must be used. In implementing this recommendation, therefore, public administrators are cautioned to take a particularly broad look to compare the total environmental, economic, and social implications of alternative sources than could be examined in this Study in formulating this marine management recommendation. The recommendation was put forth based on the belief that it will withstand such examination, but it is recognized that review from other perspectives is also necessary.

How Activities Satisfy the Recommendations

Each recommendation can be characterized as calling for one or more of the general types of activities described i Table 11.2.

TABLE 11.2 TYPES OF ACTIVITIES USED IN CATEGORIZING SENE STUDY RECOMMENDATIONS

Type of Activity	Meaning
Further planning (FP)*	Collection and analysis of more detailed local data and formulation of specific functional plans
Management and control (M&C)*	Restrict certain activities by employing land use tools, setting standards, and/or licensing
Acquisition (A)*	Purchase of full land usage rights in fee simple or lesser rights such as easements and options
Legislation (L)*	Modify existing laws or pass new laws at federal, state, or local level to be consistent with plan recommendations
Regionalization (R)*	Have one agency perform or oversee activity for several local units
Research and development (R&D)*	Advance level of technology and improve practical application
Private investment (PI)*	Stimulate the investment of private capital
Project development (PD)*	Implement specific local plans including project construction

* Correspond to abbreviations on Table 11.1.

TABLE 11.3 AGENCIES AND LEVELS OF GOVERNMENT RESPONSIBLE FOR OVERSEEING AND CARRYING OUT SENE STUDY RECOMMENDATIONS *

Agencies & Levels of Government Name	Abbreviation	Times Cited as Overseeing Agency
Mass. General Court	MGC	5
R. I. General Assembly	RIGA	7
Mass. Department of Natural Resources *	"DNRs"*	53
R. I. Department of Natural Resources	"DNRs"	50
Mass. Water Resources Commission	WRC	1
R. I. Water Resources Board	WRB	12
Mass. Department of Public Health	DPH	8
R. I. Department of Health	DOH	16
Mass. Metropolitan District Commission	MDC	2
R. I. Statewide Planning Program	SPP	11
Mass. Department of Transportation	"DOTs"	2
R. I. Department of Transportation	"DOTs"	2
Mass. Public Access Board	PAB	2
R.I. Right of Way Commission	ROWC	1
Mass. Coastal Zone Management Program	CZMP	11
R. I. Coastal Resources Management Council	CRMC	20
Mass. Department of Public Works	"DPWs"	3
R. I. Department of Public Works	"DPWs"	3
Mass. Department of Commerce and Development	"DCDs"	2
R. I. Department of Community Development	"DCDs"	2
R. I. Department of Economic Development	DED	2
Mass. Department of Community Affairs	DCA	7
R. I. Department of Community Affairs	DCA	7
Mass. Energy Policy Office	"EPOs"	4
R. I. Energy Policy Office	"EPOs"	4
Mass. Public Utilities Commission	"PUCs"	4
R. I. Public Utilities Commission	"PUCs"	4
Mass. Energy Facilities Siting Council	EFSC	9
Massachusetts Cabinet	Mass Cab	5
R. I. State Planning Council	SPC	4
R. I. Division of Rivers & Harbors	DRH	1
Congress	Congress	5
Department of Interior	DOI	1
Environmental Protection Agency	EPA	8
United States Geological Survey	USGS	2
Corps of Engineers	COE	11
National Marine Fisheries Service	NMFS	4
Bureau of Land Management	BLM	2
Department of Agriculture (Soil Conservation Service)	USDA	6
National Oceanic & Atmospheric Administration	NOAA	1
National Weather Service	NWS	1
Federal Power Commission	FPC	1
Federal Regional Council	FRC	1
New England Regional Commission	NERCOM	2
New England River Basins Commission	NERBC	1
Municipalities	M	5
Boating Advisory Committee	BAdC	1
Mass. Regional Planning Agencies	RPA's	5
Levels of Government Carrying-out Activities	**Abbreviation**	**Times Cited**
Federal	F	36
Interstate regional	I	1
State	S	107
Intrastate regional	R	12
Municipality	M	48
Private, industry, other	P	2

* The responsibilities of the Massachusetts Department of Natural Resources have been re-organized to several new departments, including Departments of Environmental Quality Engineering, Environmental Management, and Fisheries, Wildlife, and Recreational Vehicles within the Executive Office of Environmental Affairs. Since the distribution of responsibilities is still evolving, the former reference to DNR has been retained for ease in reading Table 11.1.

The middle columns of Table 11.1 indicate the type(s) of activity that most closely describes the recommendations. Thus, Recommendation GG-1, "Improve protection of critical environmental areas, priority protection (Category A) and other protection areas (Category B)," is characterized as "management and control" on a "regional" basis. Tabulating downward provides a general appreciation of the types of activity being recommended by the Study. For example, management and control is the principal activity in 76 of the 128 recommendations. The least applicable of the major activities is legislation, with only 10 citations. The number of citations for the activity types shown in the the table are as follows:

Activity Type	Citations
• management control	76
• regionalization	49
• further planning	45
• research and development	24
• private investment	23
• project development	24
• acquisition	14
• legislation	10

The following statement, in terms of these major activities, can be used to summarize the SENE program:

> *"The SENE Study recommends a management and control program, with emphasis on more detailed regional planning. It is backed up by a moderate and balanced mixture of research and development, private investment, and projects, and a minor amount of acquisition and legislation."*

How Agencies Carry Out the Activities

The recommended activities are specifically directed to an "actor" in every case, in an effort to fix responsibility for action. The format was developed for several reasons:

(1) Many levels of government agencies and non-governmental groups are involved in carrying out each one of the recommendations. To have listed them all with their many interrelationships would have been unwieldy and would have detracted from the strength of the individual recommendations.

(2) Many of the recommendations (Example: *Chapter 8, Flooding and Erosion,* Recommendation #2, "Adopt zoning to regulate flood plain construction") are obviously intended for local implementation. But to have recommended that "All municipalities adopt. . ." would have so diluted the responsibility that little, or at best sporadic and uneven implementation, would have resulted.

(3) To overcome these problems, the SENE Study cites specific agencies to oversee each individual recommendation. It would be their responsibility to carry out the program execution. These agencies are listed in the next to last column of Table 11.1. The key for agency abbreviation is in Table 11.3.

(4) The levels of government most instrumental in carrying out the recommendations are listed in the last column of Table 11.1. In the text they are occasionally cited in the complete form of the recommendations, but most of the time they are implied.

(5) Governments, especially those at state and local level, reorganize frequently. Indeed, Massachusetts will soon complete a major reorganization. The SENE Study recommendations are intended to have greater permanence. Therefore, when citing an agency the words "and future successor agencies assigned similar functions" are always implied.

Table 11.3 lists all the overseeing agencies cited in Study recommendations arranged in the frequency with which they are mentioned. The table also lists the levels of government principally involved in carrying out the recommendations.

THE RELATIONSHIP OF STUDY OBJECTIVES TO NATIONAL CRITERIA

How the SENE Study Objectives Relate to National Criteria

Thus far, this chapter has described how the SENE program is tied together systematically in a hierarchy of goals, objectives, recommendations, activities, and agencies.

To evaluate how the SENE program objectives relate to broad national and regional objectives, the Study examined objectives expressed in a number of national and state programs such as the:

- Water Resources Planning Act of 1965
- National Environmental Policy Act of 1969
- Federal Water Pollution Control Act Amendments of 1972
- Coastal Zone Management Act of 1972 and related Committee Reports
- Rural Development Act of 1972
- U. S. Water Resources Council, Principles and Standards
- Proposed federal land use bills
- Massachusetts Wetlands Act
- Massachusetts Environmental Policy Act (MEPA)
- Martha's Vineyard Land Use Act
- Proposed Nantucket Sound Islands Trust
- Rhode Island Statewide Land Use Plan

All have many elements in common. The Principles and Standards (PAS) of the U. S. Water Resources Council, perhaps more than the others, provided a model for integrating the elements of the program.

The PAS are designed to demonstrate the contribution of plan recommendations to four "accounts" – national economic development, environmental quality, regional development, and social well-being. The PAS list lengthy supporting criteria designed to be used for more detailed studies than for Level "B" studies like the SENE Study. A simplified, interpretive condensation of those criteria particularly relevant to the SENE Study is presented briefly defined in Table 11.4.

Table 11.5 applies these general water resources criteria to the seven SENE Chapter functional planning objectives. Using the same set of symbols employed in Table 11.1, the net impacts are scored as directly beneficial, indirectly beneficial, no significant net effect, indirectly adverse, and directly adverse. The brief remarks explain the basis for the scoring.

According to the evaluation in Table 11.5, four SENE planning objectives – guiding growth, locating key facilities, outdoor recreation, and water quality – make the most significant contribution to the listed criteria – four accounts (Table 11.4).

TABLE 11.4 GENERAL CRITERIA FOR EVALUATING WATER RESOURCES PLANS*

Component of National Economic Development Account

1. Cost Effectiveness - - the degree to which the program is the most cost effective approach to the supply of required physical goods.

Components of Environmental Quality Account

1. Open Space - - the amount of land set aside for non-urban development purposes.
2. Ecological Systems and Sensitive Lands - - the management and control of lands which cannot be developed without permanent loss of important resources.
3. Water Quality - - the degree to which water quality approaches swimmable-fishable waters.
4. Containment of Facilities and Growth - - the degree to which facilities and growth are concentrated to avoid environmental degradation.

Components of Regional Development Account

1. Employment Levels - the increase in employment opportunities.
2. Cost of Living - - the reduction in the household costs for taxes, power, energy, and other household goods.
3. Economic Stability and Diversification - - the region's ability to withstand cyclic changes in the economy or impacts on a single industry.
4. Competitive Attractiveness - - the region's ability to increase its competitive appeal as a place to live and work

Components of Social Well-Being Account

1. Urban/Rural Mix - - the continuation of the existing mix between urban and rural development levels.
2. Flexibility for Long-Range Response - - the range of options left open for further planning considerations.
3. Local Autonomy - - the amount of decision-making responsibility remaining with local levels.
4. Income Distribution - - the increase in the income of low income groups relative to middle and upper income groups.
5. Recreational Opportunities - - the supply and range of choice for outdoor recreation.
6. Legal and Institutional - - the ease of administering the program.
7. Political - - the probable popularity of the program.

* Criteria correspond to those used in Table 11.5. Components of the four accounts of the U.S. Water Resources Council's Principles and Standards.

TABLE 11.5 SENE STUDY PLANNING OBJECTIVES VERSUS GENERAL WATER RESOURCES CRITERIA* (Chapters 3, 4, 5, and 6)

	SENE Planning Objectives			
General Water Resources Criteria (Components of specified WRC accounts)**	GUIDING GROWTH (Chapter 3) To protect the critical water and related land resources of SENE while accommodating economic activities by guiding growth.	WATER SUPPLY (Chapter 4) To meet municipal needs for adequate supplies of fresh water in the most economically feasible and environmentally sound manner.	WATER QUALITY (Chapter 5) To achieve swimmable-fishable waters by 1983 wherever realistically attainable, economically, socially, and technically.	OUTDOOR RECREATION (Chapter 6) To meet 1990 recreational needs in economically, environmentally, and socially acceptable ways.
NATIONAL ECONOMIC DEVELOPMENT Cost Effectiveness	o Costly but probably very cost efficient. Clustering, higher densities and maximum use of infrastructure promote great efficiencies in public services and private spending.	Encourages use of more economical ground water. But, thereby imposes regulatory land use measures. Probably no net effect.	By far, most costly set of recommendations. Is generally cost effective in emphasis on non-degradation, on treating combined sewer overflow, and on controlling pollutants at source.	o "Intensive-use" programs for swimming and urban parks are highly cost effective. "Extensive-use" programs have low effectiveness. Assuming recommended priorities are followed net effect is positive.
ENVIRONMENTAL QUALITY Open Space	• Recommends preservation of 1/3 of SENE area with tight restrictions on development.	o Encourages restricted use of watersheds and aquifer recharge areas.	o Encourages streambank buffer strips.	• Encourages control or aquisition of open space for extensive recreational uses.
Ecological Systems and Sensitive Lands	• Explicitly defines, maps and protects sensitive water resource lands as part of highest priority recommendations.	o Encourages restricted use of watersheds and aquifer recharge areas.	• Emphasizes anti-degradation in areas now swimmable-fishable. Improves water quality for aquatic life.	o Encourages control of wetlands, beaches and streambanks.
Water Quality	• Controls location of development with significant impacts on water quality.	• Controls use of watershed lands and aquifer recharge areas. Proposes regional water management agency.	• Program is specifically designed to improve water quality.	• Improves region's capacity to provide recreation for the populace.
Containment of facilities and growth	• Directs growth to developable areas with concentration around existing infrastructure.	No significant net effect.	• Full use of design capacity of existing sewers encourages higher densities in present urban areas.	No significant net effect.
REGIONAL DEVELOPMENT Employment Levels	• Makes region more attractive to industries which use professional and highly skilled labor.	No significant net effect.	Some adverse effect on marginal high-polluting industries. Indirect beneficial effect on others, especially services.	No significant net effect.
Cost of Living	No net effect - removes some land from tax base, but makes better use of existing facilities.	No significant net effect	o Increases industry costs by about one percent.	Because of improved transportation and maximum use of existing facilities, costs of recreation at least maintained.
Economic Stability and Diversification	No significant net effect.	o Minor negative effect in terms of higher costs to types of industry that use much water.	ō Minor negative effect in terms of higher costs to types of industry that use much water.	o Increases region's capacity to draw and hold skills it needs.
Competitive Attractiveness	• Emphasizes resource amenity value of the region.	No significant net effect.	o Improves attractiveness of water bodies.	o Designed to enhance public opportunity for participation in outdoor enjoyment.

* Key for Table 11.5.
** Definitions for criteria based on WRC components in Table 11.4.
- • The recommendation has a net primary or direct beneficial effect.
- o The recommendation has a net significant but secondary or indirect beneficial effect.
- Blank The recommendation has little or no net effect on the objective.
- ō The recommendation has a net significant but secondary or indirect adverse effect.
- ● The recommendation has a net primary or direct negative effect.

TABLE 11.5 SENE STUDY PLANNING OBJECTIVES VERSUS WATER RESOURCES CRITERIA (Chapters 3, 4, 5, and 6) (Continued)

General Water Resources Criteria	GUIDING GROWTH	WATER SUPPLY	WATER QUALITY	OUTDOOR RECREATION
SOCIAL WELL-BEING **Urban/rural Mix**	o Attempts to contain rate of expansion of urban areas which protects rural areas.	No significant net effect.	No significant net effect.	No significant net effect
Flexibility for Long-range Response	•Preserves future land use option.	o Urges preservation of all water source options, ground water as well as surface water.	o Non-degradation policy preserves options.	o Encourages control and non-development of A and B areas for possible future recreational use.
Local Autonomy	o Seeks to retain local autonomy but calls for state guidance.	o Strongly encourages use of local ground water and nearby surface water. But also proposes regional water management agencies.	o Due to broad geographic impacts, pollution control centralized at state level.	Centralizes planning and management of regional facilities but leaves to local initiative protection of resources for future acquisition and development.
Income Distribution	Enhances land values in some areas while limiting values of other areas through use restrictions. Decreases cost of growth to local taxpayers by maximum use of existing services.	No significant net effects.	No significant net effects.	o Makes outdoor recreation more accessible to urban dwellers at lower costs than present.
Recreational Opportunities	•Protects resources for meeting near - and long-term recreational needs.	Some limited opportunities for recreation in watershed lands.	o Improves water quality for water-based sports. Encourages low flow augmentation and streambank buffer strips.	•Program is specifically designed to improve outdoor recreation.
Legal and Institutional	ō Will increase planning and regulatory responsibilities of state and local decision makers.	No significant overall effect despite some problems in regionalization.	•All tools have been legally tested and accepted. Some problems obtaining regionalization.	Requires changes in public policy regarding private enterprise, use of storage reservoir lands, and access to the shoreline.
Political	Guiding growth is controversial but gaining acceptance.	Appeal for local self sufficiency has been well received. Some problems with Connecticut over water diversions and possibly with regionalization.	•Endorses present program which is of proven popularity.	o Possibly the most visible of the study's recommendations.

* Key for Table 11.5.

** Definitions for criteria based on WRC components in Table 11.4.

- • The recommendation has a net primary or direct beneficial effect.
- o The recommendation has a net significant but secondary or indirect beneficial effect
- Blank The recommendation has little or no net effect on the objective.
- ō The recommendation has a net significant but secondary or indirect adverse effect.
- ● The recommendation has a net primary or direct negative effect.

TABLE 11.5 SENE STUDY PLANNING OBJECTIVES VERSUS GENERAL WATER RESOURCES CRITERIA* (Chapters 7, 8, and 9)

	SENE Planning Objectives		
General Water Resources Criteria (Components of specified WRC accounts)**	**MARINE MANAGEMENT (Chapter 7) To maintain the region's renewable marine resources at a level sufficient for sustained future use, and to develop the region's non-renewable marine resources in an environmentally sensitive manner.**	**FLOODING AND EROSION (Chapter 8) To reduce flood damages in the region, both riverine and coastal; and to reduce critical coastal erosion.**	**LOCATING KEY FACILITIES (Chapter 9) To provide certain vital services to society -- power, fuel, construction materials, solid waste disposal -- in a manner which supports continued economic growth and minimizes the negative environmental impacts such facilities have traditionally had.**
NATIONAL ECONOMIC DEVELOPMENT Cost Effectiveness	No significant net effect. Adverse in encouraging federal subsidies of uncompetitive local fishing industry. Beneficial in studying ports from regional viewpoint.	o Encourages use of existing safe structures, discourages development subject to costly floods, benefits public through new opportunities and lowered public expenditures.	•Cost effective in promoting resolution of prolonged indecision on essential regional issues.
ENVIRONMENTAL QUALITY Open Space	No significant net effect.	o Encourages non-development of flood plains thereby making much more open space available.	No significant net effects.
Ecological Systems and Sensitive Lands	•Encourages preservation of wetlands and shellfish areas. Recommends operational quidelines for the development of marine resources.	•Encourages preservation of wetlands, wildlife habitat and important recreational access points in flood plains.	•Because A and B lands are protected, ecological systems are taken into account while providing regional facilities.
Water Quality	o Encourages siting new sewerage discharges away from estuaries, control of dredged materials, and urban waterfront planning.	No significant net effects.	•Encourages control of location, operation and discharges from electric power plants, petroleum facilities and solid waste facilities.
Containment of Facilities and Growth	o Encourages the use of existing waterfront facilities where appropriate rather than new construction elsewhere.	o Encourages use in some cases (revitalization of existing flood plain development) but discourages new flood plain growth.	o Encourages development where infrastructure exists which tends to concentrate growth.
REGIONAL DEVELOPMENT Employment Levels	No significant net effect though could promote local fishery by reducing its foreign competition.	No significant net effects.	•Encourages resolution of decisions now inhibiting business initiatives.
Cost of Living	No significant net effect.	Reduces cost of living by reducing public expenditures and private losses.	•Encourages decisions to provide essential infrastructure rather than let shortages become future economic crises.
Economic Stability and Diversification	o Improves viability of regional fishery. Studies possibility of improved port facilities.	No significant net effect.	•Improves business stability by providing for future requirements under generally defined conditions.
Competitive attractiveness	o Improves amenity value of urban waterfronts.	o Encourages flood plain protection thereby preserving wildlife and recreational opportunities.	•Provides needed services in way that preserves physical attractiveness of the region.

* Key for Table 11.5.
** Definitions for criteria based on WRC components in Table 11.4.
- • The recommendation has a net primary or direct beneficial effect.
- o The recommendation has a net significant but secondary or indirect beneficial effect.
- Blank The recommendation has little or no net effect on the objective.
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- ● The recommendation has a net primary or direct negative effect.

TABLE 11.5 SENE STUDY PLANNING OBJECTIVES VERSUS GENERAL WATER RESOURCES CRITERIA* (Chapters 7, 8, and 9) (continued)

General Water Resources Criteria	MARINE MANAGEMENT	FLOODING AND EROSION	LOCATING KEY FACILITIES
SOCIAL WELL-BEING Urban/Rural Mix	No significant net effects.	No significant net effects.	No significant net effects.
Flexibility for Long-range Response	No significant net effects.	No significant net effects.	o Preserves sites, the need for which may be eliminated by future technological advances.
Local Autonomy	ō Most measures require national or international implementation.	o Power to implement flood control remains at local level but should be consistent with state land use and coastal policies.	o Increases regional considerations but maintains local and citizen roles in decision-making.
Income Distribution	ō Consumer will likely pay higher costs for fish products.	No significant effects.	No significant net effects although urges study of pricing policy revisions so that rates rise with consumption.
Recreational Opportunities	o Encourages restoration of urban waterfront including increased public access.	• Protects potential access points and scenic and water quality values of recreational rivers.	o Encourages recreational use of abandoned sand and gravel sites, and interim recreational use of undeveloped electric power plant sites.
Legal and Institutional	● Requires action of international level and industrial subsidies.	Requires stronger enforcement of existing legislation.	● Requires complex quasi-governmental authorities and can expect constant court suits.
Political	ō No significant regional effect. Boundary declarations may have international ramifications.	Discourages developers seeking new flood plain sites but popular because of cost efficiencies and other public benefits.	ō The nature of all resource allocation decisions for key facilities makes this controversial regardless of the recommendation.

* Key for Table 11.5

** Definitions for criteria based on WRC components in Table 11.4

- • The recommendation has a net primary or direct beneficial effect.
- o The recommendation has a net significant but secondary or indirect beneficial effect.
- Blank The recommendation has little or no net effect on the objective.
- ō The recommendation has a net significant but secondary or indirect adverse effect.
- ● The recommendation has a net primary or direct negative effect.

Reading Table 11.5 horizontally indicates that the SENE program as a whole scores very high in the environmental quality and regional development accounts as compared to the two accounts for national economic efficiency and social well-being.

If the scoring were weighted +2 to -2 from directly beneficial to directly adverse, the following measures of the contributions of the recommendations would result:

General Water Resources Criteria	Scoring
• ecological systems and sensitive lands	12
• water quality	9
• outdoor recreation	9
• competitive attractiveness	8
• open space	7
• flexibility for long-range response	7
• containment of facilities and growth	7
• cost effectiveness	5
• employment levels	4
• economic stabilization and diversification	3
• cost of living	1
• urban-rural mix	1
• political	1
• income distribution	0
• local autonomy	-1
• legal and institutional	-3

The following statement, in terms of these general criteria, can be used to summarize the general implications of the SENE program.

"The SENE Study recommends a program that gives balanced and strong emphasis to ecological systems and sensitive lands, water quality, outdoor recreation, and competitive attractiveness. It gives moderate emphasis to open space, flexibility for long-range response, containment of facilities and growth, cost effectiveness, employment levels, and economic stabilization and diversification. It has little significant effect on the cost of living, the urban-rural mix, political harmony, and income distribution. To some degree it reduces local autonomy and may encounter some legal and institutional problems."

THE MAJOR CONCLUSIONS AND THE STUDY GOAL

How the Major Conclusions for SENE Were Reached

High on the list of unanswered problems as the Study got underway were:

- How best to handle anticipated major conflicts between environmental and economic aspirations?
- How best to handle problems of growth?
- How best to get whatever the Study recommended actually carried out?

Chapter 2, The Setting, shows that the SENE economy is no longer directly dependent on water for power for industry. The trend shows a drop in the pollution generating and water using manufacturing processes with an attendant sharp rise in the service sector of the economy. Though some have argued that a relaxation of environmental improvement programs would assist the economy, in the SENE region this would seem to be out of phase with an increasingly service-oriented future. Enhancing, not degrading the major asset SENE has – its physical environment – may be the most important factor in maintaining the regions economic viability.

It is recognized that the SENE program is not an economic plan, and therefore no claim is made that the recommendations, if implemented, will greatly improve the SENE economy. It does appear, however, that the recommended approach is an efficient strategic water resource alternative, for the long-range health of the SENE economy. Succinctly summarizing this line of thinking is the SENE Study's first overall conclusion – **ENHANCING THE ENVIRONMENT ENHANCES THE REGION'S ECONOMY.**

Demographic and land use studies showed rather conclusively that for the forseeable future the overall growth in SENE is clearly not limited by the region's water and related land resources. There is enough space, for example, to accommodate all growth at least to the year 2020, even at the spectacularly high rate of land consumption of the last decade. The limitation is more a social one. Do the residents of this region want essentially all of the Boston Metropolitan, North Shore, and South Shore planning

areas urbanized over the next five decades? Or do they want to leave selected open areas near where their children will work and play? Through public workshops it was learned that people strongly preferred the latter. They want, and are on the verge of demanding, guidance to bring about the second type of future, not the first. They look to efforts such as the SENE Study to formulate strategy to bring it about. *Chapter 3,* the land capability maps in the rear pocket, many of the recommendations, and the second major SENE Study conclusion are a response to that demand – anticipated **GROWTH CAN BE ACCOMMODATED, BUT IT NEEDS GUIDANCE.**

From the beginning, a major concern was whether existing knowledge was sufficient to act and, if so, how recommendations could be implemented. Existing knowledge has been known to be generally adequate, but implementation will be more difficult. Innovative institutional arrangements, public relations efforts, and other means were examined. Planners at all levels of government, working on many different functions, all independently and collectively, were asked what, if any, new authorities or agencies would be required to get their individual portions of the program carried out. The results showed that the basic organizations, authorities and tools already exist. Performance, not new and novel institutions, should be emphasized. As was mentioned above, the SENE program requires very little new legislation. To lend conviction to its conclusion that existing agencies can, and must do the job, this Study has gone to unusual lengths to explicitly identify lead agencies. Undoubtedly, the states and the federal government will adjust these responsibilities to some degree. The assumption is that, upon review, the lead agencies will either assume responsibility, see that another agency does so, or thoughtfully and publicly conclude that the given recommendations should not be implemented.

This leads to the third and last major conclusion of the SENE Study – **EXISTING KNOWLEDGE, PROGRAMS, AND INSTITUTIONS CAN PROVIDE THE TOOLS FOR ACHIEVING RESULTS, BUT SOME CHANGES ARE NEEDED.**

Appendix: Environmental Statement Methodology Review of the Report

APPENDIX

ENVIRONMENTAL STATEMENT ES-1

Summary i, **ENVIRONMENTAL STATEMENT ES-1**, Description of the Proposed Actions ES-2, Relationship to Existing Programs ES-7, The Probable Impact of the Proposed Actions on the Environment ES-7, Alternatives to the Proposed Actions ES-9, Probable Adverse Environmental Effects Which Cannot Be Avoided ES-12, The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity ES-13, Irreversible and Irretrievable Commitments of Resources ES-13, Comments Received ES-13,

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SUMMARY
ENVIRONMENTAL STATEMENT
Southeastern New England
Water and Related Land Resources Study

( ) Draft (X) Final

Responsible Agency: U.S. Water Resources Council
New England River Basins Commission

For Additional Information Contact:

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1. Name of Action

(X) Administration Action ( ) Legislative Action

2. Brief Description of Action The New England River Basins Commission is submitting to the U.S. Water Resources Council, for transmittal to the President and by him to the Congress, a report recommending policies and actions for balanced conservation, management, and development of the water and related land resources of Southeastern New England. The report contains a series of policies and structural and non-structural solutions in the following areas: water supply, water quality, land use, outdoor recreation, sport fisheries and wildlife, offshore fishing, port development, dredged materials disposal, urban waterfront use, sand and gravel extraction, flooding and erosion, electrical power, petroleum facilities, and solid waste management. Actions are directed to all levels of government and private interests for eastern Massachusetts, all of Rhode Island, and three municipalities in southeastern Connecticut.

3. Summary of environmental impact and adverse environmental effects.

Environmental Impact. Study objectives, as outlined in the *Principles and Standards* of the U.S. Water Resources Council, were to enhance environmental quality and national economic efficiency. In sum, the recommended policies and actions which make up the SENE program can result in a significant net benefit to the environment of Southeastern New England. The Study's lead recommendation is to *increase protection of critical environmental areas.* Such action will directly benefit (i) water supply by protecting well sites and wetlands; (ii) outdoor recreation by protecting beaches and wetlands; (iii) marine management by protecting wetlands, estuaries, and shellfish areas; and (iv) flooding and erosion by protecting wetlands, flood plains, beaches, and critical coastal erosion areas. The Study's second lead recommendation – *manage areas suitable for development* – will not only reinforce protection of critical environmental areas, but will also decrease the cost of development by guiding growth to lands which can support development, and within those lands to areas already served by essential water, sewer, and transportation services.

Adverse Environmental Effects. Net environmental benefits of the recommendations are expected to be strongly positive. Environmental impacts were considered as part of the planning process throughout the Study in order to eliminate adverse or irretrievable impacts and to actively enhance environmental quality wherever possible.

One of the 128 recommendations – to develop programs regulating mineral extraction activities in coastal waters – appears that it will have a net negative effect on the planning objective for providing key facilities. However, the recommendation was formulated to control adverse environmental effects that near-shore mining is expected to cause on shellfish beds, delicate spawning grounds, and the delicate natural equilibrium maintaining the natural contours of existing beaches.

4. Summary of Major Alternatives Considered. A number of alternatives were proposed and evaluated for each of over 15 subject areas of study and for each of the 10 geographic planning areas in the Southeastern New England region. These alternatives, which included no-action options, ranged from a non-structural, non-regulatory approach to various levels of development. Formulated to meet expected needs for water and related land resources, these alternatives are *summarized* in the environmental statement. In many cases, elements of the alternatives were combined to form the recommended policies and actions.

5. Comments. Comments and views have been requested from the Governors and key agencies in Massachusetts, Rhode Island, and Connecticut, as well as Maine, New Hampshire, Vermont, and New York; the head of each federal department or agency and each interstate agency which has a representative to the New England River Basins Commission, as well as appropriate federal agency offices listed in Appendix III of the NEPA guidelines. Copies of the complete report and Environmental Statement have been sent to interests throughout Southeastern New England including: U.S. Senators and Congressmen, state senators, regional planning agencies, 213 town planning boards, town managers or mayors, conservation commissions, and several hundred individuals and groups.

Comments specifically on the Environmental Statement were received from the Department of Agriculture, Department of the Interior, Department of Commerce, the Environmental Protection Agency, and the Federal Power Commission. Considerably more agencies and individuals reviewed and commented on the full Study report. Their comments and changes made in response to them are included in the chapter on Review of the Reports.

6. Draft Statement to CEQ: May 5, 1975

Final Statement to CEQ: [To be submitted by the U.S. Water Resources Council at the time of transmittal to the President and the Congress.]

ENVIRONMENTAL STATEMENT

Introduction

This chapter takes the form of an *"overview"* impact statement, and is designed to meet the requirements of Sec. 102(2)(c) of the National Environmental Policy Act. Further, it takes into account the requirements and the intent of the Massachusetts Environmental Policy Act, as amended.

The Council on Environmental Quality has pointed out that where a number of agencies have formulated new policy initiatives and have explored a broad range of alternative actions, an **overview statement** is appropriate. *When actions are made later to implement specific Study recommendations, these actions will need more detailed 102 statements,* but those statements should refer to the overview statement for a discussion of the general policy issues. Furthermore, agencies and individual projects discussed in the SENE Study Report can use this overview environmental statement *together with the SENE Study Reports* to guide their review.

The principal source of information for this section is drawn from the detailed evaluation of the alternatives and recommendations in the Study reports. This evaluation draws on the four-account system of the U. S. Water Resources Council's *Principles and Standards:* national economic efficiency, environmental quality, regional development, and social well-being. These considerations were explicit throughout the planning process, from formulation and evaluation of alternatives, to preparing and finalizing the recommended policies and actions. The criteria for evaluation were synthesized from guidance obtained from many sources. In addition to the *Principles and Standards* (PAS), the most notable of these sources were:

- various guidelines for the preparation of environmental statements (EIS) required under the National Environmental Policy Act of 1969 (NEPA). The EIS requirements were also incorporated by the Water Resources Council in its formulation of the PAS.
- various guidelines for the preparation of environmental impact reports required under the Massachusetts Environmental Policy Act.
- the Coastal Zone Management Act of 1972, and related materials.
- the Federal Water Pollution Control Act Amendments of 1972, and related materials.
- various versions of the pending National Land Use Policy Act.
- the Martha's Vineyard Land Use Act.
- the proposed Nantucket Sound Islands Trust.
- the proposed Rhode Island Land Use Policies and Plan.

By far the most significant of these sources was the *Principles and Standards* (PAS). Under the PAS, the New England River Basins Commission has used a systematic approach for integrating environmental, economic, and social factors in planning for water and related land resources. As part of this approach, the Commission has evaluated environmental impact, plan alternatives, beneficial and adverse effects, and has encouraged all levels of government, as well as non-government representatives, to actively participate throughout the planning process. As a result, the consideration of environmental factors is reflected *throughout the final report* as well as in this environmental statement.

There are eight sections according to the guidelines in preparing environmental statements:

A. Description of the proposed actions;
B. Relationship to existing programs;
C. The probable impact of the proposed actions on the environment;
D. Alternatives to the proposed actions;
E. Probable adverse environmental effects which cannot be avoided;
F. The relationship between short-term uses and long-term productivity;
G. Irreversible and irretrievable commitments of resources; and
H. Review Comments.

The discussion in each of the sections that follow will be in the *same order as the chapters of the SENE Regional Report:* Guiding Growth, Water Supply, Water Quality, Outdoor Recreation, Marine Management, Flooding and Erosion, and Locating Key Facilities.

A. DESCRIPTION OF THE PROPOSED ACTIONS

The description of the proposed actions is the publication of a report which recommends policies and actions to be followed to achieve wise and balanced use of Southeastern New England's water and related land resources. This report contains the findings and conclusions of the Southeastern New England Study, a three and a half year study conducted by an interagency team of federal, state, regional, local, and private sector representatives. The New England River Basins Commission provided the leadership and coordination for this team of participants.

The Southeastern New England Study Area

The southeastern corner of New England, consisting essentially of Rhode Island and eastern Massachusetts, is home to nearly 50 percent of New England's population on barely 7 percent of its land. Nearly 80 percent of the region's approximately 5 million people have settled in the region's four urban centers of Boston, Providence, Worcester, and New Bedford/Fall River. The average population density for the region is about 960 persons per square mile, compared to averages of about 180 for New England as a whole and 607 for the nation. Yet this coastally-oriented region still has significant expanses of open space—extensive forests, broad wetland networks, crop and pasture lands. Projected growth by the years 1990 and 2020 is expected to put pressure on these open space areas and on fragile resources. Finding ways to accommodate the sometimes conflicting demands for conservation and growth was the goal of the Southeastern New England Study.

Study Actions and Purposes

Basic findings of the Study are three:

(1) Enhancing the environment enhances the region's economy.

(2) Anticipated growth can be accommodated, but should be guided to protect fragile resources and make development more efficient.

(3) Existing knowledge, programs, and institutions with some changes, can provide tools for achieving results.

These key findings are reflected through the Study's recommendations, which are summarized on the following pages.

Guiding Growth

The Study has identified three key steps that planners can take to guide the region's future growth: (1) protect critical environmental areas; (2) manage areas suitable for development guiding growth to where facilities already exist or are planned; and (3) regulate development having regional impact. These steps constitute a way to allocate lands to meet development needs of the future without sacrificing valuable resources which contribute to a high quality of life.

As part of the first recommendation, the region's water bodies, well sites, inland and coastal wetlands, critical erosion areas, beaches, fish spawning areas, shellfish flats, and estuaries have been classified *Priority Protection Areas* (Category A resources). The region's flood plains, prime agricultural lands (for non-forest and forest production), coastal flood hazard areas, unique natural and cultural sites, proposed reservoir sites, and upland erosion areas have been classified second priority *Other Protection Areas* (Category B resources). *Together they form the* **Critical Environmental Areas** in the region – those lands either too fragile to support any development or whose development would constitute a hazard to public health and safety. The Study has produced maps (Development Capability Maps) which depict the location of these Critical Environmental Areas throughout the region. **For each category of Critical Environmental Area, the Study has proposed ways in which resources can be protected.**

Priority Protection Areas (Category A)

- *Protect water bodies from non-point source pollution by having municipalities, regional planning agencies, and states develop standards for control of runoff and sediment, subdivision regulations requiring storm-water detention ponds, and methods of ground water recharge. Streambank and lake shore buffer strips should be obtained.*
- *Protect wetlands by acquisition and regulation of development.*
- *Protect critical erosion areas by ordinances prohibiting development and any other use that creates health and safety problems or accelerates erosion rates.*
- *Protect beaches and their immediately adjacent lands by erosion control regulations, prohibition of development, or acquisition for recreational use.*
- *Protect estuaries, fish spawning areas, and shellfish flats, though not shown on the Development Capabilities Maps, but available in Study files, by prohibiting outfalls of*

wastewater treatment facilities, power plants, or any other major producers of effluent in these locations. Prohibit dredging, sand and gravel mining, installation of pipelines, and any other disturbing activity within these areas.

Other Protection Areas (Category B)

- *Protect riverine and tidal flood plains by prohibiting further development and discouraging reconstruction after substantial storm damage. Acquire key flood plains for public uses.*

- *Protect agricultural sites by state legislation that clarifies authority for local agencies to enact transferable development rights, reform tax laws, and provide for limited acquisition of development rights for highest priority lands.*

- *Protect unique natural and cultural sites by acquisition of conservation or historic easements, development rights, or fee simple, financed by the National Historic Preservation Act and other public and non-profit funds. The use of other techniques is described in the Natural Areas Project of New England Natural Resources Center.*

- *Protect proposed reservoir sites and their related watersheds, through prohibition of all but low intensity uses such as agriculture or forestry. Monitor the use of tributaries and their banks.*

The second major recommendation – **to manage areas suitable for development** – contains two basic points.

Develop According to Resource Capability. Those lands suitable for development to varying degrees of intensity under several different levels of management control were classified by the Study as Developable Areas (Category C, F, and G resources shown on Development Capability Maps). The region's future growth must be guided to these lands to prohibit destruction of Critical Environmental Areas.

- *Manage ground water recharge areas (C1) for aquifers necessary for local water supply by: zoning ordinances and subdivision regulations restricting development density, regulation of septic systems, and maintenance of water level.*

- *Manage best upland wildlife habitat (C2) and areas of high landscape quality (C3) by zoning ordinances limiting residential development to extremely low density, or by encouraging clustering. In high landscape quality areas large scale developments should not be located on bluffs or hilltops, but should be absorbed in forested regions or lower areas to lessen their visual impact.*

- *Manage land with ledge and/or steep slopes by zoning ordinances and subdivision regulations to limit residential densities.*

- *Manage land with severe septic system (C4) limitations by zoning ordinances and subdivision regulations limiting residential densities unless sewers are present. Higher densities with sewers should be encouraged because many of the other land resource categories are only suitable for low density use.*

- *Manage lands with moderate (F) to no septic system (G) limitations by regulating development on moderate soils according to sewer availability; elsewhere no restrictions are necessary, with enforcement of existing regulations.*

Maximize Public Investment Efficiency Options. Wherever possible and desirable, guide growth to maximize use of existing infrastructure such as water, sewer, and transportation services, to achieve desired patterns of future growth; and use clustering, planned unit development, and impact zoning to increase the efficiency of resource use and decrease the cost of public investments in services. Clustering and other higher intensity land uses can result in savings of up to 50 percent in energy, water, sewer service, and transportation needs, according to CEQ's recent publication, *The Cost of Sprawl.* While sufficient land for continued sprawl exists, the Study findings suggest that it may no longer be responsible either fiscally or environmentally to encourage such development.

The third major recommendation is to **regulate developments having regional impact.** Establish criteria for economically and environmentally suitable sites for *key facilities,* large scale developments, or growth inducing developments and major public facilities, all of which have greater than local impact. To prevent preemption by other uses of the most critical sites, acquire or designate them for future public use, and lease or specify interim uses.

Water Supply

Water supply recommendations were designed to meet municipal needs for adequate supplies of fresh water in the most economically feasible and environmentally sound manner. The recommendations can be divided into three groups. The first group consists of general recommendations which should apply throughout the region. The second group applies to municipalities relying wholly or partially on ground water sources, while the third group of recommendations refers to municipalities whose needs are met by surface sources.

Those recommendations *relating to the region* are:

- *Prefer local ground water to intermunicipal surface water development, and intermunicipal surface water to interbasin transfer in order to maximize local self-sufficiency.*
- *Maintain existing water resources and acquire key watersheds and potential well sites.*
- *Limit water consumption through education and water-saving technology.*
- *Study advanced technologies leading to new sources of water, and encourage the regionalization of surface water supply systems. New or expanded regional systems should be established in the Ipswich River, Taunton, Brockton, Providence, southeastern Rhode Island, and South Shore areas.*

The SENE Study has formulated recommendations for towns which *rely* either wholly or partially *on ground water.* For these towns, the recommendations, listed in their general order of priority, are as follows:

- *Survey ground water location, quantity, and availability.*
- *Restrict activities hazardous to ground water quality.*
- *Monitor saltwater encroachment in coastal aquifers.*
- *Provide recharge basins to capture storm runoff, limit withdrawal to prevent serious stream depletion, and establish state ground water boards.*

The SENE Study has proposed additional recommendations for *municipalities relying on surface water systems* for their supplies. To meet the rapidly expanding needs of the Metropolitan District Commission (MDC) in the greater Boston area, the U.S. Army Corps of Engineers has recommended two additional diversions from the Connecticut River Basin: one via the Northfield Mountain pumped storage hydroelectric plant, and the second from the tributary Millers River Basin. The Study has concluded that the Northfield Mountain diversion should proceed at once to meet immediate needs and that planning of the Millers River diversion should be carried out. Simultaneously conservation practices should be implemented and study of additional alternatives should continue. In Rhode Island, the Study recommends that construction of the Big River Reservoir should begin immediately to provide additional supplies to the Providence water supply system. However, in general, the Study recommends development of in-basin resources to the maximum extent economically and environmentally possible. Reliance on local sources of water is expected to extend the period of time that the recommended out-of-basin supplies can serve expected needs, and will preserve flexibility in water supply policies.

Water Quality

The objective of the SENE Study recommendations for water quality is to achieve swimmable-fishable waters by 1983 wherever realistically attainable economically, socially, and technically. The recommendations generally follow current state plans, especially for the 10 planning areas. Second, the recommendations recognize the technological reality that non-point sources are still not well understood, while at the same time recognizing our rapidly increasing respect for their significance.

The recommendations therefore have two thrusts – preservation and restoration where most attainable. The individual policy and action recommendations that comprise the water quality program are presented below:

Preservation. Immediate priority is given to ensuring that no additional water quality degradation be allowed in areas of high quality water. Five recommendations are listed below in what is perceived to be their general order of importance in meeting the above-stated objective of the recommended program.

- *Stress non-degradation in areas now swimmable-fishable.*
- *Carry out current state anti-degradation policies.*
- *Attenuate runoff from new urban developments.*

- *Negotiate acceptable low-flow regimes with upstream communities.*

- *Provide streambank buffer strips.*

Restoration. Nine recommendations are set forth to restore existing water quality. They are listed below in what is perceived to be their general order of importance in meeting the objective of the recommended program.

- *Emphasize treatment of urban stormwater flows.*

- *Accelerate federal grants for municipal wastewater treatment.*

- *Continue current industrial permits programs.*

- *Begin regionwide stormwater and wet-weather stream sampling.*

- *Make towns responsible for scavenger waste disposal.*

- *Determine municipal sludge disposal policy on a plant-by-plant basis.*

- *Place burden on industry for disposing of hazardous wastes.*

- *Study and define the landfill leachate problem.*

- *Provide pumpout facilities and treatment for watercraft wastes.*

Outdoor Recreation

The protection and management of Critical Environmental Areas through the Study's proposals for guiding growth should provide land to satisfy some of the demand for hunting, hiking, canoeing, sport fishing, and certain low-intensity forms of outdoor recreation. To satisfy the region's other more intensive recreational needs by the year 1990, 20 specific actions were recommended. Highest priority was given to the following:

- *Acquire and develop the Boston Harbor Islands and Narragansett Bay Islands Park.*

- *Increase capacity at existing beaches and improve public transportation to major beaches.*

Other high priority recommendations include:

- *Securing public access to the shoreline at frequent intervals and most frequently near cities.*

- *Preparing guidelines for local water authorities to permit limited public recreational use of secondary (storage) water supply reservoir lands, at least for picnicking, hiking, fishing, and low-intensity outdoor activities.*

- *Designate parts of the Charles, North, Ipswich, Taunton, and South Rivers as Massachusetts Scenic Rivers; and the Wood, Beaver, and Pawcatuck as Rhode Island Scenic Rivers.*

- *Develop new recreational boating harbors at Salem, Plymouth, and in Narragansett Bay.*

- *Study the possibility of adding sand to 12 beaches to combat erosion and increase beach area.*

Marine Management

The principal objective of this portion of the SENE Study was to maintain the region's renewable marine resources at a level sufficient for a sustained future use, and to develop the region's nonrenewable marine resources in an environmentally sensitive manner.

Offshore Fishing. The thrust of the recommendation is to maintain a valuable fisheries resource and to provide a strong economic base for the region's fishing industry. The following actions are recommended in order of priority:

- *Declare interim offshore 200-mile Economic Zone. The U.S. Congress should extend, as soon as possible, the nation's jurisdiction over fisheries to 200-miles offshore or to the edge of the continental shelf.*

- *Adopt a national fisheries management policy and program.*

- *Increase tariffs on imported fish products.*

- *Allow privately financed purchase of foreign-built boats.*

- *Improve the market for underutilized fish species.*

- *Accommodate coastal fish facilities through improved planning.*

- *The states' Coastal Zone Management Programs, in cooperation with Departments of Community Affairs, should develop guidelines and provide technical assistance to local planning boards.*

Shellfish and Aquaculture. In Massachusetts, recommendations include increased technical assistance for local shellfish management, and increased user fees for shellfish licenses. Rhode Island should enact shellfish license legislation. Department of Fisheries, Wildlife, and Recreational Vehicles in Massachusetts, and the Department of Natural Resources in Rhode Island should actively encourage the harvesting of edible shellfish, such as the blue mussel, for both recreational and commercial use, developing underutilized species. The EPA should accelerate research into the detection and removal of viral bacteria during the wastewater treatment process, and wastewater discharges should be moved away from estuaries until such time as the removal of viral bacteria is feasible.

In addition to the above recommendations on shellfish management the following actions are recommended to produce a more favorable basis for aquacultural operations: Rhode Island should enact legislation similar to that passed in Massachusetts; both states should identify potential aquacultural sites, increase technical assistance to towns for aquaculture management, and increase research on the use of wastewater for aquaculture.

Port Development. In order to maximize regional economic efficiency, the Study recommends creation of a regionwide port development strategy. A regional port planning program should determine the most economically efficient port development system for meeting the region's shipping and cargo distribution needs. Also recommended is continued use of interim dredged materials disposal procedures, until new disposal techniques are developed.

Offshore Sand and Gravel Extraction. In the event that conventional onshore sand and gravel deposits are no longer available in supplies sufficient to meet the region's construction needs so that offshore mining becomes economically competitive, the following recommendations are presented to facilitate such ventures and protect the surrounding marine environment:

- *Develop policy and program for regulating mineral extraction activities in coastal waters.*
- *Coordinate future federal leasing of farshore sand and gravel sites with coastal zone management programs for adjacent sites.*
- *Develop predictive modeling techniques for offshore sand and gravel operations.*

Urban Waterfronts. In order to enhance the use and reuse of urban waterfronts in a rational and balanced manner:

- *Coordinate local waterfront planning and development.*
- *Provide state-level guidance and set criteria for priority waterfront uses.*
- *Review and coordinate waterfront use.*
- *Provide federal support of state and local waterfront development plans.*

Flooding and Erosion

To mitigate the region's flooding and erosion problems within the existing system of state and federal programs, the Study recommends both structural and non-structural measures. However, non-structural flood plain management measures are emphasized wherever possible. The recommendations include:

- *Prepare comprehensive basin flood plain management programs.*
- *Full participation in the National Flood Insurance Program is urged for all communities.*
- *Prevent further development or redevelopment in inland or coastal flood prone areas and coastal erosion areas.*
- *Strengthen state wetlands legislation.*
- *Acquire key wetlands and flood plain areas.*
- *Selectively construct flood control projects.*

Locating Key Facilities

The planning objective for locating key facilities was to provide certain vital services to society – power, fuel, construction materials, solid waste disposal – in a manner which supports continued economic growth and minimizes the negative environmental impacts such facilities have traditionally had.

For four vital services – onshore sand and gravel, electrical power, petroleum facilities, and solid waste disposal – siting is the key issue. For power and petroleum, the importance of siting is matched by the need to match consumption. The key recommendations are:

- *Immediately establish energy demand management and conservation programs in each state.*
- *Establish comprehensive energy facilities siting authority in Rhode Island and strengthen the one in Massachusetts; secure sites for the future.*
- *Centralize minerals management authority in each state's natural resources agencies; encourage sequential land use program.*

Other high priority recommendations include:

- *Study the electrical rate structure to eliminate decreasing block rates.*
- *Maximize development at existing power plant sites.*
- *Upgrade or phase out inefficient power plants.*
- *Provide one-stop power plant licensing.*
- *Locate future petroleum facilities inland near infrastructure.*
- *Distribute refined products by pipeline.*
- *Enforce existing landfill regulations.*
- *Fund the Rhode Island Solid Waste Management Corporation.*
- *Conduct Massachusetts mineral survey.*

Strengthening the Management System for Natural Resources

The Study recommends maximum use of existing resource policy institutions. The resource management policies and programs recommended by the SENE Study should be reviewed, and appropriate state policies adopted by the Governor's Cabinet in Massachusetts and the Rhode Island State Planning Council or their successors.

Population Projections

Projections of future trends in population, income, and employment were originally derived from the OBERS Series C projections developed for the federal Water Resources Council by the Economic Research Service (ERS) of the U.S. Department of Agriculture, in conjunction with the Bureau of the Economic Analysis (BEA, formerly the Office of Business Economics) in the U.S. Department of Commerce. Later in the Study new OBERS projections, Series E, were developed by ERS and BEA. These projections reflect a continuation of the low population birth rate level which the nation is now experiencing, rather than the higher 1960-1970 national growth rate on which the Series C projections were based. The resulting lower population figures were adopted by the Study.

B. RELATIONSHIP TO EXISTING PROGRAMS

The design of existing programs, the workings of existing institutions, and the requirements of current laws as well as significant pending legislation served as important starting points for the Study. Current laws and guidelines and the pending National Land Use Policy Act provided direction for the Study's development capability analysis as well as evaluation. The Study has recognized the leadership of the states in natural resources matters, and has endorsed many ongoing state resource management programs. The conclusions of the Study are specifically presented in a way which will be helpful to the states in meeting their responsibilities for managing land and water resources, including requirements of the Federal Water Pollution Control Act Amendments of 1972 and the Coastal Zone Management Act of 1972. At the same time, the Study has also recognized the importance of local resource decisions in town halls, through conservation commissions, planning boards, and zoning boards of appeals. The Study's recommendations are formulated to build on existing programs, requirements, and institutions wherever possible.

C. THE PROBABLE IMPACT OF THE PROPOSED ACTIONS ON THE ENVIRONMENT

As mentioned earlier, the net environmental impact of the recommended policies and actions is expected to be strongly beneficial. Environmental analysis was an integral part of the planning process. Evaluation of alternatives with respect

to environmental criteria, as well as economic and social criteria, is woven throughout all Study analyses.

Guiding Growth

Protecting Critical Environmental Areas will enhance the overall environmental quality of the region. If future growth can be directed to those lands most capable of supporting it, the traditionally negative effects of development – erosion, flooding, loss of wildlife habitat and open space, pollution or loss of water supplies – can be mitigated. The recommendations, if implemented, will also have significant positive effects on national economic efficiency, chiefly by reducing the resource and public investment costs of growth. Savings in construction costs, energy consumption, and in the costs of expanding and constructing new infrastructure such as water and sewer lines and roads, can be gained by using existing excess capacity and clustering new development.

Water Supply

Once the approaches in Guiding Growth have been developed, water supply policy can be used as a tool to bring about greater economic efficiency and environmental quality in the SENE region. Patterns of land use which protect recharge areas and which use existing infrastructure such as water supply systems enhance the environmental and economic aspects of life in this region. Furthermore, coordinated water supply and water quality planning can provide more efficient methods of water management and environmental protection. The efficient use and protection of existing sources of water, coupled with careful planning and development of additional sources, should provide the residents and industries of the SENE region with an adequate supply of reasonably economical, high quality water over the next 50 years. Maximum use of in-basin resources will maintain local autonomy and will preserve future options for flexibility in water supply policies. In addition, advanced technology may allow the region to develop new sources of water without placing increased stress on its natural resources.

Water Quality

Environmentally, swimmable-fishable waters will be achieved by 1983 wherever realistically attainable, economically, socially, and technologically. Economically, the key point in examining the recommendations comes in the realization that *all* waters in the region cannot – and in some cases should not – reach swimmable as well as fishable levels. Instead, the recommendations emphasize preserving existing swimmable waters and achieving the swimmable-fishable goal elsewhere, where reaching this goal would be most beneficial in relation to the costs incurred. Preservation of existing high quality waters will lower pollution control costs in the future. Total costs may well be in the $5 billion range, not nearly as high as the achievement of swimmable-fishable waters *everywhere.* Economic benefits should accrue through increased recreation and tourism, improved value of waterfront locations and some increase in shellfishing. Probably the most important economic benefit is less tangible – making SENE a more appealing place for attracting and holding the professionals and highly skilled workers it will need in the future. As a result of a trend toward a more service-oriented economy, direct demands on SENE waters, both as a medium for waste assimilation as well as for supply, may be significantly lower in the future. Pollution problems resulting from industrial by-products may not exponentially increase as has been the trend in the past. Thus, the outlook for improvement in water quality in SENE may be somewhat better than many might perceive today.

Outdoor Recreation

The outdoor recreation recommendations are designed to make dual use of Critical Environmental Areas in environmentally sensivite ways. Meeting expected demands for recreation will improve the region's attractiveness as a place to live and work, and thereby providing for the leisure activities of an increasingly services-oriented economy. Providing additional recreation opportunities in and near the urban areas of SENE, together with providing improved public transportation to major beaches and recreation areas will minimize auto-associated air and noise pollution as well as energy consumption. Increasing the areas open for public recreation will probably increase visitation and, therefore, impact on soil, water, land, and wildlife in those areas. But these impacts are expected to be below what can be expected to occur by 1990 without the SENE Study recommendations.

Marine Management

Implementation of these actions would encourage preservation of wetlands and shellfish areas, reinforcing the recommendation to protect Critical Environmental Areas. The recommendations would enhance water quality by encouraging the relocation of wastewater discharges away from estuaries, controlling disposal of dredged materials, and planning urban waterfront use. Implementation of these actions would be a major step toward regenerating the offshore fishing industry which, together with the increased availability of shellfish resources, should help to strengthen and stabilize the economies of many of the region's coastal communities.

One of the Marine Management recommendations, to define policy and program regulating coastal mineral extraction activities, appears that it will have a negative effect on the planning objective for providing key facilities. However, this recommendation was formulated to avoid a number of potential adverse impacts: if mining is restricted to far-shore waters, away from near-shore shellfish beds and

delicate spawning grounds, detrimental effects to valuable commercial and sports fisheries would be minimal. Near-shore mining in depths up to 80 feet is likely to upset the delicate natural equilibrium maintaining the natural contours of existing beaches. Further, the recommendation is designed to avoid potential conflict between sand and gravel mining operations and marine traffic, pipelines, wastewater outfalls, and cable crossings.

Flooding and Erosion

The policy of applying non-structural measures wherever possible in the context of comprehensive flood plain management programs is expected to minimize future flood damages, recognizing that flooding and erosion are natural processes that cannot be expected to be controlled or prevented. This approach is designed to work with, not against, the natural roles that flood plains and wetlands play in accommodating the forces to nature. This approach (1) is sensitive to the natural roles that wetlands and flood plains play in flood water storage and their particular susceptibility to the damaging forces of nature (as further indicated in the SENE Study's classification of both wetlands and flood plains as critical resources; see Guiding Growth); (2) it reflects the finding that future growth in the region can be accommodated without using wetlands or flood plains; (3) it notes that non-structural measures generate multiple benefits in terms of recreation, water supply, and preservation of landscape quality. Only where existing development is of significant importance to the economy and non-structural solutions are not available should structural measures be used.

Locating Key Facilities

These recommendations would protect water quality by encouraging the control of location, operation, and discharge from power plants, petroleum-related facilities, and solid waste facilities. Because Critical Environmental Areas are to be protected, ecological systems are taken into account while providing regional facilities. Energy conservation measures should reduce some impacts by reducing or postponing several plants until forms of power generation are available which have fewer adverse effects.

In sum, all recommended policies and actions are expected to have a minimal net adverse environmental impact.

D. ALTERNATIVES TO THE PROPOSED ACTIONS

Each recommendation of the SENE Study was selected from a number of alternative measures and alternative plans representing different combinations of those measures. Alternatives are discussed in a separate section in each of the major chapters in the Regional Report and further in each of the 10 planning area reports. In most cases, the recommendations draw from elements from each of the alternatives formulated.

Guiding Growth

The Study examined three alternative strategies for guiding the future growth of the region to guarantee the protection and wise use of its water and related lands: (1) Continuing current programs and regulations; (2) Increasing protection of Critical Environmental Areas; and (3) Improving management of Developable Areas.

These three alternatives approach the problem of accommodating needed growth and protecting valuable resources from decidedly different directions. The first recognizes that in many ways state and local governments in Massachusetts and Rhode Island have a history of leadership in resources management. This alternative emphasizes continued use of available tools to manage the future growth of the region. The second alternative seeks simply to remove certain Critical Environmental Areas from consideration for most forms of development, permitting future development and relatively unrestricted use of most other lands, yet assuring integrated maintenance of the future quality and quantity of water resources. The third alternative seeks to guide growth on the basis of the ability of the region's water and related lands to support a variety of forms of development, to increase the efficiency with which public investments in services needed to accommodate growth are made, and to control the location of those forms of development having major impacts on the region's water and related land resources.

Water Supply

In order to satisfy the objective of meeting municipal needs for an adequate supply of fresh water, the SENE Study has considered a number of alternative measures: (1) managing water demand; (2) developing ground water; (3) developing surface water; (4) achieving self-sufficiency; (5) using emerging technology; (6) improving water resource management; (7) making interbasin transfers; (8) expanding or forming regional systems; and (9) improving institutional arrangements. In order to meet the 1990 and 2020 water needs in Southeastern New England, the Study considered two alternative plans incorporating these measures. One

plan would emphasize maximum use of conservation and demand management, along with the maintenance and development of local ground water supplies. In addition, this plan would attempt to make each basin in the region as self-sufficient as possible. The other plan would stress the goal of providing all of the region's required supply at the lowest possible cost.

Water Quality

A series of alternative measures were considered in improving water quality in the region. Alternative measures for reducing the severity of urban stormwater and combined sewer problems include: (1) stormwater sampling; (2) attentuation to runoff; (3) better street cleaning; (4) separation of combined sewers; (5) in stream controls; (6) off system storage; and (7) treatment. General approaches for solving municipal wastewater problems include: (1) additional sewering; (2) higher degree of treatment; (3) better effluent disposal methods; (4) better sludge disposal methods; and (5) greater regionalization. For disposal of hazardous wastes, the Study considered (1) land burial; (2) deep well injection; (3) ocean dumping; and (4) incineration. The principal alternative measures for minimizing seepage problems are: (1) establishing and enforcing criteria and compliance procedures; and (2) increasing use of dry disposal systems. The principal alternatives for disposal of septic pumpings are: (1) disposal at existing wastewater treatment plants; (2) land spreading; (3) drying beds; (4) lagoons; and (5) land filling. To minimize in stream problems, particularly in heavily used streams with little flow, four alternative measures were considered: (1) low flow augmentation; (2) dredging of benthic deposits; (3) aeration; and (4) treatment. To handle domestic wastes generated on watercraft the alternative measures were: (1) flow-through devices providing primary treatment and disinfection; (2) holding tanks; and (3) restricted usage.

Several alternative plans were developed using these measures with varying emphasis. One plan sought to achieve swimmable-fishable waters everywhere by 1983, lower than the primary goal of the Federal Water Pollution Control Act Amendments of 1972, which called for the elimination of all discharges of pollutants to navigable waters by 1985. This plan gives equal priority to point and non-point sources of pollution. Treatment, rather than separation, would be the only alternative to solving the combined sewer overflow problem. Moreover, some kind of breakthrough in understanding the significance, distribution, and means of abating non-point source pollution would be needed. If such a breakthrough could be made, a major abatement program would have to be developed, accepted, funded, and executed. Clearly the social and environmental benefits would be very high. But so would the costs. Until a better idea of the nature and scope of the non-point source problem can be developed, the exact cost of the program cannot be estimated.

Another plan sought a lesser goal – attainment of swimmable-fishable waters on the basis of priorities set by cost effectiveness. The plan recognizes that the intangible nature of many of the benefits of improved water quality make strict cost-benefit analysis impossible. Under cost effectiveness, even though one has not measured the implications of full or partial attainment of a goal, he will seek the least costly path to that goal. As applied in priority to a water quality program, one would first accomplish those things that would produce the most swimmable-fishable waters per dollar of combined public and private expenditure. This approach places increased emphasis on anti-degradation policies, on doing much more about urban stormwater runoff and non-point sources, and on increasing the efficiency with which existing wastewater treatment plants operate. The plan would also reduce emphasis on some of the most costly municipal and industrial wastewater abatement programs. Clearly, under such a plan achievement of Class B waters would be delayed well into the future.

Outdoor Recreation

The Study considered several alternatives for meeting outdoor recreation needs. The three major alternatives for satisfying future beach needs were (1) adding facilities to existing parks and beaches including improved public transportation to beach areas; (2) securing public access to the shoreline; and (3) acquiring new beaches for state parks. One plan using these measures emphasized limited use of beaches by promoting public access to the shoreline. A second plan drawing on these alternative measures attempted to achieve maximum satisfaction of mass demands for high intensity beach use for residents and tourists alike.

Two principal alternatives for satisfying boating needs are (1) private investment in marina development; and (2) public investment in boating facilities. One plan applying these measures would concentrate on expanding the capacity of existing marinas. A second plan would involve guidance about suitable locations and development. This plan would meet a smaller portion of the boating demand than the first approach, but would maintain a higher regard for environmental quality.

Alternatives for meeting camping and picnicking needs are (1) expanded use of existing facilities; and (2) private development of new campground and picnicking facilities. Six alternatives were considered for fish and wildlife: (1) acquire wetlands; (2) acquire upland wildlife management areas; (3) provide public access to privately-owned wildlife habitat; (4) use of wetland legislation; (5) acquire public access to ponds; and (6) acquire streambank access.

Alternative measures for assuring extensive outdoor recreation

opportunities include: (1) developing Boston Harbor and Narragansett Bay Island Parks; (2) making recreational use of publicly or privately owned, but inaccessible urban resources; (3) acquiring Critical Environmental Areas; (4) limited public access to water supply watersheds; (5) multiple use of trails; and (6) scenic rivers legislation. Two alternative plans were developed, based primarily on public cost. One plan would place primary emphasis on acquiring the Boston Harbor and Narragansett Bay Islands and Critical Environmental Areas, expanding the trails system, and designating scenic rivers. A second plan would stress a lower cost combination of acquiring the Harbor and Bay Islands, using urban resources, making multiple use of watershed lands, and increasing use of existing trails.

Marine Management

A number of alternatives have been proposed in the several sections of this chapter. Alternatives for assuring future fishing supplies were: (1) continue the existing International Commission for Northwest Atlantic Fisheries (ICNAF); (2) improve and strengthen ICNAF: and (3) enact an interim 200 mile economic zone. Alternatives for improving the domestic fishing industry's competitive base: (1) continue the present situation; (2) increase tariffs on imported fish products; (3) coordinate components of fishing industry in major fishing ports; (4) allow privately-financed purchase of foreign-built boats; (5) improve the market for under-utilized fish species; and (6) accommodate fishing industry facilities through improved coastal planning.

A number of alternative measures were considered for shellfish and aquaculture: (1) delegate management of shellfish to the state; (2) increase state assistance in Massachusetts for local shellfish management; (3) develop market for under-utilized shellfish species; (4) research viral and bacterial removal to enhance shellfish habitats; (5) move wastewater discharges away from estuaries; (6) provide state and federal subsidies to "seed" the aquaculture industry; (7) enact specific aquaculture legislation in Rhode Island; and (8) increase state guidance for aquaculture development.

Several alternative measures for port development were examined: (1) port authorities and economic development commissions could continue to plan improvements for local port facilities and promote private investments for local port facilities on an individual basis; and (2) redevelop the region's two major ports based on a regionwide assessment of individual port capabilities and development opportunities by (a) accelerating the development of container ship facilities in Boston if proven advantageous, (b) developing an economically feasible and environmentally acceptable deepwater petroleum products terminal with a pipeline distribution system to major population centers, and (c) developing Narragansett Bay as a liquid natural gas (LNG) center, if proven advantageous.

Alternatives for dredged materials disposal were: (1) treatment of dredged materials; (2) incineration; (3) land disposal; (4) creating artificial islands; (5) banning all dredging; and (6) continued disposal to ocean waters.

Three systems for offshore sand and gravel mining were considered: (1) near-shore small conventional bucket dredges; (2) hopper dredges without onboard processing capability; (3) hopper dredges with onboard processing and dewatering capacity operating in far-shore areas.

Three basic approaches were considered in initiating and carrying out land use planning and development control activities in urban waterfront areas: (1) planning and development control activities could be carried out primarily by local governments; (2) local and state (or substate regional) jurisdictions could share responsibility; (3) state (or substate regional) jurisdictions could be the principal decision makers in the process.

Flooding and Erosion

Several measures were considered for reducing flood damages: (1) land use controls (such as flood plain zoning, wetlands protection including serious state and local controls, subdivision regulations, and building code restrictions); (2) structural controls (such as flood water diversions, seawalls and dikes, dams, and flood control reservoris); and (3) protection of existing development (flood-proofing, relocation, weather modification, warning systems). These various measures were combined into two alternative plans: one aimed at protecting development from flooding using lowest cost measures, and another designed to protect flood prone areas from development.

Alternative measures for inland erosion areas were: (1) establish town sediment and erosion control ordinances; (2) establish forest buffer zones within 200 feet of streams and lakes; and (3) control forest road erosion by proper road location and stabilization activities such as seeding and ditching.

Alternative measures considered in protecting or enhancing the coastal areas were: (1) planting and fertilizing with beach grass; (2) direct sand placement (artificial nourishment) and construction of backup dikes of sand and gravel, rock or concrete walls, and rock walls; and (3) protection of erodible bluffs with rock revetments, seawalls, or bulkheads. Also considered were floating breakwaters and marsh restoration. These measures were combined into three alternative plans. One plan, to do nothing, would allow present patterns of development and steadily increasing rates of erosion to continue. Another plan stressed restoration and protection of critical shoreline areas through extensive structural controls, thus permitting further development. A third plan proposed a rigid coastal zone management program precluding future encroachment on

Critical Environmental Areas such as marshes and barrier beaches, and encouraging restoration of natural impediments to erosion.

Locating Key Facilities

For onshore sand, gravel, and stone extraction the Study considered four alternative measures: (1) importation of materials from outside the region; (2) substituting crushed stone for sand and gravel; (3) offshore mining; and (4) identifying, protecting, and sequencing use of onshore deposits within the region. Also considered was the substitution of other materials, using nearshore materials such as marine muds.

Alternatives for managing the demand for power include: (1) efficient pricing of electrical power to reflect the marginal costs of supply; and (2) revising the rate structure. Alternatives for power plant siting were: (1) continue the present siting system; (2) create one-stop coordinated federal-state review of proposals; (3) establish a program of state identification and protection of potential power plant sites.

Alternative measures for meeting petroleum requirements were: (1) delivery – by pipeline, coastal tanker, or deepwater terminals; (2) refining – inland or coastal; (3) distribution – coastal tankers or pipeline distribution. One alternative plan, using these measures, would give priority for land allocation to refinery and related heavy industrial development at sites closest to delivery and market areas. A second alternative would eliminate the SENE region and New England as a whole from further consideration for refinery and related heavy development. Under this alternative, the SENE region would continue to be a 100 percent importer of refined oil products, and an extremely high degree of state controlled demand management would be essential.

Alternative approaches for solid waste management were: (1) land disposal sites should be selected to minimize the infiltration of leachate into surface and ground water; (2) established landfills should be operated under the appropriate state regulations to minimize impact; (3) communities should be encouraged to participate in state solid waste recovery programs.

Strengthening the Management System for Natural Resources

The Report sets out several alternative approaches to implementing key Study recommendations. Designed to assist the states in translating policy into action, each alternative approach illustrates a slightly different balance between state, substate regional, and local resource management decision making. For each state, the approaches illustrate three concepts: protection of Critical Environmental Areas, control over developments of regional impact, and the degree to which long-range water resources planning can be a tool for guiding growth.

The approaches are: (a) state development guidelines for use by local government; (b) mandatory local planning and zoning; (c) state designation and local regulation of Critical Environmental Areas or areas of critical concern to the state; and (d) state regulation of critical areas with municipal administration. Two more approaches demonstrate the possibilities of indirectly guiding growth through comprehensive water resources management programs: (e) regional management of water and related land resources; and (f) state planning and management of water and related land resources.

E. PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

As mentioned previously, net environmental benefits of the recommendations are expected to be strongly positive. Environmental impacts were considered throughout the planning process, with the express objective of eliminating any adverse and irreversible impact wherever possible, together with actively enhancing environmental quality and other beneficial impacts.

General criteria for evaluating SENE Study recommendations were drawn from the components of the four accounts (national economic efficiency, environmental quality, regional development, and social well-being) of the U. S. Water Resources Council's *Principles and Standards.* Evaluation based on the listed criteria shows that four SENE planning objectives score particularly high – guiding growth, locating key facilities, outdoor recreation, and water quality. Taken together, Study recommendations score high in the environmental quality and regional development accounts as compared to the two accounts for national economic efficiency and social well-being. In sum, SENE Study recommendations for protecting Critical Environmental Areas, and guiding growth to other areas which can support development, are expected to be highly beneficial to the environment.

One of the 128 recommendations – to define policy and program regulating coastal mineral extraction activities – appears that it will have a net negative effect for providing key facilities. By regulating this close-in source of sand and gravel to a metropolitan area like Boston, other

alternative sources, possibly equally undesirable, might have to be used.

The degree to which offshore sand and gravel mining affects the marine environment varies considerably by site. Some effects are known to be minor and temporary, others major and permanent, while for others little is known. Three areas of potential conflict exist: fisheries, recreation, and navigation and communications. Mining in near-shore waters could cause detrimental effects to valuable shellfish beds and spawning grounds and is likely to upset the delicate natural equilibrium maintaining the natural contours of existing beaches. And sand and gravel mining operations near the shore may conflict with commercial, military, fishing and recreational vessels; and with pipelines, wastewater outfalls, and cable crossings.

In implementing the recommendation, therefore, public administrators are cautioned to take particularly broad look to compare the total environmental, economic, and social implications of alternative sources than could be examined in this Study in formulating the recommendation. The recommendation was put forth based on the belief that it will withstand such examination, but it is recognized that review from other perspectives is also necessary.

F. THE RELATIONSHIP BETWEEN LOCAL SHORT–TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG–TERM PRODUCTIVITY

The recommended policies and actions have been formulated specificially to ensure that the cumulative and long-term impacts are beneficial in nature. SENE Study recommendations are designed to ensure that resources contributing to the quality of man's life and environment are safeguarded for future generations and that options for future actions are maintained. An example is the Study's recommendation to maintain and protect local ground water resources which offer the most economical source of water supply. Such an approach to maintain and protect such water supply options can, if properly managed, retain a flexibility greater than that of towns which have abandoned their local ground water sources for other supplies. Another example is the identification and acquisition of sand and gravel sites. The recommendations reflect the view that sand and gravel mining can be the first step in a plan for sequencing land use in areas under development pressure. After sand and gravel have been mined and the land restored, communities (with state guidance) can rezone the areas for subsequent uses consistent with economic needs and environmental aspirations.

G. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The Study recommendations were formulated with a goal to avoid irreversible and irretrievable commitments of resources. In fact, recommendations to protect Critical Environmental Resources are expected to maintain the natural functions of resources such as wetlands and to extend the capacities of other resources through conservation measures and study of new technologies. For example, the SENE Study classification system and related recommendations to protect proposed reservoir sites and their watersheds are designed to avoid an irretrievable commitment of resources – in this case, development on regionally significant reservoir sites. Acquisition of key watersheds is recommended to preserve future options for development for water supply resources. The classification system is also designed to group resources which have "like" characteristics into categories which can be protected and managed in ways which take into account their capabilities and suitabilities for certain uses.

H. COMMENTS RECEIVED

Comments on the Study report including the draft environmental statement were sought from the Governors and key agencies in Massachusetts, Rhode Island, and Connecticut, as well as Maine, New Hampshire, Vermont, and New York; the head of each federal department or agency and each interstate agency having a representative to the New

England River Basins Commission, as well as appropriate federal agency offices listed in Appendix III of the NEPA Guidelines. Comments were sought from interests throughout Southeastern New England including: U.S. Senators and Congressmen, state senators, regional planning agencies, 213 town planning boards, town managers or mayors, conservation commissions, and several hundred individuals and groups.

Brief comments specifically on the Environmental Statement were received from the Department of Agriculture, Department of the Interior, Department of Commerce, the Environmental Protection Agency, and the Federal Power Commission. Considerably more agencies and individuals reviewed and commented on the full Study report. Their comments and changes made in response to them are included in the chapter on Review of the Report.

Comments were for the most part favorable. The Department of Commerce review called the draft statement, together with the Regional Report, "a positive approach to managing the natural resources of the area." The Environmental Protection Agency judged the report "complete and accurate," and rated the impact statement as "LO–1," Lack of Objections - - Adequate, with the understanding "that the rating is interpreted as a rating of the planning study and is not to be interpreted as compliance with NEPA for the recommended actions." This latter point is key to the interest on the part of the Interior and Agriculture Department reviews for additional details in the impact statement regarding impacts, alternatives, and irreversible commitments of resources. As noted in the *Introduction*, the statement takes the form of an "overview" statement with a focus on the policy aspects of the Study. Later actions to implement specific Study recommendations will require more detailed 102 statements, which would generate more specific information to permit elaboration of the details requested above. Many of the actions cannot be evaluated more fully until further studies are performed. Most importantly, the Study recommendations were formulated with the requirements of NEPA in mind.

METHODOLOGY

The methodology of a planning process is, in many ways, as significant as the final product itself. A knowledge of the premises with which the SENE Study began, and of the course of action which was followed during its development can lead to a better understanding and evaluation of the Study's final report. Furthermore, the methodology serves as a guide for future work; it is a framework which other studies can build upon or modify to meet their specific objectives.

This chapter will attempt to *outline* the SENE Study's methodology, beginning with the background and events which led to the Study's formation. Several sections will deal with the Study's relationship to federal legislation and to ongoing federal and state programs. In addition, the basic organizational structure of the Study will be outlined. Participating federal, state, and regional resource planners, as well as citizens and the scientific community were grouped into various levels of management to coordinate their contributions. The SENE Study consisted of a number of phases, each of which had specific objectives. This chapter will briefly describe each of these phases, listing the publications produced during each step. Next, the chapter will summarize the individual methodologies used by Study participants to produce the material contained in each of the chapters of the Regional and Planning Area Reports. This discussion will provide a perspective on the development and the final products of each functional area covered by the Study. Finally, a listing by chapter will show the kind of information generated by Study participants for each of the chapters in the various reports.

BACKGROUND

The Southeastern New England Water and Related Land Resources Study was the first major "level B" study initiated by the New England River Basins Commission. During March 1968, heavy flood damages attracted regional attention to southeastern New England. In May of that same year, the Commission resolved to undertake a comprehensive study of the water and related land resources of Narragansett and Little Narragansett Bays as its first subregional study. This resolution was approved by the federal Water Resources Council and the New England Governors' Conference. Subsequently, in August 1968, the Study area was expanded to include coastal drainage areas in Massachusetts, so that the Study region coincided with the North Atlantic Regional (NAR) Study's Subarea 9. This expansion consolidated the heavily industrialized and populated eastern Massachusetts and Rhode Island areas, both characterized by their small coastal streams and their close association with marine resources. Delays in funding postponed the initiation of the Study until January 1971, when Plan of Study preparation formally began.

The basic authority for the SENE Study is Section 201 (b) (2) of the Water Resources Planning Act of 1965 (PL 89-80). This section states that, among its other duties and responsibilities, the Commission shall:

(1) Serve as the principal agency for the coordination of federal, state, interstate, local, and non-governmental plans for the development of water and related land resources in its area, river basin, or group of river basins;

(2) Prepare and keep up to date, to the extent practicable, a comprehensive, coordinated, joint plan for federal, state, interstate, local and non-governmental development of water and related resources: *Provided* that the plan shall include an evaluation of all reasonable alternative means of achieving optimum development of water and related land resources of the basin or basins, and it may be prepared in stages, including recommendations with respect to individual projects.

(3) Recommend long-range schedules of priorities for the collection and analysis of basic data and for investigation, planning, and construction of projects.

The Southeastern New England Study was given top priority among the Commission's programs in the context of Section 201(b)(3), and is a key element of the comprehensive, coordinated, joint plan for New England as called for in Section 201(b)(2) above.

Definition of a Level B Study

A "level B study", such as the SENE Study, is a preliminary, or reconnaissance level, water and related land plan for a selected region or river basin. The Study identifies and recommends actions to be taken by all levels of government and by private interests to secure, by balanced conservation and development of SENE's water and related resources, the full range of uses and benefits for the people of the region.

The SENE Study is both a process and a plan. By bringing together citizens and government officials at all levels – federal, state, regional, and local – the Study serves as a forum for discussing resource problems and management solutions for the region. By drawing on existing data and comparing ongoing programs, the Study has developed a method of analyzing resource information, establishing action priorities, and reflecting resource capabilities in formulating action recommendations.

At the same time, the record of Study analysis, data maps, alternatives considered, implications of various alternatives, and recommended actions constitutes a management program: a report recommending management actions for Southeastern New England. These recommendations, by serving as a guide to decision makers and a basis for future resource analysis, become part of the ongoing process after the Study itself is done.

The following concepts describe the requirements and functions of a level B study. They have been drawn from several sources, including: the Water Resources Planning Act of 1965 and its related guidelines *Principles and Standards,* and several policy statements, various working papers, and special annual reports on the more recent *Section 209* of the Federal Water Pollution Control Act Amendments of 1972, which calls for level B studies for all basins in the United States. These concepts are as follows:

- The Study is the principal vehicle for securing federal, federal-state, and interstate cooperation in the analysis of natural resources management issues on the basis of hydrologic or other regions.

- The Study is designed to draw together existing plans, projects, and other resource management programs at all levels of government.

- The Study is designed to identify major issues and conflicts at regional and subregional levels and to develop the means for dealing with them, including priorities. Problems unresolved, needs unmet, and opportunities foregone, will also be recorded. Problems and needs will be rated in terms of severity; consequences of not solving problems will be indicated.

- The Study serves to provide a uniform purpose for multi-objective efforts by tying these various programs together. The Study is designed to make maximum use of *existing* information arrayed so that it can be economically updated and amended as conditions change. The Study is also designed to use a high degree of judgemental planning.

- The Study is to concentrate on problems of a critical nature in the near- and mid-term periods (1975 to 1990).

- The Study will support land use, coastal zone management, and rural area development planning efforts.

- The Study is designed to identify and examine alternative methods, programs, projects, and uses of water and related land resources. Impacts of a beneficial or adverse nature will be determined only to the extent necessary to ensure the selection of proper alternatives. Plans may vary widely in scope and detail. The Plan should identify those projects and program alternatives which merit further study.

- The Study seeks to provide solutions which achieve positive economic and environmental effects.

- All alternatives must be based on reasonable assumptions of investment capabilities of the federal, state, local, and private concerns who are to carry out the plan. Plans should seek to balance funding commitments among the various levels of government.

Plans must be presented in terms of local desires and priorities, including recognition of the national interest.

The end product will have substantial intrinsic value for many users because the recommended plan should:

- maximize multi-purpose opportunities;
- minimize duplication of future efforts and land use conflicts;
- serve to crystallize public opinion as to desired alternatives;
- show which programs and projects are to be recommended for detailed (level C) planning;
- save money because of coordinated efforts.

The SENE Study has made every attempt to meet the above requirements in a variety of ways. For example, in the water quality chapters, Study participants have used existing state and federal programs, plans, and projects in the formulation of their recommendations. The Study has been designed to identify major water quality issues in the region, among them combined sewer problems and municipal and industrial wastewater discharges. Furthermore, both the economic and environmental effects of recommendations have been considered. In an effort to maximize the efficient use of funds for wastewater management, the Study has recommended the preservation of existing high quality streams and coastal waters as well as the restoration of polluted waters. Each element of the SENE Study has been developed with these kinds of guidelines and requirements in mind.

Other Major Legislative and Ongoing Program Requirements

Since the SENE Study began, several pieces of legislation which reinforce or supplement a number of key Study concepts have been signed into law. For example, the Federal Water Pollution Act Amendments of 1972 call for the consideration of *both* the water supply and water quality aspects of water quality planning. Moreover, they require the examination of the relationship of land use with point and non-point sources of pollution, such as in Section 208. The Coastal Zone Management Act requires definition of areas of particular concern with priorities of permissible water and land uses. The U. S. Congress has also considered, but did not pass, a National Land Use Policy Act. While the Act has not been signed into law, there are several elements in the various versions which were consistent with the approach taken in this level B study. In addition, the Rural Development Act has called for a land and water use and conservation needs inventory.

The above pieces of legislation, together with the National Environmental Policy Act, form the key elements of a policy for natural resources decision making. The New England River Basins Commission has applied these policy elements and appropriate planning requirements to its own process in order to make the SENE Study responsive to the most recent directives to be useful to resource decision makers, particularly on the state level. In addition to these directives, the Study has also drawn particularly on elements of the Federal Flood Insurance Act, the Massachusetts requirement to prepare environmental impact reports, and Massachusetts and Rhode Island laws to protect inland and coastal wetlands.

The basic aspects of the Commission's planning approach to which these legislative program elements apply are: inventory and analysis, alternatives and recommendations, evaluation, and coordination, all of which include public participation. These components will be covered in greater detail in a following section.

NERBC Approach

The Commission's approach to level B planning is to incorporate aspects of all the major legislative directives described in the preceding section. Essential to this approach is the concept of *joint* planning – the product is prepared by federal *and* state participants *with cooperation* from citizens and local officials.

The need for truly joint planning – as required by the Commission's enabling legislation – has been reinforced by several requirements of recent legislation:

- the Secretary of Commerce will not approve a state coastal zone management program unless the views of federal agencies principally affected have been adequately considered;
- federal agencies conducting activities affecting the coastal zone or developmental projects in the coastal zone must ensure that such activities or projects are, to the maximum extent practicable, consistent with approved state management programs; and
- the various land use bills have called for consideration of interstate aspects of land use issues involving two or more states, coordination of management plans for land and water resources in the state's coastal zone, and coordination of the land use program with state, federal, and local agencies, and with state and local agencies in other states for interstate areas.

The Commission, through the SENE Study, has sought to meet these requirements in several ways. For example, the Study has concentrated on regional and interstate issues and conflicts, has attempted to coordinate the actions of federal and state agencies, and has provided an interdisciplinary and comprehensive perspective on resource management problems.

In dealing with the region as a whole, Study planners have *applied uniform criteria throughout the SENE region* allowing a consistent basis for viewing common problems and interstate issues. The Study has drawn on plans and decisions

of local, regional, state, and federal levels of government. In addition, Study planners have taken advantage of complementarities in policies or actions wherever possible and have indicated conflicts wherever appropriate.

The SENE Study: Key Participants

In order to develop recommendations in orderly and efficient manner, the Plan of Study outlined a comprehensive organizational structure for the SENE Study's management and implementation.

The preparation of the Study represents the cooperation of many participants (Table 1). Successful implementation of sound management plans for the region will depend on the involvement of representatives of all levels of government and of private interests. In this spirit, the Study adopted an organizational structure which encouraged participation not only by federal and state agencies – the members of the Commission – but also by regional planning agencies, local governments, and citizens representing a wide range of business, environmental, research, and scientific interests.

Central to the organizational structure is the concept of *joint* planning – federal and state representatives worked together to prepare positive management recommendations for a full range of major resources uses. Agency representatives participated at both the policy and technical levels according to the structure shown in Figure 1.

New England River Basins Commission. The NERBC membership has served as the general policy-making body for the SENE Study. With regard to the Study, the Commission's functions include: (1) developing general policy and objectives, particularly with issues of regionwide significance; (2) requesting adequate funding and manpower for agencies and committees participating in the Study; (3) resolving problems which cannot be handled at lower levels of the SENE Study organizational structure; (4) reviewing and adopting the final recommendations for SENE and transmitting them to the Governors of Massachusetts, Rhode Island, and Connecticut, and to the Water Resources Council for transmittal to the President and Congress.

Coordinating Group. The Coordinating Group (CG) was chaired by the states of Massachusetts and Rhode Island along with the Chairman of the Commission, who presides at the Coordinating Group meetings. Among these members were the Departments of Agriculture, Army, Commerce, Housing and Urban Development, Interior, and Transportation; the Environmental Protection Agency, and the Federal Power Commission. Other representatives worked with the group on an *ad hoc* basis. They included the New England Regional Commission and the Department of the Navy. In addition, the Chariman of the Citizen Advisory Committee served as an *ex officio* member.

The Coordinating Group has been responsible for the policy and overall direction of the SENE Study. In particular, it has been in charge of: (1) the direction, formulation, and

TABLE 1 STUDY PARTICIPANTS

Federal – State
- New England River Basins Commission (NERBC)

Federal
- Department of Agriculture (USDA)
  - Economic Research Service (ERS)
  - Forest Service (FS)
  - Soil Conservation Service (SCS)
- Department of the Army
  - Corps of Engineers (CE)
- Department of Commerce (DOC)
  - Bureau of Domestic Commerce (BDC)
  - Bureau of Economic Analysis (BEA)
  - Maritime Administration (MARAD)
  - National Oceanic & Atmospheric Administration (NOAA) including the National Marine Fisheries Service (NMFS)
- Environmental Protection Agency (EPA)
- Federal Power Commission (FPC)
- Department of Housing and Urban Development (HUD)
- Department of the Interior (DOI)
  - Bureau of Mines (BOM)
  - Bureau of Outdoor Recreation (BOR)
  - Fish and Wildlife Service (USFWS)
  - National Park Service (NPS)
  - U.S. Geological Survey (USGS)
- Department of the Navy (DON)
- Department of Transportation (DOT)
  - U.S. Coast Guard (USCG)

State
- Massachusetts
  - Executive Office of Environmental Affairs
  - Department of Community Affairs
  - Water Resources Commission
- Rhode Island
  - Statewide Planning Program
- Connecticut
  - (Through the NERBC member: Department of Environmental Protection)

Interstate
- New England Regional Commission (NERCOM)

Advisory Groups
- Citizen Advisory Committee (CAC)
- Regional Scientific Task Force (RSTF)
- Basin Advisory Committees (BACs)

selection of the recommendations; and (2) major questions concerning planning methodology, scheduling, interagency planning relationships, budgeting, and resolution of conflicts between alternatives.

Study Management Team. The Study Management Team (SMT) was led by a member of the Commission staff – the Study Manager – and included representatives of the states of Massachusetts and Rhode Island; the Departments of Agriculture, Army, Commerce, Housing and Urban Development, Interior, and Transportation; the Environmental Protection Agency; and the Federal Power Commission. *Ad hoc* members included federal and state agency personnel who worked on the Study but did not have major responsibility for a specific study element. Also working with the SMT were staff members of regional planning agencies, field office personnel of state agencies, and other professionals from academic and research institutions.

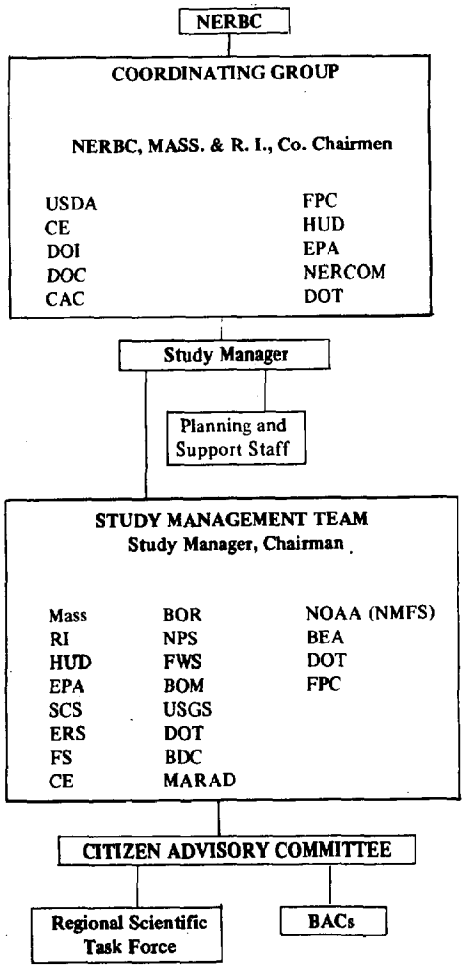

FIGURE 1 SENE STUDY ORGANIZATIONAL STRUCTURE

The SMT, together with the Study Manager and his staff, provided the nucleus for technical direction, coordination, and review of the planning activities. The team had primary responsibility for developing the recommendations and acted as the major technical and decision making body regarding Study organization, operation, and plan development.

Study Manager. The Study Manager was designated by the Commission and had primary responsibility and authority for the day-to-day conduct of the Study. He served as chairman of the Study Management Team and as executive secretary of the Coordinating Group. Members of the Study staff included resource planners, a citizen participation coordinator, and several assistants and secretaries. During the course of the Study, the staff was housed in separate offices at 408 Atlantic Avenue, Boston. These offices will be closed when the final Study reports are forwarded to Washington, D.C. File material will be retained in Commission offices at 55 Court Street, Boston.

Citizen Advisory Committee. Throughout the planning process, the technical experts and staff have incorporated citizen viewpoints into the Study. The regional group of citizen participants, the Citizen Advisory Committee (CAC), includes representatives from conservation, business, industry, real estate, and education. To increase public participation, a group of scientists, the Regional Scientific Task Force (RSTF), was also created, though it merged with the CAC midway through the Study. Members of both the CAC and RSTF were appointed by the Chairman of the Commission.

The function of the CAC has been to give the SENE Coordinating Group a regional perspective on resource problems, their possible solutions, and their priorities. In addition, CAC/RSTF members had a primary responsibility for stimulating citizen involvement in the Study's planning process. Initially the CAC/RSTF membership included two representatives from each of the ten planning areas, plus about a dozen scientists and special interests. Because the meetings were open, the membership gained others over the years, so that eventually the mailing list totalled 65 members.

To accomplish their goals, the CAC/RSTF formed three sub-committees for Goals and Objectives, Public Review, and Public Participation. The Goals and Objectives sub-committee merged with the Public Review sub-committee after its initial purpose was complete. The Public Participation and Public Review sub-committees met periodically to help organize the Basin Advisory Committee meetings (see below). The CAC/RSTF worked on these tasks primarily during quarterly meetings when they discussed the Study's findings from a professional and political viewpoint. Minutes of these meetings – several of which lasted two days – have provided valuable information in shaping the Study's findings. Furthermore, the CAC/RSTF donated their time most

generously in developing and in transmitting review comments to the staff for several versions of the regional and planning area reports.

Basin Advisory Committees. Basin Advisory Committees (BAC's), one for each of the ten planning areas, provided the Study with a representative sampling of local public issues and interests. Members of each BAC include representatives from town offices such as water and sewer commissions, conservation commissions, planning boards, industrial development commissions, and private organizations such as watershed associations, sportsmens' clubs, builders' associations, chambers of commerce, and the League of Women Voters. In all, about 4000 people in the region received invitations to workshops and hearings, and others learned about them through the media.

BAC's met during at least three phases of the Study: early – to define local problems and opportunities; midway – to examine the Study's proposed alternatives; and toward the end of the Study – in informal hearings to comment on the draft recommendations and their correspondence to citizen preferences. A total of 900 citizens had attended the nearly two dozen meetings by the end of the second phase of the Study. Interested citizens received background information prior to the meetings. This was the basis of worksheets and questionnaires which they completed during the meetings. The results of these materials were then tabulated and used in developing the Study's recommendations.

Developing Study Recommendations

The recommendations for Southeastern New England have been derived by a series of planning phases covering three and one-half years. This methodology has been outlined in Section 5 of a separate document entitled the *Plan of Study*, and consists of the following phases:

(1) Develop environmental and socio-economic framework;

(2) Develop resource inventory and analysis;

(3) Formulate preliminary single-purpose alternative plans;

(4) Formulate preliminary multi-purpose alternative plans;

(5) Review and refine preliminary multi-purpose alternatives;

(6) Produce a best economic and a best environmental plan and formulate a recommended plan;

(7) Evaluation; and

(8) Review and transmit recommended plan with major economic and environmental plans detailed to provide a basis for choice.

Each of these phases was designed to include an element of flexibility, allowing changes to be made in the methodology if circumstances during the course of the Study required them. In general, however, the Study was able to conform to these broad guidelines. A brief description of each of the above phases should provide some insight into the development of the SENE Study's recommended program.

(1) Develop Environmental and Socio-Economic Framework. The *Framework* is a two-volume report covering basic Study data and assumptions. It served as the uniform foundation for resource inventory and analysis. Moreover, the *Framework* formed the basis for evaluating plan alternatives and recommendations.

The environmental portion of the *Framework* contains an estimate of the maximum population limits consistent with the existing environmental character of each community in the SENE region. These limits – called environmental holding capacities – were based on a review of wetlands, flood plains, soils characteristics, distribution of open and forested lands, and "amenity zones." Because of a lack of consensus on their accuracy and utility, however, the environmental holding capacity figures were not used during the last phases of the Study. The environmental section of the Framework also contains, in a separate volume, the listings of unique natural and cultural sites for each town in the region.

A second section of the Framework, the socio-economic portion, presents historical population, income, and employment figures, in addition to a description of historical land use patterns. The socio-economic section also contains projections of future trends in the above categories. These figures were originally derived from the OBERS Series C projections developed for the federal Water Resources Council by the Economic Research Service (ERS) of the U.S. Department of Agriculture, in conjunction with the Bureau of Economic Analysis (BEA, formerly the Office of Business Economics) in the U. S. Department of Commerce. Later in the Study, new OBERS projections, SERIES E, were developed by ERS and BEA. These projections represent a continuation of the low population birth rate level which the nation is now experiencing, rather than the higher 1960-1970 national growth rate on which the Series C projections were based. The resulting lower population figures have now been adopted by the Study in all phases of its work.

(2) Develop Resource Inventory Analysis. The SENE region was originally separated into 14 hydrologic units; these were later combined into ten planning areas *(see Figure 2.1, Chapter 2, Regional Report)*:

Ipswich-North Shore
Boston Metropolitan
South Shore
Cape Cod and Islands
Buzzards Bay
Taunton
Blackstone, Ten Mile,
Woonasquatucket-Moshassuck
Pawtuxet
Narragansett Bay
Pawcatuck

During this second phase, the Study Management Team (SMT) gathered water and related land information for each of the ten planning areas and mapped the data at 1 inch = 1 mile. Resource subjects were arranged into 18 study elements, listed in the Plan of Study. The demand for these resources and their availability was also analyzed during this phase of the Study.

The SMT used two mapping scales:

A mapping scale of approximately 1 inch = 1 mile (1:62,500) was selected as appropriate for initial resource analysis. This scale provides a presentation format of manageable size while ensuring that the complex inter-disciplinary problems can be dealt with in a meaningful way.

For reporting purposes, information developed for the 1 inch = 1 mile scale was summarized on maps having a 1 inch = 4 mile scale (1:250,000). These maps were used, along with more detailed information, in the next two phases of Study, to be described below.

Although the identification of individual towns and the relationship of alternative proposals to these towns is somewhat difficult to see at the 1 inch = 4 mile scale, this scale provides a manageable method for determining regional issues and for summarizing elements of the regional plan.

The inventory activity concentrated on obtaining and assembling both qualitative and quantitative resource data, using existing information as much as possible. A list of the maps prepared for the SENE Study may be found in the Data Map Inventory at the end of this chapter.

(3) Formulate Preliminary Single-Purpose Alternative Plans. Drawing upon the inventory data, maps, and analysis, SMT members prepared single-purpose reports for each of the 18 study elements in each of the planning areas. These reports and the agencies responsible for them, are designated "Inventory Reports" in the list of "Material Written for or Contracted by the SENE Study" at the end of this chapter. The single-purpose reports summarized the inventory information and analysis. Moreover, they proposed preliminary alternative actions for each of two future assumptions. The first assumption anticipated a higher level of population growth (OBERS projections) than the second, and placed particular emphasis on meeting economic objectives. The second assumption was based on lower levels of population (Environmental Holding Capacity) and stressed high environmental standards and goals. In the single-purpose reports, these assumptions were known as the *economic and environmental alternative futures,* respectively. These "first-cut" alternatives were formulated solely in response to the needs of each study element. Therefore, the alternatives of one element in many cases lacked a continuity or correspondence with alternatives from other elements. They were, however, an important basis for possible actions and formed the focus for multi-purpose planning. Discussions of the methodologies for many of the single-purpose reports may be found in the last section of this chapter.

During the single-purpose planning phase, an evaluation table was prepared for each set of alternatives. The tables summarized positive and negative aspects of six types of impacts – social, technical, economic (national and regional), environmental (including considerations called for under the National Environmental Policy Act), legal and institutional, and political. This brief evaluation served to sort out alternatives which provided benefits of little or no consequence, while identifying and consolidating complementary alternatives suggested by more than one study element.

(4) Formulate Preliminary Multi-Purpose Alternatives. For the fourth phase of the Study's development, the SMT began to integrate the eighteen study elements into three categories: water use, land use, and water related land use. Integration permitted further identification of complementary planning opportunities, in which alternatives could be formulated to achieve multiple benefits. In preparing three multi-purpose reports (one for each category) for every planning area, the SMT considered regionally significant limiting factors, issues and problems, and evaluation criteria. The members also developed a compatibility matrix showing conflicts and complementarities between single-purpose alternatives and between preliminary multi-purpose alternatives. "Phased alternatives" were also considered in an attempt to resolve conflicts within or among study elements. For example, if a valuable sand and gravel resource conflicted with a proposed reservoir site, the Study could recommend sand and gravel extraction *before, and in conjunction with,* construction of the reservoir. Resource information on 1 inch = 4 mile maps is also contained in each multi-purpose report.

Summaries of the multi-purpose reports served as the basis for discussion at a series of workshops held throughout the SENE region. Through these workshops, the SMT obtained a sense of the problems and issues of importance to the citizens of each planning area.

(5) and (6) Review and Refine Preliminary Multi-purpose Alternatives, Produce Best Economic and Best Environmental Plans, and Formulate a Recommended Plan. As a transitional step between multi-purpose planning and arriving at the recommended plan, the SMT members met for several important working sessions. At these sessions they:

- defined the environmental and economic objectives for the planning areas and for the region as a whole;
- chose specific criteria to be used to evaluate the effectiveness of each plan alternative according to the objectives;
- set out the general and specific assumptions used; and
- specified needs in quantitative and qualitative terms.

SMT members then referred to multi-purpose reports for resources that could be used to meet basin or regional objectives. They considered both structural and non-structural alternatives to meet needs for 1990 and 2020. Where alternatives could not be formulated to completely meet the needs, partial solutions were considered, or the needs were modified (demand reduction alternatives).

During this same period the SMT began working on preparation of regionally significant problems, issues, and alternatives from a multi-purpose viewpoint. Priorities for each objective or component of the objective were established from both a planning area and regional standpoint.

The multi-purpose reports and the preliminary regional planning effort served as the basis for comprehensive planning, the final integrative phase in which a regional perspective was developed and in which recommended alternatives were coordinated across study elements. During this phase, consideration of land use parameters played a major role in integrating single-and multi-purpose information, because they covered Critical Environmental Areas, key facilities, and other factors concerning both resource capability and policy guidance. All these factors have been combined on subregional resource configuration maps which illustrate development capability of lands in SENE. Best preliminary comprehensive alternatives under both future assumptions, called A and B alternatives, were summarized on maps for both areal extensive and site specific actions. These "best plan" maps, together with questionnaires, formed the foundation for discussing alternatives to be chosen for the recommended plan at the "midway" series of citizen workshops held throughout the region in the spring of 1974 (see discussion on *BACs*, above). The questionnaires allowed citizens to choose between alternatives A and B or from their own preferred combinations of actions.

Following these workshops, the SMT and SENE Study staff assembled the two best plans – both policies and specific actions stressing either economic or environmental alternatives – and the recommended plan for the region and the planning areas. More often than not, the recommendations were a combination of both economic and environmental alternatives, providing opportunities for economic development which were nonetheless consistent with the region's environmental standards and goals. Further discussion of the recommendations may be found in *Chapter 1 of the Regional Report, Goals and Approach.*

It is this recommended set of actions and policies for the region and the planning area which serve as the basis for this Regional Report and the 10 Planning Area Reports. They were subject to extensive review during the 90-day public review period and were modified based on comments received from government and non-government reviewers.

(7) Evaluation. Each of the two best plans formulated to maximize either the national economic development objective or the environmental quality objective was evaluated under the four-account system of the Principles and Standards. Using key indicators for each account, Study participants examined the alternatives to determine their implications on national economic efficiency, environmental quality, regional development, and social equity. This evaluation formed the basis of the *Environmental Statement,* also included the Regional Report.

Chapter 11 of the Regional Report, Tying the Recommendations Together, examines the relationship of the SENE Study's recommendations to its stated objective. In addition, the chapter evaluates the Study's objectives in light of 16 water resources criteria. Such an evaluation helps to determine the impact that the SENE Study's recommendations could have on the four accounts of the *Principles and Standards* discussed above.

(8) Review and Transmit Final Plan. The draft Regional Report and the draft Environmental Statement along with the 10 planning area reports were carefully revised during the 90-day review period. Immediately following this review period, a revised report was submitted to the New England River Basins Commission for final review and approval. After additional modification required as a result of the Commission's final review, the SENE Study documents, including recommendations, are being forwarded for subsequent action to the Governors and legislators of the participating states, the federal agencies in the region and in Washington, D. C., and to the U.S. Water Resources Council for transmittal to the President and the Congress.

How the SENE Study Can Be Used by Decision Makers

The SENE Study has been designed to be useful to many interest groups and decision makers at all levels of government. It is essential to point out, however, that the Study cannot be "everything to everyone". Individuals or agencies are bound to disagree with some of the recommendations of this Study, be they specific actions or general policy statements. Nevertheless, the SENE Study is also bound to contain information and recommendations which will be of significant value to the same individuals or agencies. A positive approach to the SENE Study recommendations is imperative. Decision makers should use the information and implement the recommendations with which they feel comfortable. If, however, they disagree with actions or policies recommended in the Study, they must be certain to decide upon a suitable solution for the situation the Study has described. The SENE Study can thus perform a two-fold function: it can serve as a guideline for future resource use, but it can also be a catalyst for additional ideas which may not necessarily coincide with its original recommendations.

Some of the ways in which decision makers can use the SENE Study are outlined below:

- Government agencies at all levels can use Study analysis and recommendations as an information base displaying one overall management picture in which they operate.
- Further, government agencies at all levels can apply the Study perspective to shape and carry out their own coordinated and complementary planning and action programs.
- The New England River Basins Commission and the U. S. Water Resources Council can use the Study results as a component of regional comprehensive, coordinated joint plans.
- The federal Water Resources Council can use Study recommendations as a basis for reviewing the compatibility of individual federal agency plans with comprehensive management programs.
- The federal Office of Management and Budget and the Congress can use Study findings in reviewing and approving authorizations and budgets for actions recommended by the Study.
- States can use the Study as a guide for program and budget decisions by comparing cross functional problems, issues, and possible solutions based on information aggregated at a common level of detail.
- State and federal agencies can use results in judging Study and project proposals of other agencies for their appropriateness and consistency with a comprehensive program.
- States can use the Study as a vehicle for developing their coastal zone management programs as a source of data and recommendations, coordination with other federal and state programs, and as a means of achieving citizen participation.
- State agencies can use Study data and analysis as a means to coordinate and achieve agreement for interstate problem areas or issues, such as defining non-point pollution sources or developing abatement programs under the 1972 Federal Water Pollution Control Act Amendments.
- Study data and analysis can be applied by state agencies in establishing guidelines and criteria for designating and regulating areas of more than local concern.
- States can use the text and maps to develop a list of questions which may be appropriate regarding state and federal environmental impact requirements.
- Citizens can use Study recommendations as a guide for working with federal, state, regional, and local government in effecting management actions.
- Citizens can also use Study data and analysis to make judgements about new action proposals that arise after the Study is completed.

INDIVIDUAL METHODOLOGIES FOR FUNCTIONAL AREAS

The following material summarizes the sources and general methodology used by the various technical experts who participated in the Study. The form in which this material is presented is based on the likelihood that some readers may desire more background on several of the specific techniques or sources used. Further information can be obtained by contacting the New England River Basins Commission or the agencies specified in each discussion.

The Setting, Chapter 2

Economic material in this chapter was based upon a number of special economic reports prepared for the Study: *Economic Considerations for Water and Related Land Use Planning in Southeastern New England* by Thomas Grigalunas, University of Rhode Island Department of Resource Economics; *Considerations Relative to the Intro-*

duction of Economic Criteria into the SENE Study, by Barry C. Field, University of Massachusetts Department of Resource Economics; and *An Economic Analysis of Coastal Resource Allocation in Southeastern New England*, by Gregory A. Vaut, University of Rhode Island Department of Resource Economics.

Guiding Growth, Chapter 3

This discussion describes the following: (1) development pressure, tabular land use data, and environmental holding capacity in order to provide some background information; next it describes (2) critical environmental and management areas. The classification of resources by the system used in this Study is fundamental to most of the recommendations found in other chapters in the SENE Study reports.

Development Pressure

The development pressure measure formulated was used in the report as a general indicator of priority need for recommended actions.

The seven indices listed in *Chapter 3* were adapted by Justin Gray Associates from a model used by the Federal Highway Administration for making population and employment projections. The auto accessibility index was computed for 1970 by the U. S. Department of Agriculture by the Economic Research Service using factors related to size of municipalities and the travel time between communities. The communities were ranked for each variable and the ranks were summed to establish composite ranks. The communities were then divided into categories.

Finally, development districts which described areas which would likely continue to contain urban growth including infrastructure were established at one point during the Study. An approach which would have concentrated regional growth within areas of existing development was brought before Study participants for discussion. The objective was to achieve the greatest efficiency in the use of existing infrastructure, to protect critical environmental areas, and to allow time to develop growth plans for the remaining area. This concept was not used in the recommended program for a number of reasons. The objectives were achievable through much less drastic means. The excess capacity of the region's infrastructure is no greater within the defined development district than outside the districts, and protection of critical areas is more efficiently done through direct measures aimed at those areas. Limiting development to certain communities would create socio-economic implications and political and legal questions that made the concept unfeasible in the form in which it was developed.

Tabular Land Use Data. The first stages of work involved the gathering of data and the development of a conceptual framework. Data in the form of statistics were assembled by the Economic Research Service of the U. S. Department of Agriculture; this is the source of statistics for the tables included in the chapter.

The 1971 aerial photo survey conducted by Dr. MacConnell of the University of Massachusetts was used for the land use inventory, data collected in 1960 were interpolated using MacConnell's 1951 survey data, the 1971-1972 data, and several 1960-65 surveys done by other sources for portions of the area. Originally, the 1971 MacConnell survey contained 110 land use categories. That classification system was modified by the NERBC staff for direct use in a level B water and related land resources study which required a system useful for the 1:62,500 rather than the 1:24,000 mapping scale. The 110 categories were grouped into 19 categories. Of particular importance was a modification made to the residential land uses, in which four categories of residential uses were broken out. These categories permit the water resources planners to make inferential statements about the existing land use configuration and the likelihood that sewers or public water systems will be necessary, based on density. Further information on the uses of this 1 inch = 1 mile information is available at NERBC.

Environmental Holding Capacity. During the planning process, concepts were developed to establish population capacities for each municipality as a basis for functional single-purpose planning. A measure of the Environmental Holding Capacity of each community was developed to establish its population capacities. These capacity figures were used in some of the single-purpose reports, particularly for estimating water supply needs. A system was formulated by the University of Massachusetts (under contract with the National Park Service), using Community Functional Environments and amounts of developable land. More information on the technique used can be obtained from the *Environmental Base Study*. A later elaboration by Justin Gray Associates and the University of Massachusetts (under contract with the National Park Service) considered amounts of different categories of developable land with varying development capacities and development pressures. Neither of these systems was used in the final report to express population ceilings for communities. However, the EHC concept contributed to the Study's determinations of development capacity by approximating the balance between various degrees of land development and resource protection.

Critical Environmental Areas and Management Areas.

On the basis of five criteria, discussed in *Chapter 3*, water and related land resources in the SENE region were grouped into one of three major development capability classifications: Critical Environmental Areas Requiring

Protection; Developable Areas Requiring Management; and Preempted Use Areas. Within these classifications, there are seven sub-categories, labeled A through G which further describe development capabilities. The information for each of the resource categories was developed by a number of agencies using existing data and surveys to produce 1 inch = 1 mile (1:62,500) scale maps. The selection of the factors used to classify the resources was influenced both by the Study Management Team and the Citizens Advisory Committee. The following resources are among those classified.

Critical Environmental Areas Requiring Protection.

Wetlands (Category A). Open wetlands were mapped through aerial photographic interpretation by Dr. Mac Connell of the University of Massachusetts from 1971 aerial photos. Wooded wetlands were added by the U. S. Army Corps of Engineers from U. S. Geological Survey maps. Generally, only those wetlands over 20 acres were mapped in this Study, except in some cases where a large number of smaller wetlands located in the same area increased their significance.

Well sites (Category A). Well sites were mapped by the U. S. Geological Survey (USGS) from their data files and existing records, except in the Massachusetts portion of the Blackstone basin and in the Ipswich-North Shore planning area, where field checks were made. On Cape Cod, water superintendents and consulting engineers provided new information. Reports developed by the Environmental Protection Agency were also used.

Beaches (Category A). Beaches were identified through aerial photographic interpretation by Dr. MacConnell of the University of Massachusetts, from 1971 aerial photos. Beaches were also identified by the U. S. Army Corps of Engineers from field inspections and from U. S. Geological Survey topographic maps.

Critical erosion areas (Category A). The U. S. Army Corps of Engineers identified critical erosion areas from previous reports and from low level oblique aerial photographs of the coastline.

Flood plains (Category B). Using existing data from large-scale mapping efforts, along with methods which approximated depths of flooding in unmapped areas, the U. S. Army Corps of Engineers and the U. S. Department of Agriculture, Soil Conservation Service (SCS) developed the limits of the 100-year flood plain on U. S. Geological Survey (USGS) quadrangle sheets. Field checks were made to determine any changes since the USGS maps were published.

Class I and II prime agricultural soils (Category B). The U. S. Department of Agriculture, Soil Conservation Service (SCS) mapped prime agricultural soils. Class I and II soils identified by SCS soils data were correlated with land use data (see Urban Lands discussion, this section) to determine those in agricultural or other open use. In this Study, those lands over 50 acres in size were mapped.

In addition, the U. S. Forest Service (U.S.D.A.) also conducted an analysis of forest land suitability using the mapped land use data described in the section entitled "Tabular Land Use Data." An index of forest land suitability was assigned to each town and also summarized for each of the ten planning areas for five potential uses:

(1) Dispersed recreation use capacity;

(2) Wood products production capability;

(3) Wildlife habitat potential;

(4) Natural amenities and landscape variety (environmental influence); and,

(5) Waste water renovation capacity (spray effluent).

The criteria for assessing forest land suitabilities in the SENE Study included, but need not be limited to, the following factors:

- Total forested area, in acres
- The functional environmental index
- Tree heights
- Density
- Percent of hardwood cover
- Miles of forest edge (open/forest, water/forest, river/forest, and wetland, water and river/forest)
- Major soil types in each town
- Predominate forest cover type and their number
- Number of unique natural sites
- Number of ground water wells
- Aquifer recharge potential
- Acres devoted to wood products production
- Extensive uses of forest land (wood products, surface water and underdeveloped areas)

Based on the above analysis each of the ten planning areas was rated from poor to fair to good and low to medium to high, as applicable, for each of the following forest land use

suitabilities: efficient recreation, wildlife, wood products, and environmental influence.

Unique natural and cultural sites (Category B). These sites were mapped for the National Park Service (U. S. Department of the Interior) by the University of Massachusetts Department of Landscape Architecture and Regional Planning. Unique sites were identified on the basis of existing information which various agencies or experts felt were of cultural or special value to society. One of the sources used was the New England Natural Resources Center's information. Criteria used for identification and other sources consulted are listed in the *Environmental Base Study,* completed by the Department of the Interior, which is on file at the New England River Basins Commission.

Developable Areas Requiring Management.

High yield aquifers (Category C). High yield aquifers were mapped by U. S. Geological Survey from their records, except in the Massachusetts portion of Blackstone basin where reconnaissance mapping of stratified drift areas was carried out. The maps show stratified glacial deposits most favorable for wells capable of yielding 300 gallons per minute (gpm) or more, except in the Cape and Islands, Blackstone, Woonasquatucket, and Narragansett Bay basins, where different definitions were used, due to variations in hydrology (see USGS studies for more detail). Aquifers shown are normally *prime* recharge areas; additional areas adjacent to these may also be recharge areas for these aquifers.

Best upland wildlife habitat (Category C_2). These lands were identified by the U. S. Fish and Wildlife Service (U. S. Department of the Interior) as those corridor areas exhibiting the greatest habitat diversity (based on the relationship of water bodies in conjunction with wetlands, forests, or farm lands, and soil productivity), thereby having the greatest potential for wildlife species diversity. These corridors are generally along major rivers.

Landscape quality areas (Category C_3). Members of the Department of Landscape Architecture and Regional Planning at the University of Massachusetts determined and mapped landscape quality areas. Using a one mile square grid, visual and cultural qualities were judged for each square mile on the basis of: (a) diversity of land use; (b) change in elevation between the highest and lowest points; and (c) number of unique sites present (see discussion above and also the *Environmental Base Study).*

Severe, moderate, or no septic system limitations. (Category C_4, F and G). Data on soils were compiled by the Soil Conservation Service from their survey data. Soils categorized as having severe septic system limitations due to slow permeability, excess wetness, or stones, are listed and described in the single purpose general soils report.

Ledge and/or steep slope (Category C_5). Soils with ledge within three feet of, or on, the surface, and soils with slopes of over 15 percent, were identified by the U. S. Department of Agriculture Soil Conservation Service from their survey data.

Preempted Use Areas.

Urban areas (Category E). Urban areas were mapped through aerial photographic interpretation by Dr. MacConnell of the University of Massachusetts, from 1971 aerial photographs. The original classification system used at 1:24,000 was collapsed to 19 mapping categories for single-purpose report maps at one inch = one mile (1:62,500) scale. The four residential categories as well as commercial, industrial, and institutional land uses were combined into one category – urban areas – for the one inch = two mile (1:125,000) Development Capabilities Maps (plates 1, 2, and 3).

Production of Development Capability Maps

Production of the Development Capability maps began by combining the single-purpose resource maps into three maps for each planning area. Mapping categories included "Critical Environmental Areas", consisting of all A and B resources (B resources included those overlapping with A resources) and "Developable Areas", consisting of all C, F, and G resources (including those overlapping with A, B, and other C resources). Complete definitions of all the above-mentioned resources may be found in *Chapter 3 of the Regional Report.*

On the 1 inch = 2 mile scale of the Development Capability Maps, the A resources were mapped first. B resources were then mapped, eliminating any B areas overlapping A areas. Next C resources were mapped, eliminating C areas overlapping A or B resources.

The definitions and the data sources used for the mapping of each category have been described above. The principles and the resulting classification system used in the SENE Study are transferable elsewhere in the nation. For example, those definitions of *A, B,* and the *C* categories dealing with soil or geological characteristics are transferable to any area outside SENE. However, *upland wildlife habitat* and *high landscape quality* are examples of those characteristics which have been defined on the basis of the attributes of the SENE region; they would probably require modification for areas outside of SENE where resource characteristics might differ.

Water Supply, Chapter 4

Development of a recommended water supply program for the SENE Study area began with the collection by the U. S. Environmental Protection Agency of base year inventory

data from records of the Massachusetts Department of Environmental Quality Engineering (the former Department of Public Health), the Rhode Island Department of Health, and the Rhode Island Water Resources Board; regional planning reports published from 1968 to 1973; and telephone contacts with a number of water supply superintendents throughout the area. Information on 1970 average and maximum day water demands, population served, and production capacity was collected for each public water system in the region and special note made of particular problem areas. Use was also made of a SENE Study Corps of Engineers report on Climatology and Hydrology, which included information on climatology, streamflow, peak discharge frequencies, rainfall analysis, low flow duration studies, and the development of storage-yield relationships. Based on population projections provided by the Bureau of Economic Analysis, U. S. Department of Commerce, 1990 and 2020 water demands for all area towns were estimated using three different methods. These included two methods developed by the U. S. Army Corps of Engineers, one using the North Atlantic Regional Regression Equation (NARRE), another a 1 percent annual increase in daily per capita consumption. Because the *1 percent method consistently yielded the highest estimates* of demand when applied to future population numbers, *this approach was selected for safety's sake.* In addition, an approach which assumed a 0.5 percent annual increase in per capita water consumption *after* 1990 was also used for some 2020 demand projections.

Description of the ground water resources in SENE was provided by the U. S. Geological Survey. A literature search and review was made for each of the SENE planning areas, and reports summarizing the physical description of the ground water hydrology and its physical interrelationships with other resources were prepared for each planning area. Municipal ground water supply quality and quantity information for the 1970 base year was obtained from U. S. Geological Survey records, state agencies, and other sources.

Analysis of favorability for ground water development to meet future needs were made on a town by town basis. The additional maximum day demands for 1990 were compared to the areas of undeveloped aquifers in each municipality, potential infiltration recharge to these aquifers, hydraulic conductivity and thickness of the aquifers, and the record of exploratory investigations in these and geologically similar aquifers.

Existing and potential ground water and ground water related management problems, conflicts, and opportunities were identified and explained. Various possible alternative solutions to these were sought in hydrologic literature, and adapted and presented in the ground water management reports.

After future demands were compared to existing safe yields and present pumping capacities of surface sources and ground water systems, respectively, and after additional needs were calculated, a survey of planning reports published between 1960 and 1973 was conducted. This survey identified proposals designed to supply water to different areas within the SENE region. Alternative plans obtained from the survey, with some additions and modifications, were then evaluated in light of the following planning goals: (1) A sufficient quantity of water to supply projected 1990 demands (maximum day demands in communities relying solely on ground water sources); (2) A high quality supply, free from potential sources of contamination; (3) The most efficient allocation of local and regional water supply resources; (4) Maximization of local and regional economic efficiency; and (5) Maintenance and enhancement of existing environmental quality.

Input from the citizens participation program and using the planners' best professional judgements, selected alternatives were combined in a recommended water supply plan for the region which best fulfilled the planning goals within the restraints of ongoing programs.

Water Quality, Chapter 5

The first step in development of the water quality program was an inventory of the current status of conditions and proposals. This consisted of a review of state reports on water quality standards throughout the region and a compilation of municipal treatment plant data contained in state and regional planning agency reports. Industrial discharges were likewise compiled using federal discharge permit applications and information gathered from state reports and personnel. Continuous updating has been done as more current information has been made available from ongoing state efforts.

The next step in the plan development process consisted of a review of all available planning which had been done in the region pertaining to water quality control. A major input was water and sewer planning done for the U. S. Department of Housing and Urban Development by regional planning agencies. These plans, design projects for specific construction works, and state "basin plans" were reviewed and their adequacy assessed with respect to the requirements and goals of the Federal Water Pollution Control Act Amendments of 1972. In addition, social, technical, environmental, economic, political, institutional, and other legal aspects of each alternative were considered, as well as input from the citizen participation program.

Outdoor Recreation, Chapter 6

The first step in preparing the recreation components for the SENE Study was an inventory of existing resources done by the Department of Interior, Bureau of Outdoor Recreation (BOR). Prime sources of *supply* information for both

states were the State Comprehensive Outdoor Recreation Plans (SCORPs). Other sources supplemented these figures, such as town plans and campground directories for private supply information. Where voids or inconsistencies in data existed an averaging process was utilized.

Three major factors were used to estimate *demand* for recreation facilities in terms of activity days: projected per capita participation rates in selected activities, population, and a facility coefficient to estimate the percentage of demand to be met by specific facilities. Participation rates were based on the North Atlantic Regional (NAR) Study which, in turn, was derived from the census data reported in the 1965 Survey of Outdoor Recreation for New England. (For further explanation of these procedures, see the Planning Aid Report, *Outdoor Recreation Needs,* available at NERBC or in the BOR Northeast Office files.) Projected facility requirements (demand) as established by the above method was then compared to supply as inventoried in order to determine future needs.

A number of recreation related problems warranted more detailed study and the following planning aid reports were prepared by BOR: *An Urban Perspective: A Conceptual Trail System, Scenic and Recreational Rivers;* and *The Private Sector in Outdoor Recreation.*

In evaluating alternatives, an estimate was made by BOR of annual recreation benefits (in dollars), and other social, environmental, and indirect economic benefits; BOR also made estimates of acquisition, development, and other indirect costs. The dollar benefit values were assigned to recreation days on the basis of the following factors: the quality of the activity; the degree to which opportunities to engage in a number of activities are provided; proximity to urban concentration; and the uniqueness of the resource and availability of water-oriented recreation opportunities.

The recommendations were made on the basis of this evaluation and considering the promimity to urban need concentration, and on the quality of the resource. The program was aimed at balancing these latter two elements – as well as providing "in-city" and "near-city" recreation opportunities, and protecting and using these areas of outstanding quality wherever they occur.

Boating. A complete inventory of recreational boating facilities and the existing fleet, by harbor, was carried out by the U. S. Army Corps of Engineers. This was made from a series of low level oblique aerial photographs taken of all recreational harbors and mooring areas along the Massachusetts and Rhode Island coast. The increased demand for each planning area was determined assuming that the percentage of the population creating the demand in 1990 would be approximately the same as in 1970. Investigations of potential sites for increasing boating capacity were made, using maps and coast charts, aerial photographs, and existing data on channel conditions.

Salt Water Fishing. Recreational salt water fishing data were collected by the U. S. Fish and Wildlife Service (USFWS). Aerial surveys and ground checks done by the Massachusetts Division of Marine Fisheries documented numbers of fish and boats, and Rhode Island reports covered present use data. Projections were based on the proportion of population forming the demand reported by the *1970 National Survey of Fishing and Hunting.* Alternatives and recommendations stemmed from interviews with state personnel. The National Marine Fisheries Service (NMFS) also provided information from a report on marine sportfishing within the study of Marine Resources of the Offshore and Coastal Zone of Massachusetts and Rhode Island. Data were obtained from the NMFS laboratory in New Jersey.

Hunting and Fishing. Demand for hunting and fresh water fishing was measured by USFWS using New England participation rates reported in the 1970 National Survey of Fishing and Hunting, license sales data, numbers of unlicensed fishermen and hunters. Demands for nonconsumptive use of fish and wildlife were estimated on the basis of national participation rates reported in the same report.

Swimming. Existing state and local plans were used by BOR to identify potential solutions for general recreation deficiencies. For swimming, field reconnaissance was undertaken to evaluate both existing and potential resources. The Corps of Engineers identified coastal beaches with potential for being developed by sand nourishment, erosion protection, and provision of facilities.

Marine Management, Chapter 7

The activities in connection with the various subjects discussed in the Marine Management Chapter took place in the context of comprehensive and joint planning as described earlier in this chapter. The main sources of information used are described below.

Offshore Fisheries. A study of Marine Resources of the Offshore and Coastal Zone of Massachusetts and Rhode Island was prepared by the National Marine Fisheries Service (NMFS) using internal data and data from the International Commission for Northwest Atlantic Fisheries.

Shellfish and Aquaculture. The main source of information was the NMFS *Marine Resources Study,* license sales statistics, town maps in some areas including Cape Cod, and reports of the Division of Marine Fisheries on major harbors and estuaries. In Rhode Island, a full survey was made of Narragansett Bay, and commercial harvest figures and various studies were used. State shellfish wardens were interviewed in both states. Data on aquaculture, also contained in the *Marine Resources Study,* were obtained by the National Marine Fisheries Service from Marine Research Incorporated, in Wareham, Massachusetts.

Port Development. The U. S. Army Corps of Engineers reviewed water-borne commerce statistics for the SENE ports and adjacent ports. Using past trends and projections for economic growth, future demands for commercial navigation were developed. An analysis of existing channels and port facilities was then accomplished to determine their capability for meeting future demands.

The NMFS report on *Ocean Disposal,* part of the Marine Resources Study, covered disposal of dredged materials at offshore sites. Data for this report were obtained primarily from EPA publications. Possible site locations for inland disposal were studied by the U. S. Army Cold Regions Research and Engineering Laboratory (CRREL) and the New England Division Corps of Engineers (NED). This was an independent project aided by SENE funds. CRREL and NED, using aerial photographs for the Boston Harbor and Narragansett Bay areas, identified possible disposal sites up to three miles inland and in a zone 3 to 15 miles from shore.

The dredged materials disposal sites have been identified using NASA RB-57 photograph images flown at 60,000 feet with a resolution of 15 feet. Each identified site is to provide a data base for specific proposals for land disposal of dredged materials. Because the composition of dredged materials can vary within the limits of each dredging project, detailed evaluation of possible dredged materials disposal sites is not possible until the proposed dredged materials are analyzed. However, the final report may contain general recommendations demonstrating how the study data can be used to help locate potential sites for dispostal of dredged materials in the SENE region.

Offshore Sand and Gravel. NERBC and NMFS using available information such as reports produced by the Coastal Resources Center at the University of Rhode Island developed the content of this portion of the Marine Management chapter.

Urban Waterfronts. Information for this portion of the chapter was developed by Skidmore, Owings and Merrill on contract to NERBC. Much of the material, obtained by personal interview, is available in the *Urban Waters Special Study,* available at the NERBC offices.

Flooding and Erosion, Chapter 8

The U. S. Army Corps of Engineers completed a hydrological analysis based on a review of records for each major stream. This included river flow data from USGS gauging stations, recorded high water marks from past floods, and descriptive material on past floods. Using these data, the known hydrologic characteristics, and projected growth in each river basin, estimated flood levels for a 100-year frequency flood were determined. Flood plain delineation was carried out by the Corps for mainstream rivers and major tributaries and by the Soil Conservation Service for PL-566 areas and other tributaries (usually less than 5 square miles of drainage area).

The next step was to evaluate the flood damage in the 10 planning areas. Available damage figures from past floods were updated to reflect new flood protection projects and additional development in flood prone areas. Damage figures were obtained from flood control studies where they have been recently completed, or from rough estimates made on the basis of a field check.

An analysis was then made of the wetlands in each basin as they related to flood damages. The area of each wetland on the maps was measured (for wetlands approximately 20 acres or larger) and the total wetland area for each town and drainage basin was compiled. Large wetland complexes were identified and basins in which wetlands play an important role in minimizing flood damage were identified. A general evaluation of the wetlands in each basin was developed, and alternatives were formulated to provide a framework for evaluating the importance of each wetland.

Use was also made of a Crops of Engineers report on *The Effects of Urbanization on Peak Runoff.* This report develops a method of determining the increased flood heights caused by the increased urbanization within a watershed. A table showing the increased flood heights expected at 16 USGS gauging stations in 1990 using the SENE population projections was compiled.

Finally, possible solutions were investigated. These solutions included flood control dams, walls and dikes, flood water diversions and channel modifications. Non-structural solutions were also investigated, particularly for areas where damages had not yet reached serious proportions. These included flood plain zoning, preservation of natural valley storage, flood proofing, early warning systems, and removal of flood prone structures. Recommendations were made to either reduce flood damages or prevent a significant increase of damages.

Tidal flooding was investigated by the Corps of Engineers by comparing damages from past storms to those that would be expected in a recurrence of similar storms. Prior Corps of Engineers reports on tidal flooding were reviewed and any changes that have occurred since they were published were noted. In areas where federally-supported structural protection was not feasible, alternative approaches for flood damage reduction were considered. These consisted of various structural and non-structural solutions for state and local governments. Locations of areas of coastal erosion were identified by reviewing existing reports on coastal erosion, which covered only limited sections of the coastline, and by aerial observation of the rest of the coastline. An engineer with experience in coastal erosion flew the Massachusetts and Rhode Island coastline, and a series of low level oblique aerial photographs were taken. Once the

seriousness of the erosion was determined, general alternative approaches to minimize the harmful effects of this erosion were developed.

Upland erosion and sedimentation data and alternatives were supplied by the U. S. Department of Agriculture, Soil Conservation Service, with the assistance of the U. S. Forest Service and the Economic Research Service.

Locating Key Facilities, Chapter 9

Onshore Sand and Gravel. A survey was made by the U.S. Department of the Interior, Bureau of Mines, of the mineral producers within the Study area, to obtain information pertaining to supply and demand, environmental factors, and water and land use. Overlay maps of potential resource locations were prepared from published and unpublished U. S. Geological Survey surficial geology and ground water maps, and a Rhode Island aggregate survey report. Zoning regulations available from the Massachusetts Division of Natural Resources and the Rhode Island Statewide Planning Program were used in the portion of the report covering regulations affecting the mineral industry.

Two methods were used to develop projected demand for aggregate calculated for benchmark years to 2020. A straight-line projection of tons produced in the years 1959-1970, based on U. S. Bureau of Mines data, is headed "low projection". The second projection, calculated by using regression analysis of tons of sand and gravel produced (dependent variable) against OBERS Series C projections of population (independent variable) for the same period, is headed "high projection".

A special report prepared by J. Sutinen and L. Nicholson of the University of Rhode Island, Department of Resource Economics, *The Economics of Sand and Gravel Mining in Southeastern New England* was also used.

Electrical Power. A single purpose plan report on power was prepared by the Federal Power Commission, New York Regional Office, which contains descriptions of sources and criteria used. A special report *"The Economics of Power Plant Siting in Southeastern New England"* was prepared by J. M. Gates, N. F. Meade, and J. G. Sutinen of the University of Rhode Island Department of Resource Economics. Reports prepared by the University of Rhode Island Coastal Resources Center on power plant site considerations at Charlestown, Rhode Island were also used.

Petroleum. Studies providing background material and data included the MIT Georges Bank Petroleum Study and subsequent related Sea Grant Studies, the NERBC Regional Report entitled *"The Oil Issue"* (vol. 5, no. 2, 12/73), the National Marine Fisheries Service Report on oil and gas included in the Study of Marine Resources of the Offshore and Coastal Zone of Massachusetts and Rhode Island. A report on petroleum included in the single purpose navigation study and a study prepared for the Massachusetts Port Authority by Arthur D. Little, Inc., Raytheon, and Frederic R. Horres, Inc.: *A Preliminary Economic and Environmental Study of Alternative Methods of Supplying Petroleum Products to Eastern Massachusetts.*

Solid Waste. A special study prepared by Thomas Pontes *"A Solid Waste Management Review of the Southeastern New England Region"*, was the basis for the Study's recommendations along with reports prepared by the states of Massachusetts and Rhode Island and by regional planning agencies.

Strengthening the Management System for Natural Resources, Chapter 10

The Legal and Institutional element of the SENE Study investigated first the legal and institutional implications of specific recommendations of the SENE program as well as selected issues which the program attempts to address. Secondly, it sought to develop information relating to the means by which the program may be implemented.

To meet these objectives, a preliminary analysis of tentative recommendations was conducted to identify selected issues and particular recommendations requiring legal and/or institutional study. Once identified, this information was framed in five major subject areas, namely: *the Design of a Legal and Institutional Structure for Management of Significant Water Resources; Wetlands Administration; Fiscal Policy and Water Related Land Use Controls; Methods to Ensure Access to Natural Resource Areas; and Proposed Legislation Relevant to the SENE Study.* NERBC contracted with consultants for the preparation of reports on each of the above issues. These reports consisted essentially of review and critique of existing laws and institutions of relevance to the particular topic. Once prepared, these reports were reviewed by the NERBC – SENE Staff and appropriate Study Management Team members. They form the basis for discussion of legal and institutional ramifications of specific recommendations in the various functional chapters of the Regional Report.

On a second level, after preliminary review of substantive Study findings, the legal and institutional framework was identified which enabled the major Study findings to be carried out. After sketching the parameters of this effort, the Study contracted with two consultants, one of whom was charged with the responsibility for the design of institutional arrangements and the other was given responsibility for identifying an implementation process or strategy. Material was prepared based on consultation with state and federal officials and agencies and on appropriate laws and

legislative documents. Revisions were made as a result of review by the Study participants in the course of an overall review of the SENE Study program. This material forms the basis of *Chapter 10 of the Regional Report.*

Tying the Recommendations Together, Chapter 11

This chapter synthesizes the evaluation process used throughout the Study, the framework for which has been described in the first portion of the Methodology. The Study Management Team prepared several versions of matrices which were used to evaluate the compatibility and conflicts and positive and negative impacts of: recommendations to various land use categories; recommendations to objectives; and recommendations and priorities for planning areas and for the SENE region.

The material contained in *Chapter 11* is the result of work by several consultants as well as the NERBC–SENE staff, based on information developed initially by the Study Management Team.

MATERIAL WRITTEN FOR OR CONTRACTED BY THE SENE STUDY

The following list of documents and maps represents the material which was produced during the course of the SENE Study. This list is organized by subject, following the order of the chapters in the Regional Report. General Information and Citizen Participation publications are also included at the end of the list.

The Inventory Reports listed under most of the chapter headings are single-purpose reports covering functional areas such as water supply, water quality, outdoor recreation, etc. Inventory reports on the subjects listed below are available for each of the ten planning areas in the SENE region (e.g., Ipswich-North Shore, Boston Metropolitan, South Shore, Cape Cod, Buzzards Bay, Taunton, Blackstone and Vicinity, Pawtuxet, Narragansett Bay, Pawcatuck). The number in parentheses which follows each listed Inventory Report is its "Study Element" number. For example, the Inventory Report on Related Land (under *The Setting – Chapter 2)* is Study Element 2.02. These numbers are an internal code used during the course of the Study for reference purposes.

Multi-purpose reports, listed under *Guiding Growth, Chapter 3,* were prepared to integrate the single purpose reports into three categories: Water Use, Land Use, and Water Related Land Use. These three types of reports are also available for each of the Study's ten planning areas.

Abbreviations have been used to indicate many of the agencies which produced reports or maps. The full titles of these agencies may be found on Table 1 of this chapter.

Goals and Approach – Chapter 1

Southeastern New England Water and Related Resources Study; Plan of Study, Vols. I & II, April, 1972.

The Setting – Chapter 2

Base Reports

Environmental Quality Elements of a Water and Related Land Resources Plan; Ervin H. Zube, Amherst, Mass., June, 1971

Environmental Base Study; University of Massachusetts, for the National Park Service; August 1972

Socio-Economic and Environmental Framework, Vol. 1: Base Report; Vol. II, Tables; March 1973

Data Books and Population Projections (adjusted OBERS and Environmental Futures projections) SENE, June, 1974

Inventory Reports

Climate, Meteorology, Hydrology, Water Quality, Geology and Ground Water Availability, Producing Agencies: CE, SCS, USGS, EPA (2.01)

Related Land, Producing Agencies: SCS, USGS, CE, HUD. (2.02)

Special Reports, Economic

Economic Considerations for Water and Related Land Use Planning in Southeastern New England, Thomas Grigalunas, Department of Resource Economics at the University of Rhode Island; June, 1973

Considerations Relative to the Introduction of Economic Criteria into the SENE Study, Barry C. Field; Sept. 1973

Data Maps

SURFICIAL GEOLOGY (drift, till, marsh) [1:250,000]. Sources: Corps of Engineers files, USGS map for glacio-fluvial deposits, Producing Agency: CE. (3.03)

INDIVIDUAL BASINS [1:62,500]. Set of 21 maps made from a composite of USGS quadrangle maps without topography. Maps cover each river basin and the coastal zone in SENE. Title blocks and borders are included. Sheet size of 30 x 40". Producing Agency: NERBC.

SENE Area [1:250,000]. One map each showing basin boundaries, major rivers, state boundaries. Sheet size 34 x 32". Producing Agency: NERBC.

SENE Area [1" = approx. 4.8 mi.]. Entire area with basin boundaries delineated in red, rivers delineated in black, and basin names in red. Sheet size 24 x 36". Producing Agency: NERBC.

SENE POPULATION CENTERS [1" = approx. 5 mi.]. Shows study area boundary, major cities by name with 1970 population figures next to the name. Producing Agency: NERBC.

POPULATION DENSITY [1" = approx. 5 mi.]. Overlay showing SENE with five categories of population density. Producing Agency: NERBC.

RIVER BASINS [1" = approx. 5 mi.]. Delineates and names all river basins in the SENE Study area. Producing Agency: NERBC.

NERBC REGION [page size]. Map of New England delineating the 11 major basin areas. Producing Agency: NERBC.

USGS QUADRANGLE INDEX MAP [1:125,000] Quadrangles delineated within the basins. Producing Agency: FS.

WATERSHED BOUNDARIES [1:24,000] Hydrologic boundaries on USGS maps for Mass. only. Producing Agency: SCS.

Guiding Growth – Chapter 3

Inventory Reports

Land Use Patterns, Allocations, and Management: MAPC Consulting for Dept. Housing and Urban Development. (3.06)

Multi-purpose Reports

Water Use for each planning area

Land Use for each planning area

Water Related Land Use for each planning area

Summaries of each of these reports are also available

Special Studies

Remote Sensing Land Use and Vegetative Cover in Rhode Island, William P. MacConnell, Department of Forestry and Wildlife Management, University of Massachusetts, 1974. (3.05)

Data Maps

RELATED LAND – SOILS – GENERAL SOILS (23 classifications) [1:62,500]. Sources: Existing Soils Survey Reports, Field Mapping sheets and field trips. Producing Agency: SCS.

RELATED LAND – SOILS: SLOPE [1:62,500]. (0-8°,8-15°, 15° and greater, unclassified urban). Sources: Interpretation from General Soils map and USGS Quad Sheets 1:24,000. Producing Agency: SCS.

RELATED LAND – DEPTH TO BEDROCK (dominant soils, 3 feet; co-dominant soils, 3 feet; dominant and co-dominant soils, 3 feet; unclassified) [1:62,500]. Sources: (Same as above). Producing Agency: SCS.

RELATED LANDS – DEPTH OF SEASONAL HIGH WATER TABLE (shallow; deep and moderately shallow; deep to shallow; deep; unclassified). Sources: (Same as above). Producing Agency: SCS.

LAND USE PATTERNS, ALLOCATIONS AND MANAGEMENT – LAND USE [1:62,500] – One for each of 10 planning areas.

1 – Residential One (R1)
[less than ¼ acre lots plus multi-family, apts., tenements, etc. – greater than 4 dwelling units/acre];
2 – Residential Two (R2)
[single and multi-family if they cannot be separated on ¼ to ½ acre lots – 24 dwelling units/acre]
3 – Residential Three (R3)
[single family on lots greater than ½ acre including 1 acre lots and clusters of homes in rural areas – less than 2 dus to 1 dwelling unit/acre];
4 – Residential Four (R4)
[lots larger than 1 acre and estates of 3 acres and more – less than 1 dwelling unit/acre];
5 – Commercial (C);
6 – Industrial (I)

7 – Extractive (E)
8 – Transportation (T)
9 – Public, Institutional (PI)
10 – Open Space Recreational (OSR)
11 – Agriculture – Cropland (AC)
12 – Agriculture – Pastureland (AP)
13 – Forest (F)
14 – Open Transitional Land (OT)
15 – Disposal Sites (DS)
16 – Wetlands Inland (WI)
17 – Wooded Wetland (WW)
18 – Wetlands Salt Water (WS)
19 – Water (W)
Sources: Air photos, 1970 University of Massachusetts 1:20,000 interp. placed on 1:24,000 USGS Quad Sheets. Producing Agency: MAPC for HUD.

LAND USE PATTERNS, ALLOCATIONS & MANAGEMENT – TRANSPORTATION SYSTEM (limited access highway and access points; major arterial; passenger railroad and stations; freight railroad; transit and stations; airport; ferry terminal). [1:62,500]. Sources: Official State Transportation Map 1973. Producing Agency: HUD.

LAND USE PATTERNS – ZONING MAP (residential; commercial; industrial; institutional; open space). [1:62,500]. Sources: Most recent town zoning by-laws and town plans. Producing Agency: MAPC for HUD.

SPECIAL ENVIRONMENTAL FACTORS – TOWN FUNCTIONAL ENVIRONMENTS (center city; intermediate city; fringe city; forest town clustered; forest town dispersed). [1:62,500]. Sources: See page IV of Environmental Base Study, available from NERBC. Producing Agency: Univ. of Mass. for NPS.

SPECIAL ENVIRONMENTAL FACTORS – UNIQUE NATURAL AREAS (federal; state; private & semi-public; Audubon; Trustees of Reservations; municipal; private; unknown). [1:62,500]. Sources: (Same as above). Producing Agency: Univ. of Mass for NPS.

SPECIAL ENVIRONMENTAL FACTORS – UNIQUE CULTURAL AREAS (historic; national register; state; local; archeological; educational). [1:62,500]. Sources: (Same as above). Producing Agency: Univ. of Mass. for NPS.

RELATED LANDS – LIMITATIONS FOR SEPTIC TANK SEWERAGE DISPOSAL (slight; slight and moderate; slight, moderate and severe; severe; not classified). [1:62,500]. Sources: General Soils Maps. Producing Agency: SCS.

SPECIAL ENVIRONMENTAL FACTORS – LAND USE QUALITY (subregions A-G – see explanation on subregions in Single-Purpose Report 3.06, available from NERBC. [1:62,500]. Sources: Univ. of Mass. interpretation – 1" = 1 mi. Producing Agency: Univ. of Mass. for NPS.

POPULATION GROWTH TRENDS [1" = approx. 5 mi.]. Overlay showing 6 categories of population growth trends in SENE. Producing Agency: NERBC.

FUNCTIONAL ENVIRONMENTS (FE) [1:62,500]. Unique natural and unique cultural sites in SENE (by town). Producing Agency: Univ. of Mass. for NPS.

ENVIRONMENTAL BASE STUDY [1:62,500]. Functional environments of each town in SENE area. Town lines delineated and (FE) written in. Producing Agency: Univ. of Mass. for NPS.

FOREST COVER & WETLANDS MAP (For all ten planning areas) [1:62,500]. Producing Agency: FS.

FOREST INDUSTRIES [1:250,000]. Primary and secondary cover types. Producing Agency: FS.

FOREST USE (IPSWICH PLANNING AREA) [1:250,000]. Areas designated by size of circle showing acres by town of forest land, public management, and use of forest land for wood products, surface water supply and developed public recreation. Producing Agency: FS.

GENERALIZED FOREST TYPES [Approx. 1:1,000,000]. Major vegetational cover types. Producing Agency: FS.

PUBLIC OWNERSHIP MAP [1:62,500] Producing agency: FS.

EXISTING DEVELOPMENT AND RELATIVE ACCESSIBILITY [1:500,000]. Producing Agency: JGA for HUD.

DEVELOPMENT CAPABILITIES MAPS [1:125,000]. *Plate 1:* Greater Boston and North Shore; *Plate 2:* Southeastern Massachusetts; *Plate 3:* Rhode Island and the Blackstone. See Chapter 3 – Guiding Growth for a full discussion of the maps and their purpose. Producing Agencies: NERBC and JGA/Wallace Floyd Ellenzweig, Inc., January, 1975.

Water Supply – Chapter 4

Inventory Reports

Ground Water Management; Producing Agency: U.S. Geological Survey (3.03)

Water Supply; Producing Agency: Environmental Protection Agency (3.04)

Special Reports, Economic

Economic Implications of Water Supply and Demand Issues in Southeastern New England Nathanial Clapp, Consulting Engineer; May 1974 (summary available)

Special Reports, Legal and Institutional

Legal and Institutional Arrangements for Water Supply Service in the Southeastern New England Area; Edward R. Kaynor, U. Mass. Water Resources Research Center, July 1974

Data Maps

GROUND WATER MANAGEMENT – GROUND WATER RECHARGE AREAS (ground water reservoir & recharge areas; ground water recharge areas; till & bedrock; municipal & industrial supply wells & yield in millions of gallons per day). [1:62,500]. Sources: Field work and USGS reports 1962-1967. Producing Agency: USGS.

WATER SUPPLY – EXISTING WATER SUPPLY SOURCES & SERVICE AREAS – 1967 (existing well sources; existing surface water sources; existing water service area) [1:62,500]. Sources: Camp, Dresser, McKee Report 1967 Producing Agency: EPA.

WATER SUPPLY – POTENTIAL WATER SUPPLY SOURCES & SERVICE AREAS – 1990 (proposed reservoirs; proposed service areas) [1:62,500]. Sources: (Same as above). Producing Agency: EPA.

PROPOSED WATER SUPPLY SYSTEMS FOR INDIVIDUAL TOWNS AND CITIES – 1990 [1:500,000]. Producing Agency: EPA.

EXISTING AND PROPOSED WATER SUPPLY TRANSFERS AND PROPOSED RESERVOIRS – 1990 [1:500,000]. Producing Agency: EPA.

Water Quality – Chapter 5

Inventory Reports

Water Quality Control; Producing Agency: Environmental Protection Agency (3.02)

Health Aspects; Producing Agency: Environmental Protection Agency (3.16)

Special Studies

A Solid Waste Management Review of the Southeastern New England Region; Thomas Pontes, 1974.

Water Quality in Southeastern New England – a Planning Report; Environmental Protection Agency, 1974.

Data Maps

WATER QUALITY (present & proposed water quality) [1:62,500]. Sources: Water Quality Standards, State of Mass. 1967. Producing Agency: EPA.

EXISTING AND PROPOSED SEWER SERVICE AREAS (existing & proposed sewer services; wastewater discharges). [1:62,500]. Sources: Camp, Dresser, McKee Report 1967 Permit Applications, 1971. Producing Agency: EPA.

EXISTING WATER QUALITY [1" = approx. 5 mi.]. A set of 3 overlays showing existing water suitable for all uses except bathing and shellfishing, and water suitable for most uses. Producing Agency: EPA.

PROPOSED WATER QUALITY [1" = approx. 5 mi.]. A set of 3 overlays showing proposed water quality under the three categories listed above. Producing Agency: EPA.

CITIES AND TOWNS HAVING COMBINED SEWER FACILITIES [1" = approx. 5 mi.]. Overlay locating by dot and name all towns in SENE with combined sewer facilities. Producing Agency: EPA.

POSSIBLE WASTEWATER TREATMENT SYSTEMS AND FACILITIES [1:500,000]. Producing Agency: EPA.

Outdoor Recreation – Chapter 6

Inventory Reports

Fish and Wildlife; Producing Agency: U. S. Fish and Wildlife Service (3.07)

Outdoor Recreation; Producing Agency: Bureau of Outdoor Recreation (3.08)

Special Reports, Legal and Institutional

Methods to Ensure Access to Natural Resource Areas, Tom Arnold and Francis Cameron, 1974

Planning Aid Reports (prepared by U. S. Department of the Interior, Bureau of Outdoor Recreation, Northeast Regional Office)

Existing Outdoor Recreation Areas
Outdoor Recreation Needs
The Private Sector in Outdoor Recreation
Scenic and Recreational Rivers
Recreation Trails; A Guide for Action
An Urban Recreation Perspective

Data Maps

RECREATION (general parks administration – L = local, P = private, C = commercial; forest or wildlife preserves; beaches; marinas; boat launch areas & public access sites; roadside parks & picnic groves; federal lands) [1:62,500]. Sources: Bureau of Outdoor Recreation statistics & maps, Statewide Comprehensive Outdoor Recreation Plan for Mass (SCORP). Producing Agency: BOR.

NAVIGATION (yacht club; marina or boatyard; public landing; public ramp; oil terminal; power plant terminal; historical or training station terminal; Coast Guard station; anchorage areas; channel improvement) [1:62,500]. Sources: Corps of Engineers reports, aerial photos 1971, National Ocean Survey charts, USGS maps 1:24,000 and field inspection. Producing Agency: CE.

COASTAL RESOURCES – OWNERSHIP & USE (public - public recreation; public - military or restricted; private - public recreation; private - private beach; private - commercial-industrial; public - wildlife reservation) [1:62,500]. Sources: 1971 Aerial photos, CE reports, USGS 1:24,000 topo maps, field inspection. Producing Agency: CE.

FISH AND WILDLIFE HABITATS – WILDLIFE HABITAT CORRIDOR (best corridor - greatest habitat diversity; better corridor - diversity of habitat; good corridor - habitats lack water area, poor soils; special corridor - federal, state, or conservation group areas to protect development; urban corridor - devoted to man-made structures but have wildlife of interest to residents) [1:62,500]. Sources: 1:24,000 interpretation & field survey, and Dept. of Natural Resources, Mass. Producing Agency: USFWS.

FISH AND WILDLIFE – FRESH WATER FISHERIES (cold water fishery; warm water fishery; salt water portion) [1:62,500]. Sources: 1:24,000 interpretation and field survey, and Dept. of Natural Resources, Mass. Producing Agency: USFWS.

FISH AND WILDLIFE – SALT WATER SPORT FISHING (anadromous stream; salt water fishing areas) [1:62,500]. Sources: Field checks. Producing Agency: USFWS.

INLAND WETLAND MANAGEMENT – QUALITY OF WILDLIFE WETLANDS (best; better; good; publicly owned land) [1:62,500]. Sources: 1951-52 Univ. of Mass. Land Use Maps 1:31,360 USGS topo maps, limited field inspection. Producing Agency: USFWS.

NAVIGATION SUMMARY OF EXISTING DEVELOPMENT & FUTURE GROWTH POTENTIAL OF NAVIGATION FACILITIES (high growth potential; moderate growth potential; low growth potential) [1:62,500]. Sources: CE Engineering Reports, Aerial photos 1971, National Ocean Survey charts, USGS maps 1:24,000 and field inspection. Producing Agency: CE.

SIGNIFICANT PUBLICLY OWNED RECREATION & CONSERVATION AREAS (Parks, forests, management areas and sanctuaries of over 300 acres are located. Shellfish areas, stocked trout streams and ponds are also delineated) [1:250,000]. Producing Agency: USFWS.

Marine Management – Chapter 7

Inventory Reports

Navigation; Producing Agency: Corps of Engineers (3.10).

Coastal Resources; Producing Agency: Corps of Engineers (3.11).

Special Studies

An Initial Assessment of the Deepwater Coastal Zone, Paul Kirshen, December 1971.

Marine Resources of the Offshore and Coastal Zone of Massachusetts and Rhode Island, Christopher Mantzaris, National Marine Fisheries Service; July 1974.

Urban Waters Special Study, Skidmore, Owings & Merrill, January 1975.

Data Maps

MARINE MANAGEMENT [1:500,000]. Producing Agency: NERBC with agency information.

OFFSHORE FISHING GROUNDS [1 in. = 20 mi.]. Producing Agency: NMFS.

Flooding and Erosion – Chapter 8

Inventory Reports

Flood Plain Zoning and Streamflow Management; Producing Agency: Low Flow Assessment Report; Corps of Engineers (3.01).

Inland Wetlands Management; Producing Agency: Corps of Engineers (3.09).

Irrigation and Drainage; Producing Agency: Soil Conservation Service (3.14).

Sediment and Erosion; Producing Agency: Soil Conservation Service (3.15).

Special Reports, Legal and Institutional

Changes in the Wetlands Law; Tom Arnold and Francis Cameron, 1974.

Data Maps

FLOOD PLAIN AND STREAMFLOW MANAGEMENT – EXISTING RESOURCES (mainstem flood plain [estimated 100-yr. flood]; USGS Gauging Station; mainstem dam; major damage area; flood plain zoning) [1:62,500]. Sources: Field inspection, CE reports, SCS reports, USGS stream gauging records, USGS topo maps. Producing Agency: CE.

COASTAL RESOURCES – PHYSICAL CHARACTERISTICS & TIDAL FLOODING (erosion conditions, critical; erosion conditions, non-critical; beach areas; areas subject to tidal flooding) [1:62,500]. Source: 1971 aerial photos, CE reports, USGS 1:24,000 topo maps, field inspection. Producing Agency: CE.

STREAMFLOW OF MAJOR RIVERS [1" = approx. 5 mi.]. Map showing basin boundaries, rivers, basin names, location of gauging stations and high and low flow graphs for each major river. Producing Agency: NERBC with agency information.

PRESENT FLOOD DAMAGE AREAS AND WETLAND AREAS [1:500,000]. Producing Agency: NERBC with agency information.

Locating Key Facilities – Chapter 9

Inventory Reports

Power; Producing Agency: Federal Power Commission (3.12).

Minerals; Producing Agency: Bureau of Mines (3.13).

The Economics of Power Plant Siting in Southeastern New England, J. M. Gates, N. F. Meade, J. G. Sutinen, Department of Resource Economics at the University of Rhode Island; June 1974 (summary available).

An Economic Analysis of Coastal Resource Allocation in Southeastern New England, Gregory A. Vaut; June 1974 (Summary available).

The Economics of Sand and Gravel Mining in Southeastern New England, J. Sutinen and L.

Nicholson, Department of Resource Economics, University of Rhode Island, June 1974 (summary available).

Data Maps

POWER – PRIME MOVERS (location of generation stations) [1:62,500]. Producing Agency: Federal Power Commission.

SUITABILITY ZONE – BASE LOAD POWER PLANT SITING (inland rural; inland urban; coastal rural; coastal urban) [1:62,500]. Sources: Interpretation by Federal Power Commission. Producing Agency: FPC.

MINERALS – POTENTIAL SAND AND GRAVEL RESOURCE AREAS (areas of potential commercial deposits; areas of no commercial value) [1:62,500]. Sources: Geological Survey data (see hydrological data, Ground Water Management). Producing Agency: BOM.

1980 POWER FACILITIES [1" = approx. 5 mi.]. Overlay showing generating plants and interconnecting transmission lines for 1980. Producing Agency: FPC.

EXISTING BULK AND PEAKING POWER PLANTS; PROPOSED BULK POWER PLANT SITES – 1990 [1:500,000]. Producing Agency: FPC.

Strengthening the Management System for Natural Resources, Chapter 10

Special Reports, Legal and Institutional

Design of Legal and Institutional Structure for Management of Significant Water and Land Use Issues, Ed Selig, 1974.

Fiscal Policy and Related Lands Control, Tom Arnold and Francis Cameron; 1974.

Proposed Legislation Relevant to the SENE Study, Peter Freeman, 1974.

Implementation of the SENE Study, Development Sciences, Inc.; 1974.

Tying the Recommendations Together, Chapter 11

Data Maps

Maps were prepared at a scale of 1:250,000 for each "subregion". Subregion I (Greater Boston) is composed of the Ipswich-North Shore and Boston Metropolitan planning areas. Subregion II (Southeastern Massachusetts) includes the South Shore, Cape Cod, Buzzards Bay, and Taunton planning areas. Subregion III (Rhode Island and the Blackstone) contains the Blackstone and Vicinity, Pawtuxet, Narragansett Bay and Pawcatuck planning areas. The maps cover topics of:

Preliminary Proposed Environmental and Economic Water and Related Land Use Actions – AREAL EXTENSIVE

Preliminary Proposed Environmental and Economic Water and Related Land Use Actions – SITE SPECIFIC AND TOWNWIDE

General Information Publications

Water and Land for People in Southeastern New England; pamphlet, 1971. Producing Agency: NERBC.

Southeastern New England Water and Related Land Resources Study; newsletter July 1973. Producing Agency: NERBC.

Tomorrow is Today: Planning With the People in Southeastern New England; handbook, November, 1973. Producing Agency: NERBC.

SENE map overlay packet; Spring 1974. Produced by Stephen Logowitz for NERBC.

You Live Here; pamphlet, Spring 1974. Producing Agency: NERBC.

An Annotated Bibliography of Major Water and Related Land Resource Studies in Southeastern New England; July 1971. Vols. 1 & 2. Producing Agency: NERBC.

Citizen Participation Publications

Tabulations

Major watershed problems seen by public workshop participants in each of the SENE planning area watersheds.

Citizen-preferred solutions, by planning area.

Meeting Summaries

News release summaries of public workshops for each watershed, discussing major watershed issues.

News release summaries of second series public workshops, discussing possible solutions.

Minutes of third series of public workshops commenting on the 90 day review draft.

Regional Citizen Advisory Committee meeting minutes.

Document Summaries

Tabloid with draft recommendations. Available in large quantities.

REVIEW OF THE REPORT

The following is a summary of major reactions to the draft report for Southeastern New England and the draft Environmental Statement by members of federal, state, and interstate agencies, local governments, citizen groups, and individual citizens.

Review and comment on the draft report for Southeastern New England and the draft Environmental Statement by the general public and representatives of all levels of governments throughout the region took place during a 90-day review period from May 4, 1975 to August 5, 1975. To implement this review process, the following measures were taken:

(1) 1500 copies of the draft report were distributed to local, regional planning, state, interstate, and federal officials as well as to 208 libraries, 75 citizen groups, 18 U.S. senators and congressmen, and 90 state senators.

(2) Copies of the draft regional report and the draft Environmental Statement were provided to the Council on Environmental Quality, and a summary of the draft Environmental Statement was printed in the May 16, 1975 edition of the *Federal Register*.

(3) 15,000 copies of a 28 page newspaper summarizing the recommendations of the plan were distributed throughout the region.

(4) A series of 11 public meetings was held on weekday evenings during the months of May and June.

(5) Several smaller working session meetings were held with citizens, private organizations, and public officials to assist the staff in revising specific recommendations at issue.

(6) Oral public testimony at the 11 public meetings was tape recorded and summarized.

(7) 275 letters were received and responded to regarding the draft report and draft Environmental Statement.

During the two months following the close of the 90-day review period, the staff of the Southeastern New England Study reviewed each of the comments received, and revised the draft report and the draft Environment Statement preparatory to final publication, in the light of these review comments. It should be noted that the minutes of all public meetings, copies of prepared testimony submitted at those meetings, and copies of all correspondence received during the public review period, have been submitted under separate cover to the U.S. Water Resources Council for transmittal to the Council on Environmental Quality. In addition, tapes of all eleven public meetings are on file at the office of the New England River Basins Commission, 55 Court Street, Boston, Mass.

Following is a summary of what the staff believed to be the most significant comments on the draft report and the draft Environmental Statement, together with a description and sampling of those making the comment and a staff response to that comment. Many other changes were also made, however.

MAJOR COMMENTS ON THE DRAFT SENE STUDY REGIONAL REPORT AND DRAFT ENVIRONMENTAL STATEMENT

1. SUBJECT: Overall Report

Public and official response to the overall draft report was highly positive. The majority of criticisms stemmed from:

(a) local interests which would be adversely affected by SENE Study proposals for regional recreation facilities to help meet the very large unsatisfied needs for SENE's large urban population;

(b) interest groups and individuals who categorized the report as either economically or environmentally extreme; and,

(c) misinterpretation of the text.

SENE Response:

(a) generally revised the draft report to accommodate intense local attitudes;

(b) except for some clarification and toning, the posture of a balanced report was maintained.

Terms such as "Environmentally sensitive areas, ecology, economic viability, economic efficiency, and unsatisfied social needs" were retained as valid indicators of some of the principal, occasionally competing, thrusts of the report; and,

(c) Clarified the text in many places.

2. **SUBJECT: Accuracy of Massachusetts agency designations**

The Commonwealth of Massachusetts felt that the recent major reorganization of that state's government was not adequately reflected.

SENE Response:

The eleven reports were revised, using the new names of all Massachusetts agencies where mentioned, about 500 times throughout the regional and planning area reports.

3. **SUBJECT: Manufacturing sector**

The tone of the text in *Chapter 2, The Setting,* was believed by the Associated Industries of Massachusetts and Energy and Research Development Administration to leave the impression that the manufacturing had been omitted as a viable sector of SENE's economy.

SENE Response:

The intent of the Study was not to eliminate manufacturing from consideration as an important sector of the economy. Additional text was placed in *Chapter 2* which recognized the importance of providing a balanced economic mix of various sectors which, when accompanied by services, can provide employment to keep pace with ordinary population growth in the number of jobs for low skilled labor.

4. **SUBJECT: Limits to population growth and alternatives to guide growth**

Department of the Interior and Zero Population Growth believed that the Study had ignored limiting population growth in the SENE region. Interior and the Massachusetts Coastal Zone Management Program also wanted the alternative approaches selected by the Study to guide growth to be clarified.

SENE Response:

The *Solution* section of *Chapter 3, Guiding Growth* was revised to indicate that the scope of the Study did not permit including such considerations as population control by regulation of birth rate or migration patterns, which, among other factors, should be a part of a program for planning limitations on growth.

It is difficult in a comprehensive study which deals with the entire spectrum of water and related land resource issues to designate complex alternatives which are mutually exclusive. The alternatives were modified to more clearly reflect three basically different approaches: the first alternative emphasizes continued use of available tools on an ad hoc basis to manage the future growth of the region (essentially a "no action" alternative); the second alternative goes a step further by defining certain Critical Environmental Areas and removing these areas from consideration for most forms of development (yet relatively unrestricted use and development of most "other lands" is permitted); and the third alternative suggests managing development on those "other lands" – Developable Areas – most capable of supporting it (no new controls other than current programs and regulations would be used for protecting critical water and related lands).

5. **SUBJECT: Accommodating growth on developable lands without controls**

In separate, but related comments, several reviewers including the Sierra Club, Association for the Preservation of Cape Cod, and Department of the Interior, were concerned that the Study conclusion that enough developable land exists to accommodate growth in SENE through the year 2020 may be interpreted by development interests as meaning that no control is necessary on such lands.

SENE Response:

The staff agrees that such interpretation from the text was possible. However, the Study approach and recommendations were designed to protect Critical Environmental Areas (land which should not be developed) and to manage and guide growth on all other lands, including Developable Areas, in the Southeastern New England region. Therefore, this tone was added to "The Implications of the Development Capability Analysis for Accommodating Growth" section and to recommendation number 2, "Improve Management of Developable Areas" in *Chapter 3, Guiding Growth.*

There it was emphasized that the recommendation has three parts which deal with management of developable areas, both within existing developed areas, as well as in areas yet to be developed: there are no developable areas in which management of some kind is not required.

6. **SUBJECT: Capability of urban lands for absorbing more growth**

The Department of the Interior, Massachusetts State Senator William Saltonstall, the Massachusetts Coastal Zone Program, the Sierra Club, and others felt that more emphasis was necessary in *Chapter 3, Guiding Growth,* on the opportunity for absorbing more growth in "Pre-empted Use" categories which include already urbanized portions of the SENE region.

SENE Response:

The discussion of "Urban Areas" in the Pre-empted Use category was enlarged to include an elaboration of the major problems which exist for redevelopers. A discussion about how the recommendations and policies put forth in the SENE Study reports can be applied to these areas was also added. The portion of recommendation number 2 "Improve Management of Developable Areas" which deals with maximizing the use of excess capacity of existing infrastructure was modified. It now reflects the importance for local or state agencies of dealing with lands which are vacant and suitable for development or redevelopment.

7. **SUBJECT: Clustering of development**

Several reviewers, notably, Energy and Research Development Administration, Department of the Interior, and U.S. Department of Agriculture, believed that the Study was suggesting only clustering as a way to overcome adverse economic and environmental damage in *Chapter 3, Guiding Growth.*

SENE Response:

The Study recommendations, particularly with respect to its presentation of development guidelines in a table entitled, "Suggested Guidelines for Use of Developable Areas" were designed to present a high degree of flexibility for the developer. The guidelines were designed to be used within the existing framework of land use controls and engineering practices. This explanation was added to *Chapter 3* in the section entitled "Develop According to Resource Capability." The flexibility suggested in that table includes standard zoning patterns as well as clustering options.

8. **SUBJECT: Protection of agricultural lands**

The Massachusetts Department of Agriculture, U.S. Department of Agriculture, Sierra Club, and Rhode Island Statewide Planning Program believed further emphasis and clarification was needed on the character of prime agricultural lands in SENE and on the ways these lands would be protected.

SENE Response:

Forests were added to the agricultural products dependent on the fertility of prime agricultural lands. In addition to production of food and fiber, the role of prime agricultural lands in providing important ground water recharge areas and landscape diversity (reflective of Southeastern New England's heritage) was also stressed. The portion of recommendation number 1, "Protect Critical Environmental Areas," dealing with prime agricultural sites was substantially revised. The number of approaches which could be used to protect agricultural lands was increased from four to ten. These additions along with changes in wording reflect input received during the SENE Study review period from the above reviewers, and benefit as well from the input the Massachusetts Department of Agriculture received during public meetings held to review the Commonwealth's suggested *Policies and Programs for Food and Agriculture in Massachusetts.*

9. **SUBJECT: Air quality and development**

Both the Environmental Protection Agency and the Department of Transportation, and the municipality of Winthrop, Massachusetts, believed additional discussion of the relationships of air quality to development were necessary.

SENE Response:

References to ongoing air quality programs were made in the beginning of *Chapter 3, Guiding Growth,* in *The Setting* and in the section entitled *Regulate Developments of Regional Impact.* These references underscore the necessity for effective coordination of development among all responsible agencies.

10. **SUBJECT: Accuracy of SENE Development Capabilities Maps**

While most reviewers acknowledged the accuracy and usefulness of the Study's Development Capabilities Maps, problems did surface during the review period, notably: wetlands missing on the west bank of the Kickemuit River, R.I. (Kickemuit River Council); the upper stretch of the Charles River missing (Charles River Watershed Association); several ponds missing from the Town of Easton (Easton municipal authority); more accurate information now available for Nantucket (Nantucket Planning and Economic Development Commission). There were suggestions that these colored plates be updated.

SENE Response:

The maps were developed using the best available information which has been synthesized and reduced in scale several times. Inevitably occasional small, although still important inaccuracies occur in the process.

The purpose of the maps is to suggest a concept and system for characterizing development capabilities of natural resources and for providing a start in identifying their location. The scale and level of detail is inappropriate for site planning. Further, they have been designed for gaining a regional perspective of resource capability using one scale and a uniform classification system. A notation will be added to each of the remaining 4500 colored plates reflecting these points.

11. **SUBJECT: Northfield Mountain and Millers River Diversions**

Many reviewers noted that the SENE Study has neglected to repeat the qualifications of the 1980 Connecticut River Basin Plan with regard to development of the Northfield Mountain diversion and subsequent diversions from the Connecticut River and its tributaries. This was suggested by Connecticut River Ecology Action Corporation, Citizens Advisory Group of Connecticut River Supplemental Study, Massachusetts Executive Office of Environmental Affairs, and Connecticut Valley residents.

They also felt that additional consideration should be given to alternative sources of water supply, other than the Northfield Mountain and Millers River diversions.

SENE Response:

Discussion of the diversions was re-written in order to endorse the 1980 Connecticut River Basin Plan's recommendations and to report activities undertaken in compliance with these recommendations, as well as conditions yet unsatisfied.

An additional section, discussing alternatives to the diversion, was added to *Chapter 4, Water Supply.* It was concluded that while these alternatives might provide long-term solutions to the MDC's water supply problems, they could not remove the need for the Northfield Mountain diversion and were not presently feasible as replacements for the Miller's River diversion. The recommendation now reads: "Expand MDC sources by completing the Northfield Mountain facility and carrying out conservation measures; plan the Millers River facility."

12. **SUBJECT: Existing water resources**

Massachusetts Coastal Zone Management Program suggested that the recommendations involving the maintenance of existing resources be strengthened.

SENE Response:

The discussion explaining the importance of maintaining existing water supplies in *Chapter 4, Water Supply,* was strengthened, and the recommendation for the maintenance of existing resources was changed to highest priority category.

13. **SUBJECT: Refinery use of water supplies**

The Sierra Club commented that the SENE Study should include refinery demands for water supplies in its calculations of future water needs.

SENE Response:

The problem is beyond the scope of the SENE Study especially since the size and siting of energy related facilities in the SENE region is uncertain. Water for all industrial use, including new industries, is considered in the factor of a 1 percent per capita increase in water use per year.

14. **SUBJECT: Regional water supply systems: Weweantic River and the Lakeville Ponds**

Some reviewers voiced concern over the potentially harmful environmental consequences of the recommended diversion of the Weweantic River to the Lakeville Ponds in order to serve the New Bedford Water Department. This comment was specifically

from City of New Bedford, Southeastern Regional Planning and Economic Development District, and concerned residents.

SENE Response:

After additional investigation, it was determined that the New Bedford Water Department should develop potential ground water supplies in New Bedford and Acushnet to supplement its existing safe yield, rather than divert the Weweantic. This change was made in *Chapter 4, Water Supply.*

15. SUBJECT: Regional water supply systems: Abington-Rockland-Brockton relationships

Old Colony Planning Council and Town of Abington disagreed with the Study's recommendation that the Abington-Rockland Joint Water Works should join with the Brockton Water Commission in a regional water supply system.

SENE Response:

The Study replaced this recommendation in *Chapter 4, Water Supply,* with one suggesting that flood skimming of Howard and Pine Brooks and the Jones River in Kingston should be explored to augment Silver Lake, Brockton's source of supply.

16. SUBJECT: Vessel wastes

Massachusetts, Connecticut, and Rhode Island believed that the Study recommendation of holding tanks for treating vessel wastes is too strong in light of continuing federal uncertainty as to the best solution. On-board treatment devices may be preferable to holding tanks/pumping out facilities.

SENE Response:

The uncertainty about the best solution for vessel wastes has to do with present levels of technology for on-board treatment, which are inadequate. The recommendation in *Chapter 5, Water Quality* remains unchanged, although revision is advised in light of future improved technology.

17. SUBJECT: New methods for waste disposal

The Study should place strong emphasis on more unconventioanl methods of waste disposal such as land irrigation, dry disposal methods, commercial use of sludge as a fertilizer, combustion of sludge as an economical source of power, and instream aeration. Ecology Action for Rhode Island, Sierra Club, and many attending the Spring 1975 public meetings voiced support for this step.

SENE Response:

The text in *Chapter 5, Water Quality,* was clarified and amplified wherever the previous description seemed inadequate for conveying both the potential of the methods and the most significant problems that must be overcome if such methods are ever to come into widespread use.

18. SUBJECT: Industrial discharges

All industrial discharges, not just the major discharges, should be controlled according to Ecology Action for Rhode Island and Sierra Club.

SENE Response:

The Study staff concurs. The text in *Chapter 5, Water Quality,* was rewirtten to correct the impression given by previous wording. The National Pollutant Discharge Elimination System program of the Environmental Protection Agency requires a permit for all discharges.

19. SUBJECT: Scavenger wastes

The Massachusetts Coastal Zone Management Program suggested that the state, not municipalities, should be made responsible for providing adequate disposal facilities for scavenger wastes obtained from septic tanks.

SENE Response:

It is believed that the municipalities, who operate the waste treatment facilities, are in the best position to provide this badly needed service. Therefore the recommendation in *Chapter 5, Water Quality,* was not changed.

20. SUBJECT: Emphasize recreation

The SENE Study should place greater emphasis on improving water quality for recreational purposes, according to the Massachusetts Coastal Zone Management Program and concerned residents in the region.

SENE Response:

It is believed that the stated objective of achieving "swimmable, fishable waters by 1983 wherever realistically attainable economically, socially, and technically" was the strongest emphasis possible.

This objective when met will improve the water quality for recreational purposes.

21. **SUBJECT: Emphasize urban water quality restoration**

The Massachusetts Coastal Zone Program and Ecology Action for Rhode Island believed that since most of the SENE population is concentrated where the water is most degraded, restoration of these areas to swimmable quality should be given the highest priortiy, not anti-degradation in generally rural areas.

SENE Response:

The staff concurs with intent of comment. However, the SENE Study has concluded that the region can gain many more recreation days and miles of clean water quickly, per dollar spent, by emphasizing anti-degradation and restoration of only marginally substandard waters than it can by attempting to solve (and probably unsuccessfully) the worst problems first. Efforts to make Boston and Providence harbor areas swimmable in the near future are apt to be defeated by extremely high costs.

22. **SUBJECT: Land and Water Conservation Fund**

The Department of the Interior believed that the states' problems in getting Land and Water Conservation Funds cannot be solved simply by increasing the level of federal funding. It is felt that state officials can be imaginative in the way they match Bureau of Outdoor Recreation monies and the legislatures must be willing to authorize matching expenditures.

SENE Response:

The text in *Chapter 6, Outdoor Recreation,* now suggests that states investigate funding sources like the Housing and Community Development and that legislators recognize the importance of states' role in matching Fund monies. The suggestion that the federal government (either Interior or Congress) review the effectiveness of the Land and Water Conservation Fund Program, including the possibility of a sliding fee scale, was retained.

23. **SUBJECT: Limited recreational use of water supply watershed lands**

(a) The Rhode Island Water Resources Board commented that recreational pressures in Rhode Island presently do not indicate the need to use water supply reservoirs, and other fresh water and salt water resources should first be developed.

(b) The Supervisor of Water Supply, City of Worcester, commented the main duty of water authorities is to supply potable drinking water and they are too understaffed to manage reservoir areas for recreation, particularly those near urban centers.

(c) Trout Unlimited and the Rhode Island Department of Fish and Wildlife believed that recreational use of reservoir lands should be allowed but should be limited and controlled by a permit system. Rhode Island Statewide Planning Program suggested that studies of the recreational impacts on water quality are needed.

SENE Response:

(a) New emphasis was added in *Chapter 6, Outdoor Recreation,* to reiterate that low-intensity use of reservoir *lands* should be planned for the *future* to meet low intensity recreational demands, not water-based recreational demands. Demand projections calculated both by the SENE Study and by Rhode Island Statewide Planning Program indicate there will be real needs for low-intensity recreation in the future which could be met by use of lands adjacent to *storage* reservoirs.

(b) and (c)
Controlled use can be achieved by new and coordinated efforts on the part of several existing agencies. A multi-purpose group (health officials, water authorities, natural resources planners) should prepare guidelines for consistent management and decide on the most effective funding source (permit system, user fees) to cover new costs.

24. **SUBJECT: Recreational boating harbors**

(a) The Department of Interior and various municipal officials commented that the rationale behind proposed regional marinas should be explained and the environmental suitability of marina developments must be examined on a case-by-case and within a regional context.

(b) Massachusetts Audubon Society, Association for the Preservation of Cape Cod, Trout Unlimited, and municipal officials throughout the region commented that marinas are nuisances and the solution is not to encourage the development of boating facilities.

(c) The estimates of potential slips and moorings in the planning area reports seem consistently high (general comment).

SENE Response:

(a) The text now states that public marinas are badly needed and, to take advantage of public investment, they should be developed in areas where services already exist and which are central to the demand and in environmentally non-sensitive areas. The suggestion that the proposed statewide boating advisory committee assess the suitability of increased boating development in a cove-by-cove, harbor-by-harbor study was added.

(b) There is a general trend of increasing demands for recreational boating facilities and they cannot be ignored. However, an effort was made to re-emphasize that the demands be met primarily by enlarging the capacity of existing marina areas instead of encouraging development of new marinas.

(c) Tables where estimates of potential slips and moorings appear were modified to point out that the figures are not intended as aboslute recommendations. The figures are preliminary estimates which should be refined in the boating potential study mentioned in (a) above.

25. SUBJECT: National Park Service

(a) The role of the National Park Service (NPS) in satisfying recreational demands was not clearly specified.

(b) The National Park Service also felt that the importance of the Cape Cod National Seashore for satisfying regional recreational demands and the future of its management policies is not spelled out.

SENE Response:

(a) A discussion of the NPS, including the Natural and Historic Landmark Program was added to *Chpater 6, Outdoor Recreation.*

(b) While the National Seashore is the largest recreational facility in the SENE region, present management policies for low-intensity uses mean that its capacity to satisfy the region's recreational demands and tourist recreational demands is limited. The text was revised to suggest that the present policy should be reviewed and revised in the future if pressures for greater recreational use increase beyond the present level.

26. SUBJECT: State beaches and parks

(a) Local management and protection of coastal beach areas is preferable to state acquisition and development as regional facilities, particularly barrier beaches in Duxbury (according to Duxbury Beach Association, Gurnet-Saquish Corporation, municipal officials, and local residents), Marshfield (according to Humarock Civic Association, Coastal Area Advisory Council, and municipal officials), Westport and Dartmouth (according to Slocums River Association, South Westport Property Owners Improvement Association, officials and commissions from both towns, Southeastern Regional Planning and Economic Development District, and 1500 residents), and Quonochontaug Beach in Westerly, R.I. (according to municipal officials and local residents).

(b) The above mentioned also insisted that no expansion of existing state park and beach boundaries and no new acquisitions should be allowed because of the strain on municipal services and local environmental quality. (The same groups as 26(a) commented on this point, plus officials in Douglas Mass.).

SENE Response:

(a) Recommendations for state acquisition of Duxbury Beach in the South Shore area, and Quonochontaug Beach in the Pawcatuck Planning Area and a six mile stretch next to Horseneck Beach were changed to local and/or private protection of coastal Critical Environmental Areas. If this form of management does not successfully satisfy public and private needs, the issue of state acquisition will again arise. Furthermore, state acquisition of appropriate beach areas not presently accessible to the general public and capable of sustaining intensive use should be considered.

(b) *Chapter 6 of the Regional Report* suggests that the proposed state recreational advisory committee investigate methods for state sharing of costs of access, traffic control, facility development, etc.

27. SUBJECT: Public right in Massachusetts to use the foreshore

Massachusetts Water Resources Commission and Sierra Club noted that use of the area between the

mean high and mean low watermark (the foreshore) is unconstitutional.

SENE Response:

Recommendations dealing with public access to the foreshore were modified. Reports now urge improved public access to the Massachusetts coastline through various alternatives, among them the on-going work of the Special Legislative Commission on the Availability and Accessibility of Public Beaches and the consideration that the state share costs of access, traffic control, etc., in return for general access to town beaches.

28. **SUBJECT: Public access to Critical Environmental Areas**

(a) The Department of the Interior noted that the use of easements for satisfying extensive outdoor recreation demands was overlooked.

(b) Massachusetts Water Resources Commission and Charles River Watershed Association pointed out that mill ponds are Critical Environmental Areas which serve flood protection, recreational, and possibly power purposes, but maintenance of mill dams is sorely neglected.

SENE Response:

(a) A discussion of conservation and public easements was added in *Chapter 6, Outdoor Recreation,* as one way to gain public access for extensive outdoor recreation activities.

(b) A suggestion was added that the Commonwealth act on a program to repair and maintain small dams, and that public rights to use mill ponds be regained when the public interest can be clearly demonstrated.

29. **SUBJECT: Prohibiting near-shore sand and gravel mining**

The Corps of Engineers pointed out that insufficient information exists to conclude that the states must consider legislation restricting near-shore (depths less than 100 feet) minerals extraction activities. The Corps believed that recommendations restricting mineral extraction activities in near-shore waters should be deleted.

SENE Response:

Analysis of economic and environmental impacts of mining in depths beyond 80 to 100 feet are preliminary, but indicate certain negative economic and environmental impacts. References to on-going research which suggests the environmental implications may not be simply a function of depth were added. The recommendation dealing with near-shore mining was changed to suggest that state's coastal zone management efforts should assess new results and develop policies and program regulating mineral extraction activities in coastal waters.

30. **SUBJECT: Dredged materials disposal**

According to the Corps of Engineers, finding suitable sites for the disposal of dredged materials is problematic because federal agencies cannot purchase land sites. The Corps suggested a new recommendation that Congress should consider expanding federal navigation authority to acquire land or reimburse local interests for use of land sites for disposal of dredged materials.

SENE Response:

A discussion about the problems of land disposal sites was added, as was the suggestion that Congress consider expanding the Corps authority to acquire land disposal sites. Because opportunity for final public review had passed, a new recommendation was not added.

31. **SUBJECT: Aquaculture**

Massachusetts Division of Marine Fisheries, municipal officials, and Association for the Preservation of Cape Cod commented that several sites recommended for additional study for aquaculture are important for recreational purposes, and the two activities are conflicting. Massachusetts Division of Marine Fisheries noted that aquaculture will not dramatically increase commercially valuable living marine resources.

SENE Response:

The areas of greatest regional recreational importance were deleted from the list of potential aquaculture sites. No changes were made which would discourage aquaculture because of the potential for increased shellfish resources in New England has not been fully tested.

32. **SUBJECT: The declining fishing industry**

(a) City of New Bedford and Ecology Action for Rhode Island commented that the discussion of federal assistance programs is out of date and incomplete. Further, the recommendation for improving the Fisheries Management Loan

Fund is inaccurate becuase the Fund has been indefinitely impounded.

(b) Rhode Island Division of Fisheries and Wildlife and Ecology Action for Rhode Island disagreed with the statement that the Port of Point Judith is in a state of decline.

(c) Massachusetts Coastal Zone Management Program suggested that some of the burden for improving the fishing industry should be taken off the shoulders of the federal government.

SENE Response:

(a) The recommendation for expanding the Fisheries Management Loan Fund which has been impounded indefinitely was deleted and discussion of two new federal programs which aid financing fishing boats was added in *Chapter 7, Marine Management.*

(b) and (c). Discussion about the Point Judith Fishing Cooperative was added to explain why the Port of Point Judith is flourishing. This lead to a new alternative for improving the fishing industry in other ports by urging coordination of various components.

33. SUBJECT: Port planning

Associated Industries of Massachusetts commented that regional port planning may reduce competition among New England ports which may in turn reduce their vitality. The Corps of Engineers suggested more detailed economic analysis is needed to determine the extent that regional port planning is needed to serve SENE and New England.

SENE Response:

The goal of regional port planning is to revitalize ports by making the most efficient use of existing port facilities, not to interfere with competition or the vitality of ports. The text in *Chapter 7* now suggests that the first part of the planning effort should be an economic analysis.

34. SUBJECT: Wetlands.

Several comments were received regarding the section of wetlands administration in *Chapter 8, Flooding and Erosion,* including the need for reform of the wetlands legislation, if at all.

SENE Response:

The Study included this special section on wetlands legislation both because of the importance of wetlands to a number of resource areas (such as flood control, fish and wildlife habitat, open space preservation, and recreation), and because wetlands were continuing to be lost at an alarming rate despite the enactment of protection legislation. The analysis performed for the Study, and contact with a number of citizens, local, and state officials confirmed the need for strengthening several aspects of the existing legislation including its administration. Several corrections of fact were made in response to comment during the review period, but recommendations remained essentially the same.

35. SUBJECT: Additional subjects related to flooding and erosion

Review comments included requests for including additional subjects in the chapter: small dams, impact on the tax base of purchase of key wetlands and flood plain lands, and changes in the Department of Housing and Urban Development process of delineation of coastal flood plain areas.

SENE Response:

Language was added to the chapter referring to: (1) multiple values of small dam retention and maintenance. (2) considerations for public purchase of wetlands and flood plain lands, and other less expensive acquisition techniques such as conservation easements; and (3) new ways being considered to define coastal flood plains to reflect local conditions more accurately.

36. SUBJECT: Electricity rate structure

The suggestion in *Chapter 9,* that the decreasing block rate structure be reversed was questioned by several sources, notably Boston Edison, Associated Industries of Massachusetts, and NEPOOL. Several suggested the discussion of rationing was inappropriate.

SENE Response:

Insufficient information exists to make such a recommendation, but the text was revised to urge immediate study of the rate issue (already underway in Massachusetts). Moreover, it is recognized that because the fuel adjustment costs are so high, especially for heavy users, that the decreasing block rate "reward" may no longer be significant.

37. **SUBJECT: One-stop power plant permitting process**

There was universal agreement from all sectors, both from conservation groups and power industry, that while the existing system is often unwiedly and expensive it at least provides ample opportunity for public scrutiny. All concerned were cautious of changes.

SENE Response

Personal contacts were made with government officials, conservation groups and power industry to define most troublesome portions of existing permit review system. Based on new guidelines developed by a Nuclear Regulatory Commission federal-state workshop on the environmental review process, the recommendation was modified to focus on simplication of, and federal-state coordination in, the Environmental Impact Statement hearing process.

38. **SUBJECT: Nuclear power**

While some respondents, notably power and industrial interests, were favorably impressed with acknowledgement that near future power needs will be met by nuclear generation, the Sierra Club, Massachusetts Forest and Parks Association, and others spoke strongly against accepting the safety risks nuclear power entails. Concern was voiced over: (1) transportation and disposal of radioactive wastes; (2) low level emissions; (3) security; and (4) insufficient attention to other alternatives.

SENE Responses:

The discussion of alternatives and risks of nuclear generation was strengthened to some degree, but basic policy was substantially unchanged. The Study's greatest emphasis was, and is, on the role conservation can play in substantially reducing need for additions to the generating capacity in the region.

39. **SUBJECT: Petroleum facilities**

Several state agencies and private groups suggested that the *Petroleum Facilities* section of *Chapter 9* be updated to reflect new developments, new information, and newly funded impact planning programs.

SENE Response:

The section was substantially rewritten although the recommendations remain substantially unchanged.

40. **SUBJECT: Adequacy of the existing institutional arrangements to guide growth.**

Massachusetts Forest and Parks Association, Massachusetts Coastal Zone Management Program, and the Sierra Club felt that there are certain disabilities with existing institutional structures if growth is to be guided in a different way than has been done in the past. Simply stating that the existing system could provide the tools to achieve results is not quite accurate.

SENE Response:

Institutional changes are, the staff agreed, necessary and important. While the draft report suggests that some changes were necessary and offers alternative forms for such change, the point was not made strongly or clearly enough. Language was added to the Summary and *Chapter 10* to emphasize and clarify the fact that new enabling authority, new legislation, and additional funds will be needed if we are to change the process for managing growth. Also, the point was added that, while the Study offered alternative approaches or models of various relationships which could exist between the state, the region, and the municipality, a final decision on the re-alignment of powers is a political decision, arrived at by each state acting through its legislature.

41. **SUBJECT: Local vs. regional vs. state involvement in resource decision making.**

Several groups, including the Department of Transportation, Massachusetts Forest and Parks Association, Massachusetts Coastal Zone Management Program, the Sierra Club, and Ecology Action for Rhode Island, raised the issue of the respective roles and responsibilities of the state, the region, and the municipality in guiding growth. There is a strong tradition of home rule and broad state responsibility which should be reconciled.

SENE Response:

There was agreement that their respective roles

must be clarified. Language was added in *Chapter 10, Strengthening the Management System for Natural Resources,* to indicate the following points: local input is extremely important in the land use planning and control process, although local interests must sometimes be balanced against regional impacts and state policy. Part of the reason that growth has been misguided in the past is that local development decisions with impacts which go beyond the boundaries of that community have been made without input from other communities which are affected. At the very least, guiding an area's growth requires a degree of control by, and direction from, a level of government which can balance the needs of more than one community beyond the traditional relationships between the state, the region, and the municipality. Municipalities however, will continue to make the bulk of land use decisions. Models for this kind of arrangement exist in the American Law Institute's Model Land Development Code, and the Martha's Vineyard Law, which relies on a regional commission for certain kinds of development decisions. In fact, the Study uses these examples which formed the basis of the approaches found in *Chapter 10.* Given the principles of state, regional and local involvement, suggested specifically by Massachusetts Coastal Zone Management Program, and set forth explicitly in the text, and after extensive public reivew, the Study endorsed a particular approach which most closely embodies these concepts -- but the final choice will still be up to the States.

42. SUBJECT: Clarity and usefulness of tables in Chapter 11.

There were very few comments on *Chapter 11, Tying the Recommendations Together,* other than criticism from the Department of the Interior and Federal Power Commission (FPC) on the clarity and usefulness of the tables. Interior felt that components of objectives had been confused with factors to be evaluated in a system of accounts as called for in the Principles and Standards (PAS). FPC also criticized the lack of distinction between highest and high priority recommendations and the lack of narrative to explain why various entries had been made.

SENE Response:

Since the Chapter had been prepared with the help of some of the same consultants who had assisted in drafting the PAS, the staff felt that the tables did reflect an adequate understanding of components of objectives and evaluation criteria. Regarding explanation of priority ranking, these indications were made to provide a quick, summary view of which recommendations might be acted on first. Additional detail was not developed by the Study Management Team as part of the Study Process.

Representatives of Contributing State And Federal Agencies

FEDERAL—STATE

New England River Basins Commission
R. Frank Gregg, Chairman**; Robert D. Brown, Staff Director** **Southeastern New England Study Staff:** Robert Kasvinsky, Study Manager*; Jane F. Carlson; Cornelia V. H. Ferber; Alan Jacobs; Ernesta Kracke; James Luty; William Mahoney; Priscilla Newbury; William E. Nothdurft; William E. Richardson; Philip Tabas.

New England River Basins Commission
R. Frank Gregg, Chairman**; Robert D. Brown, Staff Director**; Robert Kasvinsky, Study Manager*; Jane F. Carlson; Cornelia V. H. Ferber; Alan Jacobs; Ernesta Kracke; James Luty; William Mahoney; Priscilla Newbury; William E. Nothdurft; William E. Richardson; Philip Tabas.

New England Regional Commission
Thomas Fitzpatrick**; Tirath Gupta* (consultant); Robert Bogen*.

MASSACHUSETTS

Executive Office of Environmental Affairs
Dr. Evelyn Murphy, Secretary**

Coastal Zone Management Program
Matthew Connolly**; Dan Calano*.

Department of Environmental Management (formerly Department of Natural Resources)
Arthur W. Brownell, Commissioner** (to February 1975); Dr. Bette Woody, Commissioner** (as of June 1975).
Division of Water Resources: Charles Kennedy**; Emerson Chandler* (as of June 1974); Clinton Watson* (to June 1974).
Water Resources Commission: Robert E. Lautzenheiser.

Department of Community Affairs
Lewis S. W. Crampton, Commissioner** (to February 1975); David Terry*.

Resources Management Policy Council
Vincent Ciampa.

Department of Environmental Quality Engineering
Division of Environmental Health (formerly Department of Public Health): George Coogan.

Division of Water Pollution Control: Tom MacMahon**; Dick Young*; Al Cooperman*.

RHODE ISLAND

Rhode Island Statewide Planning Program
Daniel W. Varin, Chief**; Patrick V. Fingliss*; Lou David.

Coastal Zone Management Program
Coastal Resources Management Council: John Lyons, Chairman.
Coastal Resources Center: Stuart O. Hale; Malcolm Grant.
Water Resources Board: Robert Russ**; Peter Calese*.

CONNECTICUT

Department of Environmental Protection
Joseph Gill, Commissioner**; Robert B. Taylor, Director* of Water Compliance.

FEDERAL

Department of Agriculture
Soil Conservation Service: Dr. Benjamin Isgur**; Philip H. Christensen**; Stephen Claughton*.
Economic Research Service: John Green*.
Forest Service: Kenneth Johnson**; Sam Becker* (to December 1973); Neil Lamson* (to March 1974); Douglas Monteith* (as of March 1974).

Department of Commerce
National Weather Service: Norman L. Canfield** (to September 1975); Albert Kachic**; Joseph J. Brumbak.
National Marine Fisheries Services: Russell T. Norriss**; Christopher Mantzaris*.
Bureau of Economic Analysis: Henry DeGraff; Gene Janisch.
Maritime Administration: William S. Chambers**; Robert L. Safarik.

Department of Defense, Department of the Army, Corps of Engineers
Planning Division: Joseph Ignazio, Chief** (to June 1974).
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Plan Formulation Branch: Steven Onysko
Coastal Development Branch: Harvey Minsky

Department of Housing and Urban Development
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Department of Transportation
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U.S. Coast Guard: Capt. Bernard Thompson* (to October 1973); Capt. Alvin P. Durgin, Jr.* (October 1973 to August 1974); Cdr. C. R. Lindquist* (to February 1974); Capt. Royal E. Grover, Jr.* (as of August 1974); Rear Admiral James P. Stewart** (as of October 1975).

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Water Supply Branch: Jerome Healey*; Stephen Lathrop*; Alma Rojas* (to February 1974).

Department of the Interior
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Bureau of Mines: Robert D. Thompson*; Joseph Krickich* (to March 1974); Peter Morey* (as of March 1974).
Bureau of Outdoor Recreation: James Donoghue* (to March 1973); Eric Finstick* (to September 1974); Alan Hutchings* (as of September 1974); Earl Nichols (as of September 1974).
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Old Colony Planning Council
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Cape Cod Planning and Economic Development Commission
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Dukes County Planning and Economic Development Commission
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