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# UPPER NARRAGANSETT BAY
## An Urban Estuary in Transition
### Preliminary Report

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Donald D. Robadue, Jr.
Virginia Lee

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# Table of Contents

Chapter 1: Introduction and Summary

Introduction . . . . . 1
The Urban Estuary. . . . . 3
Major Issues . . . . . 6
    Fisheries . . . . . 6
    The Port Industry . . . . . 7
    Recreation . . . . . 7
The Need for Leadership . . . . . 7
References . . . . . 8

Chapter 2: Fisheries

Introduction . . . . . 10
Shellfishing in the Upper Bay . . . . . 10
    Historical Perspective on Major Shellfisheries in the Upper Bay . 11
    Oysters . . . . . 11
    Softshell Clams . . . . . 12
    Quahogs . . . . . 12
    Status of the Present Fishery . . . . . 16
Finfish in the Upper Bay . . . . . 23
    Historical Perspective . . . . . 23
    Status of the Present Fishery . . . . . 24
    Menhaden . . . . . 24
    Sportfish . . . . . 26
    Government Policies and Regulations . . . . . 30
    Pollution Effects on the Finfishery . . . . . 30
Summary Findings: Upper Bay Fisheries . . . . . 31
References . . . . . 34

Chapter 3: Ports

Introduction . . . . . 35
Growth and Development of Providence Harbor . . . . . 37
    Introduction . . . . . 37
    Historical Activity . . . . . 38
    Harbor Improvements . . . . . 38
    Present Harbor Configuration . . . . . 39
Present Harbor and Port Characteristics . . . . . 40
    Waterborne Cargo Movement . . . . . 40
    Shorefront Land Use . . . . . 50
    Development Plans and Programs . . . . . 56
Conditions for Renewal and Future Growth . . . . . 59
    Introduction . . . . . 59
    Public Commitment and Guidance . . . . . 59
    Physical and Environmental Improvements . . . . . 60
    A Development Strategy for Providence Harbor . . . . . 63
References . . . . . 65

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Chapter 4: Recreation

Introduction . . . . . 68
Recreation Needs of Urban Residents . . . . . 68
Recreation Along the Upper Bay Shore . . . . . 73
Shoreline Access . . . . . 73
Parkland . . . . . 74
Beaches . . . . . 74
Recreational Boating . . . . . 79
Urban Waterfront Recreation Opportunities . . . . . 82
Introduction . . . . . 82
Protecting Sites with Recreation and Conservation Values . . . . . 82
East Bay Bikeway and Providence River Linear Park . . . . . 85
Improvements in Recreational Boating . . . . . 87
Access for Sport Fishing . . . . . 88
Removal of Debris . . . . . 89
References . . . . . 93

Appendix A: Metropolitan Development and Estuarine Resources

Introduction . . . . . 95
Urbanization of Upper Bay Communities . . . . . 98
Settlement and Economic Growth . . . . . 98
Suburbanization and Coastal Development . . . . . 98
Residential Character of Upper Bay Coastal Towns . . . . . 99
Implications of the No-Growth Metropolitan Area . . . . . 106
The Urban Estuary . . . . . 110
Introduction . . . . . 110
Susceptibility to Erosion and Flooding . . . . . 112
Tributary Streams . . . . . 125
Water Quality . . . . . 129
Fields Point Sewage Treatment Plant . . . . . 135
References . . . . . 137

# List of Figures


Chapter 1: Introduction and Summary

Figure 1-1. Upper Narragansett Bay
Figure 1-2. Population Changes in Providence and Rhode Island 1700-1970

Chapter 2: Fisheries

Figure 2-1. Leased Oyster Grounds in Narragansett Bay, 1914.
Figure 2-2. Shellfish Catch 1880 to 1960.
Figure 2-3. Trend in Soft Shell Clam Landings From Rhode Island Coastal Waters.
Figure 2-4. Trend in Rhode Island Commercial Landings for Quahogs.
Figure 2-5. Recent Trend in the Numbers of Commercial Quahog Licenses Issued to Rhode Islanders.
Figure 2-6. Percent of any Given Year That Upper Narragansett Bay Shellfish Beds are Closed by R.I. Department of Health
Figure 2-7. Map of Upper Narragansett Bay Showing the Area of the Upper Bay and Providence River Permanently Closed to Shellfishing Because of Coliform Pollution.
Figure 2-8. Map of Narragansett Bay in Which the Dashed Line Marks the Area North of Which No Commercial Trawling is Permitted.
Figure 2-9. Menhaden Landings Over Time.
Figure 2-10. Map of Narragansett Bay Showing Density of Menhaden Larvae, July 1972.
Figure 2-11. Rhode Island Landings of Menhaden, Bluefish and Striped Bass.

Chapter 3: Ports

Figure 3-1. Providence Harbor
Figure 3-2. Growth in Total Cargo Movement
Figure 3-3. Total Waterborne Commerce in Providence Harbor
Figure 3-4. Shipments and Receipts in Providence Harbor
Figure 3-5. Boundaries of Land Use Analyses Presented in Table 3-9.
Figure 3-6. Land Zoned For Industry in Providence Harbor.
Figure 3-7. Land Use Near Municipal Wharf.

Chapter 4: Recreation

Figure 4-1. Metropolitan Park System.
Figure 4-2. Parkland
Figure 4-3. Beaches
Figure 4-4. Recreational Boating.

Appendix A: Metropolitan Development and Estuarine Resources

Figure A-1. Upper Narragansett Bay
Figure A-2. Population of Upper Bay Communities
Figure A-3. Population of Upper Bay Communities
Figure A-4. Land Use Based on Municipal Zoning.

Figure A-5. Upper Narragansett Bay Census Tracts
Figure A-6. Median Family Income.
Figure A-7. Average Value of Owner Occupied Housing Units, 1970.
Figure A-8. Relationship of Family Income and Housing Values.
Figure A-9. Decline in Rhode Island Per Capita Income Compared to National Average.
Figure A-10. Two-Layered Estuarine Circulation.
Figure A-11. Seasonality of Freshwater Input to Narragansett Bay
Figure A-12. Shoreline Character.
Figure A-13. Major Tributaries and Basins of the Upper Narragansett Bay.
Figure A-14. Bullock Cove.
Figure A-15. Major Water Quality Classifications of Narragansett Bay.
Figure A-16. Location of Sewage Treatment Plants Discharging into Narragansett Bay.
Figure A-17. Historical Trend in Discharge of Sewage Effluent.

# List of Tables


Chapter 3: Ports

Table 3-1. Exports From All United States Ports
Table 3-2. National Trends in Financing Port Development
Table 3-3. Historical Growth Rates of General and Dry Bulk Cargo Tonnage Moving via New England Ports.
Table 3-4. Imports and Exports in New England by Customs Region of Shipment and Receipt.
Table 3-5. Land Transportation of International Waterborne Commerce To and From New England.
Table 3-6. Historical Cargo Flows, Providence, R.I.
Table 3-7. Traffic in Providence Harbor.
Table 3-8. Inbound Vessel Traffic in Providence Harbor.
Table 3-9. Land Use in Shoreline Census Tracts.
Table 3-10. Character of Industrially Zoned Land.

Chapter 4: Recreation

Table 4-1. Deficiencies in Recreation Opportunities Expressed By Total Demand as a Percentage of Supply.
Table 4-2. Comparison of Recreation Spending in Northeastern States, FY 78.
Table 4-3. Comparison of Municipal Recreation Spending with National Averages for Cities of Similar Size, FY 78.
Table 4-4. Parks and Open Space Along the Upper Narragansett Shore.
Table 4-5. Beaches.
Table 4-6. Recreational Boating.
Table 4-7. Projected East Bay Trips to Providence Year 2000.
Table 4-8. Sources of Debris.
Table 4-9. The Providence River and Harbor and the Seekonk River, R.I. Debris Study.

Appendix A: Metropolitan Development and Estuarine Resources

Table A-1. Destination of Families Migrating From Providence 1950-1959.
Table A-2. Median Income in Upper Bay Census Tracts.
Table A-3. Low Income Families in Upper Bay Census Tracts.
Table A-4. Percentage of Rental Units of Upper Bay Census Tracts.
Table A-5. Average House Value of Upper Bay Census Tracts.
Table A-6. Employment Levels in R.I.
Table A-7. Shoreline Character Type.
Table A-8. Erosion by Waves in a Single Storm.
Table A-9. Municipal Sewage Discharges.

# 1 Introduction and Summary

## INTRODUCTION

Across the nation, the potential value of old commercial and residential waterfronts to the success of urban renewal and redevelopment is gaining increasing recognition. The traditional zoning based view that the industrial waterfront is not suitable for other purposes is disappearing. In many cities residential, commercial and recreational uses of the shore have been integrated with revitalized port activities.

Concern for the Upper Narragansett Bay urban waterfront has been rising over the past decade. India Point was transformed from a scrap metal facility to a 12-acre municipal park in the 1970s after a major public and private fund-raising effort. The frequent closure of the quahog fishery in the Upper Bay has led to greater public concern about the operation of the Fields Point sewage treatment plant and the need for investments to upgrade water quality. Non-petroleum cargo imports and exports have increased at the Port of Providence, resulting in greater interest in port development needs in Providence Harbor. Upper Bay communities such as East Providence and Warwick have undertaken their own coastal planning studies. In 1977 the Coastal Resources Management Council adopted a comprehensive set of policies for protecting the environmental quality of the coastal zone. The program offers a major tool for addressing urban waterfront issues. The Center for Ocean Management Studies at the University of Rhode Island sponsored the conference Upper Narragansett Bay; Decline or Revitalization? in July of 1979. During July 1980, Save The Bay held a two-day workshop The Providence River: Help Turn the Tide, which dealt with environmental issues along the City of Providence waterfront.

This report was prepared for the Rhode Island Coastal Resources Management Program to serve as a basis for discussion and action on a broad range of urban estuary issues. The goal has been to explore the changing relationship between people and natural systems in the Upper Bay and to test some assumptions about its character, condition, and future. The boundary of the Upper Bay as used in this text includes tidal waters from Pawtucket to the northern tip of Prudence Island. The inland reach of the "Upper Bay" ranges from the Bay shoreline to include the two-state Providence Metropolitan Area and the several municipalities that border the Bay to the south (Figure 1-1). Such a broad definition of the social and ecological features of the Upper Bay is necessary if we are to demonstrate the regional significance of the estuary and the need for cooperative state and local management and redevelopment efforts.

Our exploration began with an effort to describe the principal social and physical features of Upper Narragansett Bay within the context of the Providence Metropolitan Area. This material is summarized below and is

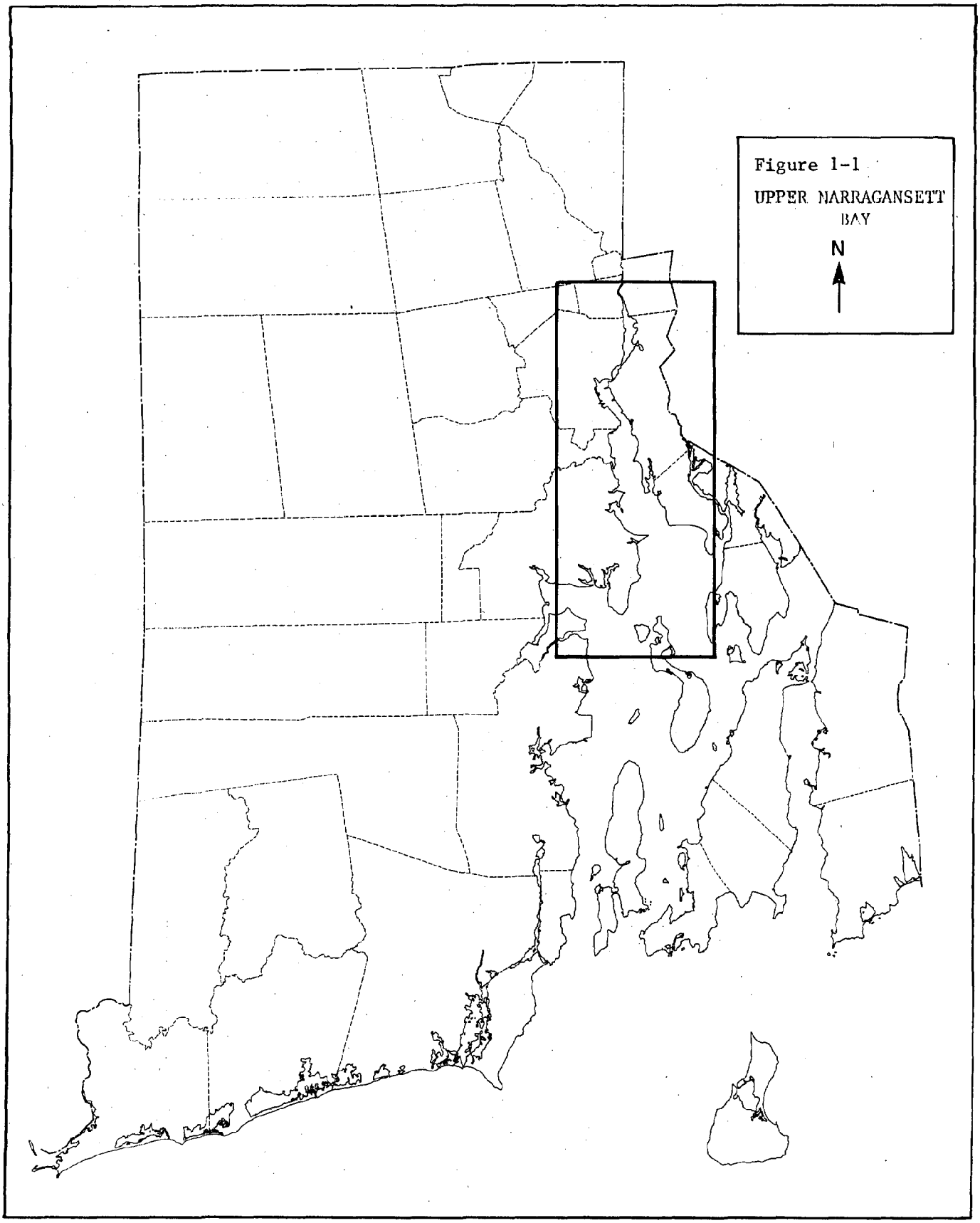
Figure 1-1
UPPER NARRAGANSETT BAY
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further described in Appendix A of the report. Three major aspects of human activities that are supported by the Upper Bay resources were identified: the commercial fishery, the port industry and recreation. Issue papers have been prepared which describe the history, present problems and potential solutions for each topic. These are treated in the remaining chapters of this report.

## THE URBAN ESTUARY

The upper portion of Narragansett Bay and the band of urban development which surrounds it possesses a rich and diverse social and environmental character. Altered by two centuries of economic activity and residential development, the Upper Bay's waters are still productive and its shoreline is still dominated by natural features.

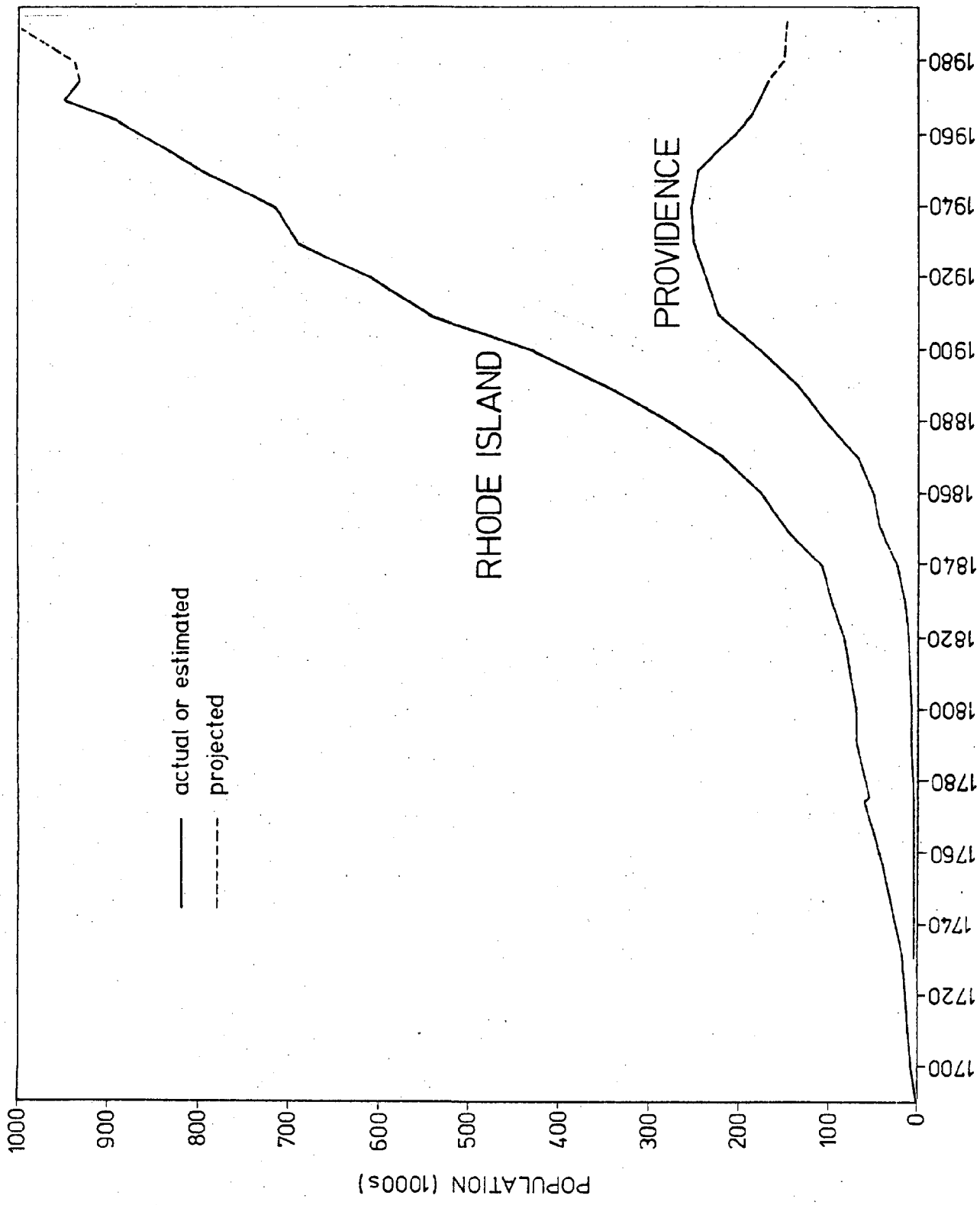
The urban development which has both modified and been shaped by the topography and physical forces at work in Upper Narragansett Bay began as Providence's economy expanded and its population increased during the 19th century. Farm land and summer colonies on the periphery of the area became absorbed in a rapidly enlarging metropolis. The consequence of this economic and urban growth was an increase in the total wealth and population of the region and a noticeable change in the character of the Upper Bay environment. By the 1870s, complaints about pollution in the Providence River and its tributaries were common, leading to the construction of the Fields Point sewage treatment plant in 1890.

At the turn of the century when Providence possessed 40 percent of the state's population, its influence peaked. Providence attained its highest population level in 1940. This was followed by a steady decline as surrounding municipalities saw rapid growth (Figure 1-2). Post-war prosperity and deteriorating conditions within the city led to the present patchwork of residential developments of different housing values, unit ages, and social characteristics.

Most of the Upper Bay shore is dominated by, and zoned for, residential use with the exception of Providence Harbor which is dominated by port-related industry. The diversity of housing stock and neighborhoods may be one of the Upper Bay's most important assets. An untapped resource of older structures of historic value is interspersed throughout shore-front communities. Deteriorated housing exists in isolated pockets rather than dominating large areas.

Many of the coastline's natural features, particularly tributary streams and coves, have remained intact and served as a natural barrier to development. They now provide an important reservoir of open space to many neighborhoods. However, these small estuaries require management and protection--perhaps to a greater degree than their rural counterparts. Storm water runoff laden with sediment and pollutants affects the water quality of both streams and coves. Filling, dumping, and other encroachments degraded the character of many of these places. However, with some cooperative effort they can be revitalized and where they are now encroached upon or neglected, they could be focal parts of green space in otherwise crowded urban communities.

Figure 1-2. Population Change s in Providence and Rhode Island, 1700-1970



Despite dramatic urban growth, the Upper Narragansett Bay remains a valuable ecological resource. The Upper Bay is a typical temperate estuary, a coastal embayment in which seawater mixes with, and is measurably diluted by, freshwater from land drainage. The Upper Bay is best described as a stratified system in which freshwater derived from rivers, rain and runoff flows out over heavier salt water that moves up the Bay from the Sound along the bottom. Superimposed on this basic pattern of two-layered flow are currents driven principally by the wind and tides. Tidal flushing is an important force in the Bay. It has been estimated that the tides flush almost 250 times the volume of water in and out of the Bay as does the mean total river input (Kramer and Nixon, 1978). Tidal flushing, combined with the intrusion of well oxygenated, relatively clean Bay water well upstream into the Providence River, prevents the existance of much worse water quality problems. The inflow of Bay water along the bottom is probably a major reason why anoxic conditions are not more frequent and wide-spread in the Providence and Seekonk Rivers (Olsen and Lee, 1979).

A striking characteristic of the Upper Bay as an estuary is its great variability. There are distinct seasonal variations in sunlight, temperature, river discharge and salinity. In the Upper Bay, average salinity varies seasonally from about 18 to 27 parts per thousand and the annual water temperature range is normally from 0-24$^{o}$C. Although rainfall is fairly constant year round, there is a distinct seasonal pattern to river discharge in which there is low flow in the summer and high flow the rest of the year. In the summer, vegetation in the watershed transpires to the atmosphere what would have otherwise been discharged to the Bay. There are seasonal variations in the aquatic life in the Upper Bay which accompany the changes in physical parameters. There is a seasonal succession of spawning by organisms that inhabit the area as well as a seasonal pattern of migration of fish that move in and out of the Bay. Great schools of menhaden come into the Bay from offshore waters in early spring and leave in the fall. They are pursued by large numbers of bluefish and striped bass.

Besides being a highly variable system, the Upper Bay is also a productive one. Annual phytoplankton production for the Bay as a whole is estimated to fix about 300 grams of carbon per square meter. The secondary production is also high (Furnas, et al., 1976). During spring and summer there are abundant numbers of fish larvae that form a substantial portion of the zooplankton community. Dense quahog beds extend into the lower reaches of the Providence River.

Marked spatial gradients in the bottom habitat extend down-Bay. Silt clay sediments are the characteristic bottom type in the Upper Bay while sands are abundant in the lower Bay. There is a high proportion of organic matter in the surface sediments due to organic particles flushed from the sewage treatment plants, urban runoff, and phytoplankton cells sinking to the bottom. Consequently there is a gradient down-Bay in which nutrients and carbon content are much higher in the Providence River and Upper Bay sediments than down-Bay. The communities of organisms that inhabit the bottom of the Upper Bay are patchy in their distribution in response to gradations of dissolved oxygen, organic content and sediment size.

The chronic discharge of inadequately treated sewage from the Fields Point treatment plant, and pollutant inputs from rivers, storm sewers, and other treatment plants have been the subject of heightened public concern. The immediate consequence has been the Department of Environmental Management's frequent closure of Upper Bay shellfishing ground to commercial fishermen, along with declining recreation and aesthetic appeal of the water.

The environmental problems of the Upper Bay extend beyond water quality to include shoreline debris, natural area protection, erosion and flooding. Resolutions to each of these concerns require increased public commitment.

## MAJOR ISSUES

In this report, each of the major issues selected for detailed discussion represents an aspect of the physical character of the Upper Bay linked with its social and economic context. Commercial fisheries, the port industry, and recreation all are important due to the presence and character of Narragansett Bay. Water quality is a major issue in the context of public concern about the well being of these important economic and social activities.

### Fisheries

The Upper Bay commercial fishery is an example of an important activity supported by a biological resource that has changed radically over time. A very large and lucrative managed oyster fishery flourished in the 1800s but declined after the 1920s and disappeared by 1957. This fishery was superseded by the present quahog fishery. However, the quahog fishery is limited by persistent water pollution problems. The productive beds in the lower Providence River have been closed since the 1950s. The permanent closure line has been moved south since then, with a conditional area between Warwick and Poppasquash Point. The conditional area is closed for a week to ten days after a heavy rainfall when storm water overloads flush sewage into the river and Upper Bay. The conditional area was not open at all in 1979 due to failures in the Providence sewage treatment plant. Progress must be made toward improving the quality of effluent discharged from the Providence sewage treatment plant, as well as the reduction of other sources of pollution, to increase the amount of time the quahog fishery is open, and to have legal access to the soft shelled clams in the lower Providence River. Improved water quality may also contribute to a return of the oyster fishery.

The Upper Bay also supports an important recreational finfishery although little is known about Upper Bay finfish resources or harvesting. However, even the upper Providence River supports a surprisingly diverse population of fish despite occasional low oxygen conditions. Increasing the physical access to these resources is an important possibility.

## The Port Industry

Providence Harbor includes the city-operated Port of Providence, several private petroleum and bulk cargo terminals, as well as marine repair and piloting services. Although petroleum traffic dominates port activity as measured by tonnage, it grew only 24 percent between 1950 and 1977, while bulk and general cargo increased 417 percent in the same 27-year period. In 1977, of the ten major New England ports, Providence Harbor ranked fourth in both total tonnage and petroleum handled, but was second only to Boston in non-petroleum commodities. Providence was first in automobiles, lumber, and asphalt imports and scrap metal exports, and second in cement, iron, and steel sheet and pipe handling. Providence Harbor had the highest growth rate of any New England port for inbound general and dry bulk cargo between 1960 and 1977. The estimated annual cargo handling capacity of the Municipal Wharf is 8.6 million tons, five times its present use and twice that of the next largest terminal which is in New Haven. Projections based on past performance indicate that general and dry bulk cargo will double in the next twenty years.

The growth of the port industry during the 1970s has raised expectations for its future contribution to the municipal and metropolitan economy. Some of the ground work for achieving further growth in port activity is already underway by the city and industry. However, the state must also become involved by providing needed legislation, establishing a framework for public and private sector cooperation in the harbor as a whole, coordinating state planning, regulatory and economic development efforts, and pursuing federal matching funds.

## Recreation

Studies show that metropolitan Providence suffers a shortage of outdoor recreation opportunities. Decades of suburban development in this century stimulated by the economic success and population growth of Providence and other cities has overtaken most of the agricultural and recreational uses of the shore. Increasing shoreline access as well as protecting remaining open space, and recreational facilities are essential for enhancing the quality of the urban environment and keeping the now densely developed shoreline a desirable place to live. Full and creative use of publicly owned existing land and rights-of-way and conducting vigorous efforts to assure public access in major private developments is particularly important in Rhode Island, which ranks 42d of 50 states in state and local spending for parks and recreation.

# THE NEED FOR LEADERSHIP

A crucial lesson of the national experience in urban waterfront revitalization is that the revival process cannot occur unassisted, and that a partnership between public and private sectors is essential. John Ames, Director of the Boston Harbor Associates, and an advocate of harbor redevelopment, stated at the Upper Narragansett Bay Conference in July 1979, "The feeling of tribal feudalism that dominates some of the decision-making in Boston Harbor is a wonder to behold. I suspect if you are at

all similar to Boston politically, and I have every reason to believe you are, that feeling of tribal feudalism between public agencies exists in Rhode Island as well." The Port Authority of New York and New Jersey is taking the lead on waterfront redevelopment in the two-state New York inner harbor. It has adopted a strategy based on two roles, first as "active developer" of physical projects in conjunction with municipalities and secondly to "advocate, organize and energize" the redevelopment efforts of others. The authors of the Baltimore Metropolitan Coastal Area Study (1978) observe that "over the years, the coastal environment has deteriorated and has not been adequately managed because of a complicated and difficult to understand decision-making process, the sheer number of affected interests and responsible authorities, and an inability to reconcile differing values and roles into an effective resolution." The absence of an organized mechanism to catalyse awareness, attract resources and advocate metropolitan solutions to regional coastal problems continues to be a major concern. "The (Chesapeake) Bay functions as a unit and so must we. Interjurisdictional cooperation and the attention of state and federal agencies is essential."

In the decade of the 1980s high energy costs and mortgage interest rates and a less expansive economy are changing the conditions which influence individual decisions about where to live and how often to move. It is unlikely that the deep appreciation of local geography, culture, and history which characterized the attitudes of earlier generations of Rhode Islanders will suddenly reappear in the Upper Bay communities. However, there is a clear need for a reexamination of both the heavy subsidies provided to development at the urban fringe, and the true costs of a failure to correctly value and manage urban resources. The consequences of continued neglect can be avoided by taking needed steps now while choices still exist.

This report is a culmination of a one year project that ended in June 1980 that was undertaken by the Coastal Resources Center for the Governor's Office with funding from the Rhode Island Coastal Resources Management Program. The goal of the project was to identify and describe the major urban waterfront issues which affect the quality of the Upper Narragansett Bay environment and to identify ways in which those concerns can be addressed by the state. The results of the assessment presented here has led to a second year of work where the Center will work with appropriate agencies of state government, particularly the Governors Office and Coastal Resources Management Council and assist them in taking action on specific issues including dredging, debris removal, and waterfront improvements.

We hope that this report will stimulate greater public interest in working toward a brighter future for Upper Narragansett Bay in terms of improved environmental quality, economic activity and public enjoyment.

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# 2 Fisheries

## INTRODUCTION

Fisheries have always been one of the most important of man's activities in Upper Narragansett Bay. Early records from the 1600's describe large anadromous fish runs, extensive soft shell clam beds and oyster bars, and finfishing by seines, fyke nets and fish traps. A century ago, a managed oyster fishery flourished in the Upper Bay that yielded millions of pounds of oysters and employed several thousand people in harvesting, processing, and shipping. Shellfishing and finfishing are still important activities in the Upper Bay, though the species sought have changed. Now, over a thousand people rely on quahoging for some portion of their income and there are hundreds of sportfishermen that look to the Upper Bay as a prime source of recreation. However, the present fisheries of the Upper Bay seem to be suffering because of deteriorating water quality. Fish stocks are not as high as they once were and some of the most productive quahog beds in the Upper Bay have been permanently closed because of pollution. In addition, a "conditional area" incorporating the rest of the Upper Bay has been closed for increasing proportions of the past several years and all of 1979, primarily because of malfunctions at the Fields Point sewage treatment plant.

In order to assess the present status and possible options for revitalization of the Upper Bay fisheries, this chapter examines historical trends to ascertain whether fisheries have truly declined and note the probable causes. Recent data is summarized to estimate the present stock of finfish and shellfish. Also included is a discussion of the role of overfishing, pollution, and government regulations in limiting the fishery of the Upper Bay. Suggestions for revitalization are listed in the summary.

## SHELLFISHING IN THE UPPER BAY

The Upper Bay provides a particularly hospitable environment for shellfishing since it is a tidal estuary of moderate depth with extensive shallow stretches of level bottom comprised primarily of sandy silt. The Providence River covers an area of about 5,000 acres with an average depth of 14 ft. and the Upper Bay covers an area of 11,000 acres with an average depth of 24 ft. (Kremer and Nixon, 1978). Nutrients from land drainage and sewage flow into the Upper Bay and support abundant crops of phytoplankton, a rich food supply for the filter feeding shellfish. At present the major shellfishing effort is for quahogs. Quahogs, or hard shell clams, are the most important commercial shellfish in Narragansett Bay, and the upper Bay harbors some of the most productive quahog beds in all of Narragansett Bay. Soft shell clams are less abundant than quahogs in the Upper Bay since they are found in siltier sediments but they are distributed

both intertidally and subtidally in patches throughout the Upper Bay and Providence River. Conchs also support a small fishery in the Upper Bay.

## Historical Perspective on Major Shellfisheries in the Upper Bay

Shellfishing is one of the oldest and most continuous uses of the Upper Bay. The native Indian population relied on shellfish as a major source of food and fashioned quahog shells into Wampum. Goode (1887) gives an excellent description of early fisheries in the Bay. He mentions that the Indians were reportedly angered by the colonists' hogs fattening themselves on shellfish beds at low tide, since the soft shell clam and oyster beds that lined the Seekonk and Providence Rivers were to them a valuable food source. However, the colonists also relied on these resources. In 1639, when a famine was imminent, a general assembly of freemen voted that all water below sea level was declared free for fishing. In the 1683 charter from England establishing the Providence Plantations, the right of free fishing was guaranteed to every citizen. The right of free and common fisheries for the public benefit still is jealously guarded by Rhode Islanders. In the late 1700s laws were passed prohibiting the dredging of oysters for use as lime. The oyster fishery was to be conserved as a source of food with access for everyone rather than usurped by one industry.

## Oysters

In colonial times, the Upper Bay produced exceptionally abundant oysters. Schooners from Welfleet, Massachusetts used to get seed from Narragansett Bay to transplant on their beds. But by 1887, Goode reported in his survey of U.S. fisheries that, "little remains of the natural wealth of oysters upon which the early planters half a century ago could draw to what seemed an unlimited extent." Good natural oyster beds at one time covered the entire upper half of the Providence River extending into the cove next to the railroad station. One of the best beds, known as Great Bed, covered 160 acres south of Fields Point. The Seekonk River produced good oysters regularly even through the 1800s.

During the 1800s, most of the natural oyster fishery was replaced by a flourishing oyster culture industry in the Bay, in which the seed had to be imported from other states. Starting in 1844, sections of the Bay bottom were leased for oyster growing. As many as half a million bushels of seed were transported annually from Long Island or other coastal embayments in southern New England, and later from the Chesapeake Bay when local seed stocks ran out because of overfishing (Goode 1887).

According to Goode, local seed were planted on the best beds and imported seed placed on beds in the rest of the Bay. The best beds were considered to be those off Fields Point, Pawtuxet Cove, Gaspee Point, Conimicut Point, Nayatt Point, Rumstick Point, the Warren, Barrington and Kickamuit Rivers. Bullocks Cove was known to be the very best place to plant oysters in the whole state because of the many freshwater springs along the bottom. The rest of the Bay was planted with imported "Chesapeakes." There was a regular coastal trade in oyster seed which were brought up from the Chesapeake

to beds in New England. Oysters came to Narragansett Bay from the James River, and the seed was set out on oyster shell clutch on the Bay bottom in April and May. Several years later they were harvested as mature oysters. Narragansett Bay oysters were famous for their exquisite flavor and were shipped to markets and restaurants all through New England and Canada. In 1880 over 1,000 acres were leased and oysters made up more than half the total value of all fisheries in Rhode Island. By 1892 oyster grounds were leased all the way up the Providence River and into the Seekonk River (Fig. 2-1). Some of the most prized and productive beds were on Starvegoat Island, an oyster bar now covered by fill at Fields Point. The industry peaked in 1910 with 20,000 acres leased which brought $106,839 in fees into the state's treasury. Nearly 1,500 people were employed in the industry and 15.3 million pounds of oyster meats were landed that year (Alexander, 1966). Subsequently, the fishery declined through the 1930s as seed became more expensive to import and the industry moved south to the Chesapeake (Fig. 2-2). The last oyster business in the Bay closed its doors in 1957.

Now there are virtually no oysters havested from the Upper Bay. Many reasons are given for the loss of the fishery, including pollution, starfish predation, overfishing of seed beds, hurricane destruction, and poaching. It appears that the decline started long before the hurricane of 1938 and although it may have contributed to the decline it was certainly not the cause. Starfish predation is no longer considered to have been an important factor. Pollution may have damaged the health and marketability of oysters in the Providence River and Upper Bay, but it is unlikely to have ruined the oysters in the West Passage. The major reason for the decline of the industry was probably the increasing scarcity and expense of seed stock and the management problems that led to widespread poaching. Unlike today, oysters were a staple of the common man. Travellers, city dwellers, even gold miners out West all relied on live or canned oysters that were stewed, fried, and frittered. The market and industry outstripped the supply. The seed source gradually moved from Cape Cod to Narragansett Bay to Long Island to Chesapeake Bay, and the industry followed.

Soft Shell Clams

The soft shell clam fishery in the Upper Bay and Providence River has also been extensive. Good reported in 1887 that this was a fishery for the poor who dug them in the winter along both sides of the Providence River south of Fields Point. At that time an estimated 85,000 bushels were dug in a year from the Upper Bay and Providence River and shipped to New York, where they were sold for bait in the offshore mackerel and cod fishery. The variation over time in the Rhode Island landings of softshells can be seen in (Fig. 2-3). The Rhode Island catches have declined markedly since 1949, when 634,000 pounds were landed. Last year total Rhode Island commercial landings amounted to only 8,200 lbs. Although abundances are quite high in the Upper Bay (R. Sisson pers. comm.), the area is closed to softshell fishing due to pollution.

Quahogs

Since the demise of the oyster industry in the 1900s, quahoging has been the most important shellfishery in the Upper Bay (Fig. 2-2). According to Rhode Island landings, the quahog fishery for the entire state peaked

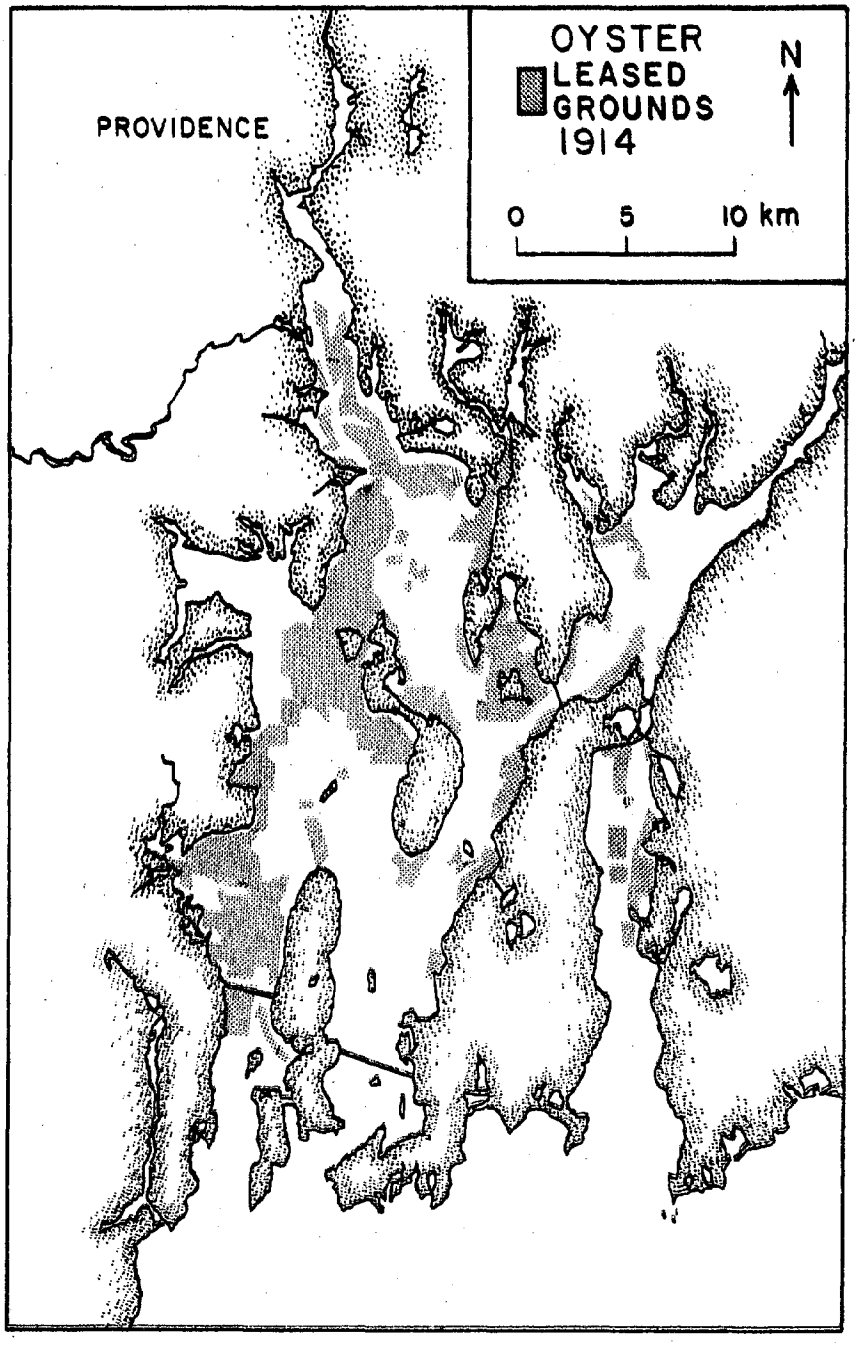


Figure 2-1. Leased oyster grounds in Narragansett Bay, 1914.
From L. Alexander, 1966. Narragansett Bay: A Marine Use Profile.

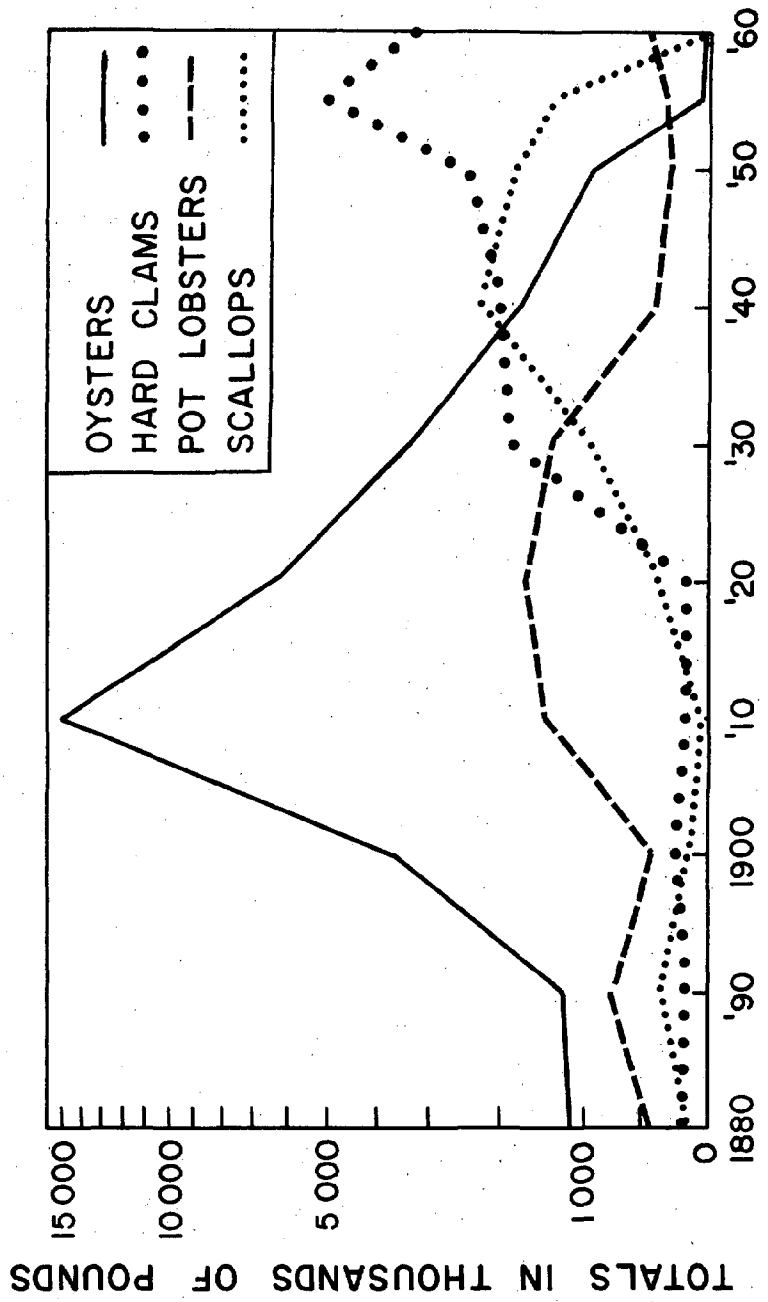


Figure 2-2. Shellfish Catch 1800 to 1960
Narragansett Bay

From: L. Alexander, 1966.

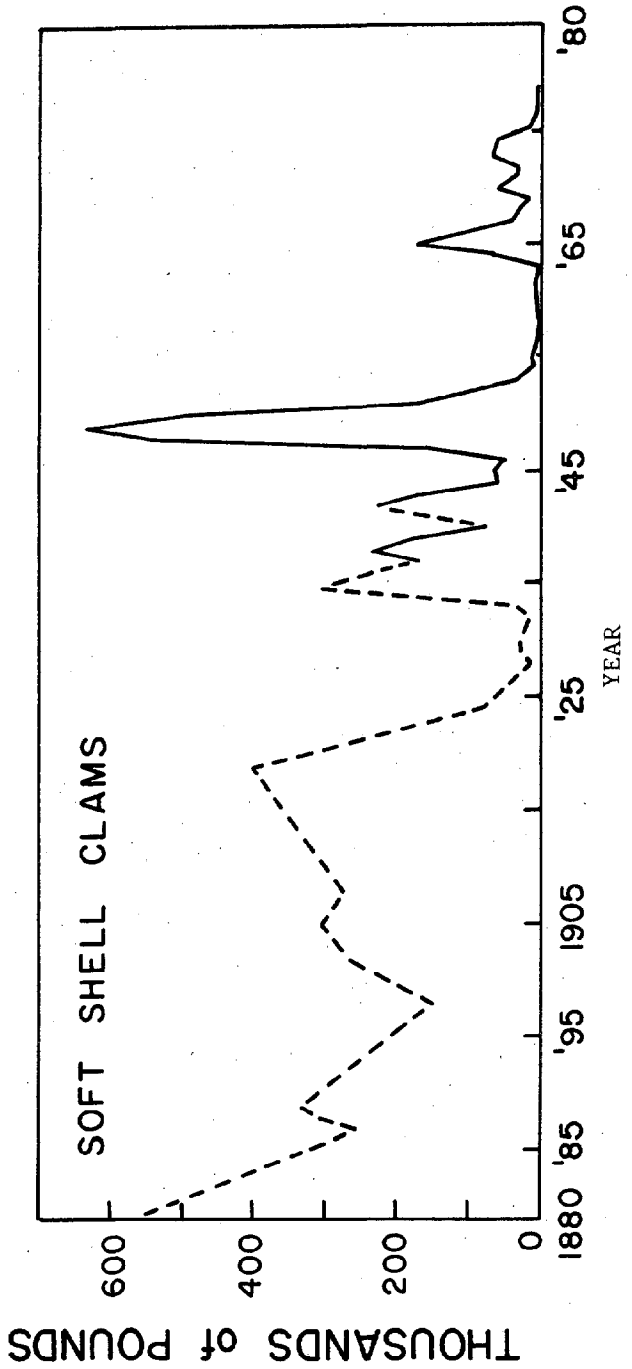


Figure 2-3. Trend in softshell clam landings from Rhode Island Coastal Waters. Olsen and Stevenson, 1975.

at 5 million pounds of meats in 1955 (Fig. 2-4). In the early days they were harvested by both dredge and hand rake. Dredge boats drag a metal dredge behind the boat that digs into the bottom and scoops up the quahogs. Although dredging is more efficient than hand raking, the more numerous hand rakers have succeeded since the 1950s in barring dredging from the Bay. Dredging is now permitted by law only in the Sakonnet River and only at the discretion of the Director of the Department of Environmental Management.

Status of the Present Fishery

At present, quahoging is the largest commercial fishery in the Bay. Although much smaller than catches in the 1950s, commercial landings have increased during the last four years (Fig. 2-4). In 1978 nearly two million pounds (meat weight) worth $4.3 million (ex-vessel) were reported as landed in Rhode Island. The Rhode Island landing statistics usually underestimate the catch because a portion of the fish and shellfish caught and sold are never reported to the National Marine Fisheries Service. However, these are the only available numbers to compare year to year trends in catch.

Most of the quahog catch is taken from Narragansett Bay by hand rakers. Hand rakers fish with tongs or a bullrake on the end of a long pole operated from small open skiffs. Tongers work waters up to 20 feet deep while rakers can work up to 50 feet deep with the long aluminum poles. Last year there were an estimated 300 full-time quahogers and an additional 1,600 part-timers who supplement their regular income by quahoging weekends or during the summer (R.I. DEM). The summertime recreational fishery exerts a fairly minor pressure on the resource, since recreational fishermen do not usually invest in a boat and raking equipment. Instead, they work the shallow waters nearshore and are content with a much smaller catch (the legal limit is 1/2 bushel per day). Commercial handrakers are restricted to a legal limit of 12 bushels of quahogs per day. The average quahoger, however, does not fish his limit in bushels, but rather decides on the monetary need for the day and fishes until he has it, usually $100 to $300. The smaller clams are the most sought after since they bring the better price. The catch is divided into three size categories: littlenecks, 1 1/2" - 2 1/8"; cherry stones, 2 1/8" - 2 1/2"; chowders, greater than 2 1/2" (measured from the hinge to the shell margin). The 1979 ex-vessel prices offered per pound were as follows: 80¢ for little necks, 15¢ for cherry stones, and 10¢ for chowders. As the size decreases, the market value is greater because the small clams are prized for serving raw on the half shell.

Due to good sets and increasing prices, the numbers of licensed quahogers have increased over the last few years (Fig. 2-5). As a result of this increased effort, the catch in Rhode Island has been increasing steadily, even though the beds in the Upper Bay have been closed. In 1978, R.I. landings were 10% of the U.S. harvest.

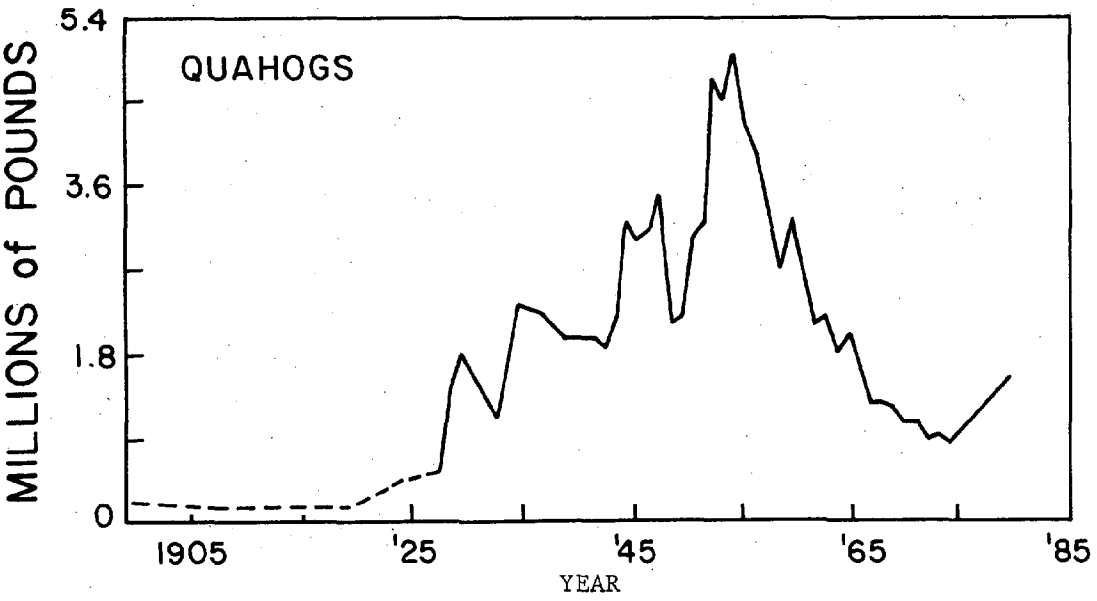


Figure 2-4. Trend in Rhode Island Commercial Landings for Quahogs. Note that the landings picked up in the 1930s as the oyster catch declined (see Figure 2-3) and that they are increasing in recent years from a low point in the early 1970s.

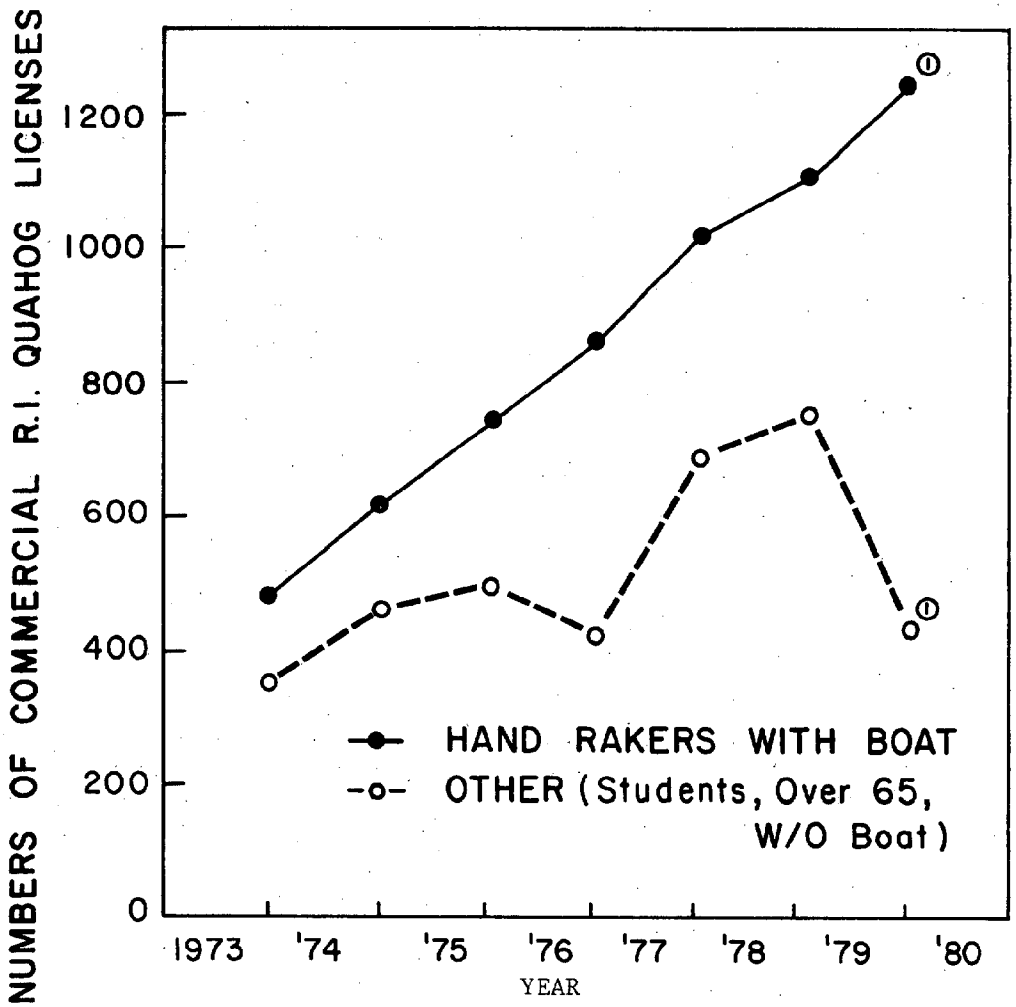


Figure 2-5. Recent trend in the numbers of commercial quahog licenses issued to Rhode Islanders. The numbers of hand rakers with boats is steadily increasing since 1973. The numbers for 1979-1980 are preliminary. They are totals for the first half of the year (as of January 1980) and expected to increase this spring and summer with the advent of good weather and summer vacations.

Distribution in the Bay. Quahogs are abundantly distributed over the bottom of Narragansett Bay, particularly in the West Passage, Greenwich Bay, the Upper Bay and the edges of the Providence River. They feed on phytoplankton which they filter from the water as they pump it in through their siphon tubes and over their gills. They spawn in the summer from mid June to mid August, when water temperatures rise above 60°F. A female releases a total of about 2 million eggs each season which metamorphose into planktonic larvae that are suspended in the water 10 to 12 days before settling on the bottom.

It is well known that some of the best quahog beds are located in the Upper Bay and lower Providence River. It is, however, difficult to estimate the size of the population, or what sustainable yield could be fished. In the most recent survey of the quahog stock completed by the R.I. DEM in 1978, in which 12 stations were sampled on both sides of the lower Providence River (north of Conimicut Point, south of Gaspee Point), cherrystones and littlenecks were found in surprising abundances. No chowder sized clams were found. In a 1975 survey in the same area, abundant numbers were also found, but a few chowder sized clams were present in addition to the large proportion of cherries and necks. Earlier surveys provided varying estimates of the quahog population in the Upper Bay and Providence River. The density on each side of the channel in the lower Providence River (between Conimicut Point and Gaspee Point) has been estimated at 166 bu/per acre in 1956, (Stringer, 1956) at 346 bu/per acre in 1965 (Saila, 1965), and at approximately 42 bu/per acre for the Upper Bay and lower Providence River in 1974 (Sisson, 1974). However, the equipment and survey methods differ so much that it is not appropriate to surmise changes in actual abundance from these data. The surveys do indicate that there is presently an abundant population of the smaller quahogs which are the sizes most valuable for marketing. They are also the sizes in which most of the reproduction occurs, and therefore most valuable in terms of maintaining a fishable stock.

Pollution Effects on the Quahog Fishery. Many of the prime quahog beds have been permanently or conditionally eliminated from the fishery because of pollution in the Providence River from industrial discharges, storm sewer outfalls and sewage treatment plant effluents. Over 5,600 acres of the Providence River north of Conimicut Point are now permanently closed to shellfishing and an additional 9,400 acres of the Upper Bay are conditionally closed. During recent years, the conditional area has been closed for increasingly long periods of time due to equipment failures at the Fields Point sewage treatment plant (Figure 2-6 ). According to a DEM report (Sisson, 1976), areas in the lower Providence River and conditional areas of the Upper Bay that are presently closed to shellfishing could produce an annual harvest of about 6 million pounds, worth some $1.5 million (ex-vessel) (1979 prices). Using a multiplier of 2.76 for R.I. quahoging (Callaghan and Comerford, 1979), this harvest could contribute about $4 million annually to the state's economy through direct, indirect and induced multiplier effects.

Government Policies and Regulations. The Rhode Island Department of Environmental Management sets water quality standards primarily on the basis of coliform bacteria counts and dissolved oxygen levels. In Class SA waters (salt water in which shellfishing and bathing are permitted) coliform

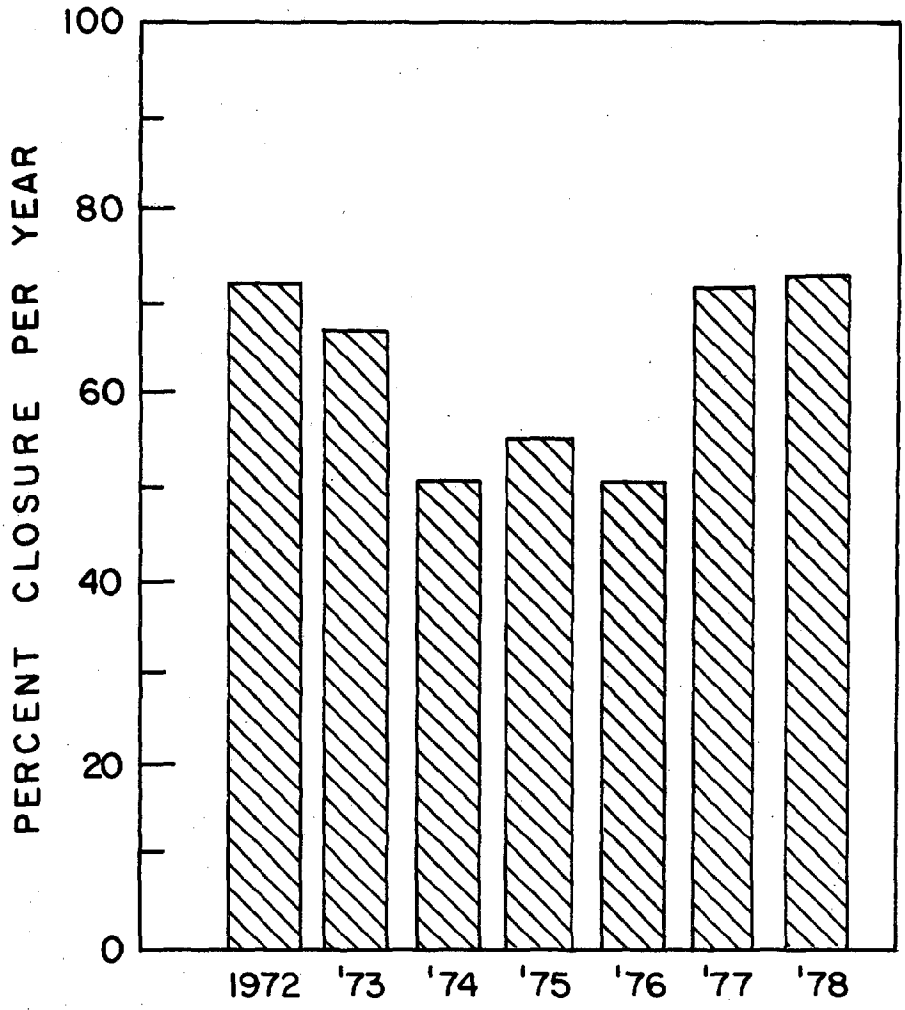


Figure 2-6. Percent of any given year that Upper Narragansett Bay shellfish beds are closed by R.I. Department of Health, usually as a result of heavy rainfall. Summarized from R.I. DEM.

levels must not exceed a median most probable number (MPN) of 70 per 100 ml of water. SB waters may be used for bathing and for shellfishing after depuration. Coliform levels in this water must not exceed a median MPN of 700/100 ml. Class SC is suitable for fish and wildlife habitat, recreational boating and industrial processes and no coliform levels are specified. Because of high coliform levels and low oxygen concentrations, the Providence River is less than SA, and is classified SC for much of the northern section. Consequently, the Providence River north of Conimicut Point has been permanently closed to commercial shellfishing since the 1950s. Since commercial shellfish are marketed out of state, the DEM establishes the closure boundaries in consultation with Federal FDA officials whose mission is to protect public health rather than manage the environment. As a result, the areas closed to shellfishing include a conservative safety margin. For instance, beds are closed on the basis of coliform counts taken from samples of surface water. In the Providence River, the surface waters have much higher concentrations than bottom waters of, than the quahogs themselves. In 1966, Dr. Andreas Holmsen of URI did a study of the practicality of quahog depuration. Quahogs contaminated with high levels of coliform in need of depuration could not be found for experimentation in the Upper Bay during the non-summer seasons. Nonetheless, the area is closed to shellfishing. The permanently closed area was extended down Bay in early 1980 (Figure 2-7).

In addition to the permanently closed area, the state conditionally closes the entire Upper Bay, approximately 10,000 acres of prime quahog beds, after a heavy rain (Figure 2-7). The conditional area is closed from 7 to 10 days following 1/2 inch or more of rain in 24 hours in the Providence area because the treatment plant cannot treat the excess volume of storm water. During high storm runoff, bypass valves are opened that shunt storm water and sewage directly into the river. As a result, surface waters of the Upper Bay become contaminated with coliform bacteria above levels set by Federal standards for shellfishing areas.

Besides regulations that are set by coliform concentrations, there are FDA standards set for mercury and some pesticides, PCBs (2.5 ppm) and kepone (.1 ppm). Concentrations in quahogs harvested from the Upper Bay and lower Providence River are below these standards. Since metals are concentrated in sediments and accumulated in organisms to greater concentrations than they are found in the water, they may constitute a health hazard even though concentrations in the water are relatively low. With this in mind, the Federal Food and Drug Administration has set "alert" levels for quahog tissue as a forewarning to public health officials to check an area more thoroughly if such levels should occur. These levels are not legally binding but serve as a warning mechanism. Although metals are found in high concentrations in clams taken from the Upper Bay than in those father down Bay, concentrations are well below the alert levels, with an occasional exception of high copper and chromium levels in clams in the Providence River. High concentrations of oil have been found in clams from the Upper Bay (Farrington 1971, Boehm 1977).

It may well be that government regulations closing shellfish beds on the basis of coliform concentrations in surface waters are too restrictive Rarely do fecal coliform levels in the quahogs in the Upper Bay and lower

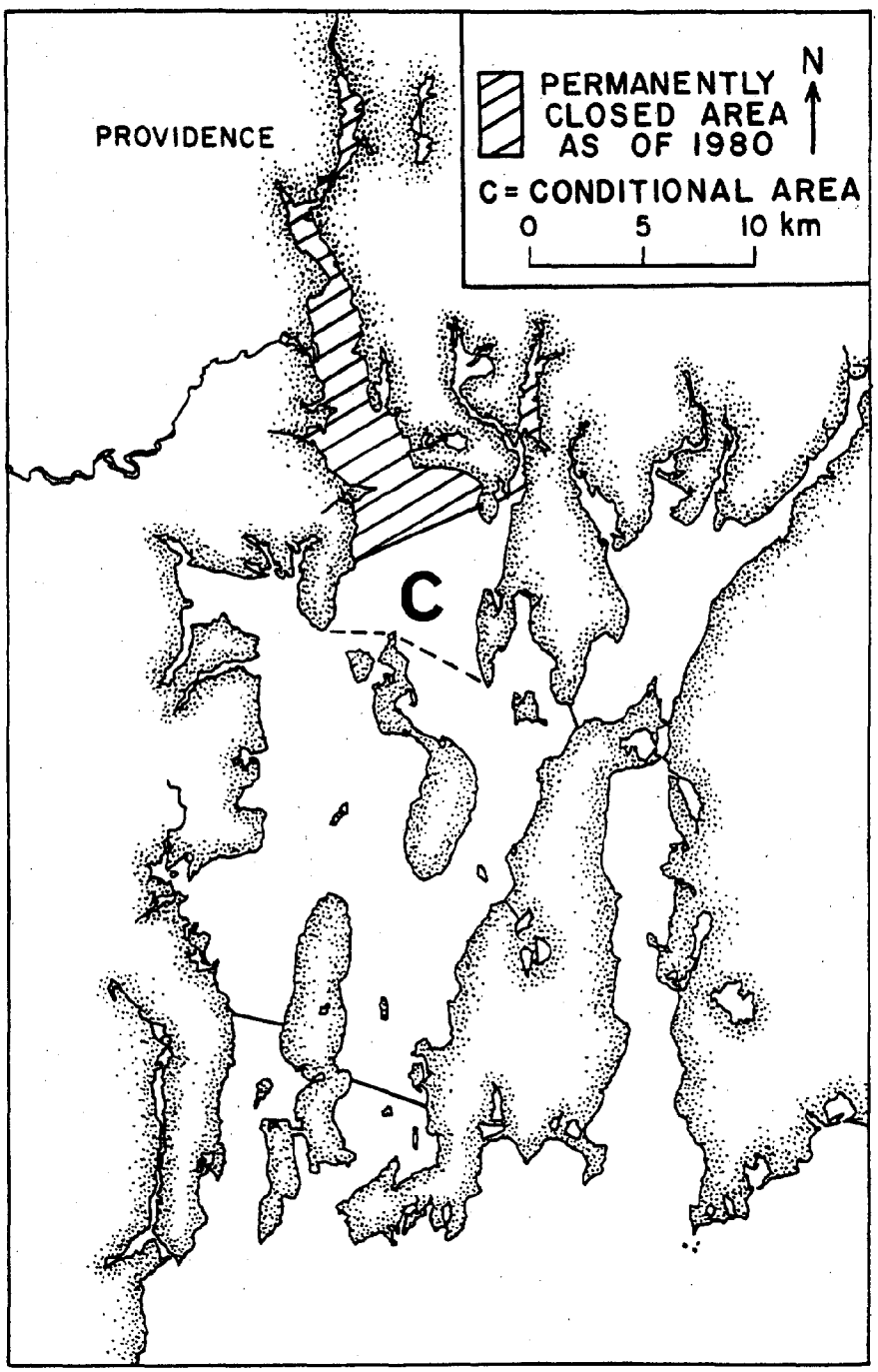


*Figure 2-7. Map of Narragansett Bay showing the area of the Upper Bay and Providence River permanently closed to shellfishing because of coliform pollution. Below it is the "conditional area" which covers the rest of the Upper Bay and is closed after a heavy rainfall (1/2" in 24 hrs.) in Providence because storm runoff overloads the sewage treatment plants which discharge into the Providence River.*

Providence River exceed FDA market standards. If closures were based on routine bottom water sampling or shellfish meat sampling they would be more indicative of the actual state of the resource. As a result, more of the most productive beds in the Bay might be safely opened to fishing.

## FINFISH IN THE UPPER BAY

At present the Upper Bay finfishery is primarily recreational. Thousands of pounds of bluefish, striped bass, and blackback flounder are caught in the Upper Bay by hook and line from small boats and from the shore. Much of Rhode Island landings for striped bass and bluefish are caught by sport-fishermen. With the exception of a small amount of menhaden seining, there is virtually no commercial finfishing in the Upper Bay. Draggers are legally restricted by DEM to fish south of Prudence Island. Anadromous fish runs which were once an important fishery in the tributaries to the Upper Bay and Providence River have dwindled to almost nothing. The state is trying to revitalize the fishery with a restocking and fish ladder construction program. Finfish data pertaining to the Upper Bay or Providence River are very sparse. Few surveys have been done in the area, so it is difficult to assess the size of the fish stocks or the effects of pollution or overfishing.

### Historical Perspective

Although there is no complete historical record of fish caught in Narragansett Bay, or more particularly in the Upper Bay and Providence River, it appears that fish and shellfish populations have been much more abundant than they are today. Scattered information since the colonial period suggests that increasing pollution together with expanding fishing effort and more efficient technology were the major causes for the shrinking abundance and variety of fish in the Upper Bay.

In colonial times, anadromous fisheries in the rivers that flow into the Upper Bay were particularly important. Alewives and smelt were seasonally abundant and there were shad, salmon and sturgeon, as well. Goode (1887) reports that in the early 1700s laws were passed forbidding erection of dams or weirs on any stream that would hinder the passage of fish and forbade fishing for three days a week except by hook and line. However, the state government considered industrialization more beneficial to the public good than fishing, so more and more mills and dye works and processing plants constructed dams and discharged wastes into the rivers. By the 1790s it was noted that there was a decrease in the amount of migratory fish in Upper Bay rivers due to increases in mill sites. Goode reports that by the late 1800s, Warren was the northern limit of fishing in the Bay due to increased industrialization and factory pollution. Below Warren, alewives, shad, and scup were common in the spring. They were followed later in the season by squeteague, tautog, flounder, bluefish and eels. These species were fished by gill nets, fyke nets, fish traps and eel pots. In 1880 there were five fish traps on the Warren River for shad, three scallop boats, 18 dredges, and 10 clam boats, which landed an estimated 5,000 shad, 2,500 bushels of clams and 1,000 gallons of scallops. At that time, seventy-five men were employed clamming or scalloping or net fishing most of the year off Pawtuxet.

The floating or staked fish trap dominated fishing efforts in the Bay in the early 1900s. The traditional net and hook and line fishermen were driven out of business because the traps drastically reduced the abundance of fish in the Bay. These nets were very efficient and intercepted schools of fish as they passed along the shore during spring and fall migration. In 1910 there were nearly 400 fish traps in Rhode Island. Concern for declining fish stocks led to restrictions of where and when traps could be used. By 1964 most of the Bay was closed to trap fishing and there were only 24 traps in the state landing 8,843,000 lbs. of fish, 24 percent of the total Rhode Island landings (Holmsen, 1973). Today there are only a few floating traps operating off the south shore and Sakonnet River that catch only a few percent of the fish landed in the state.

More recently, heavy fishing offshore by U.S. and foreign fleets has decreased Bay fish stock even further. Only half a dozen or so boats trawl for ground fish and there is considerable lobstering but these occur only in the lower Bay.

Status of the Present Fishery

Commercial finfishing is virtually non-existent in the Upper Bay and Providence River, with the exception of a small amount of seasonal menhaden seining. There are only four or five draggers presently working the Bay, primarily for blackback flounder. They are restricted to the lower Bay by DEM regulations (See Figure 2-8). Fishing by gillnets, fyke nets and drift nets is permitted in the Upper Bay, but the catch is not of commercial significance.

Menhaden

Purse seining by menhaden boats is permitted in the Upper Bay and Providence River south of Sabin Point. In recent years there have been only two Rhode Island registered menhaden boats seining in the Bay. If the catch is good they are joined briefly by as many as five vessels from New Jersey each of which catch two to three times as much as the local boats. However, the catches of the Jersey boats do not show up in Rhode Island landing statistics. Each of the local boats has a crew of 12 to 15 men and they usually fish the Bay from the first week in June until October. In the past few years, these boats have landed 10 to 20 million pounds of menhaden each summer in Rhode Island. Since the fish are processed into oil or chicken feed, this enormous volume of fish is not very valuable and yields only $200-$300,000 at the dock.

Adult menhaden usually move into the Upper Bay to spawn in April. By May, surface schools have formed which are easily visible and harvestable. In June the largest catches are taken from the Upper Bay, then the population disperses to the lower Bay, and most leave the Bay by early fall to begin their southern migration. Menhaden usually spend their first year in the Chesapeake, their second in coastal New Jersey and New York, and their third and fourth years as far north as Narragansett Bay. Since Rhode Island is on the northern edge of their range and there is heavy fishing

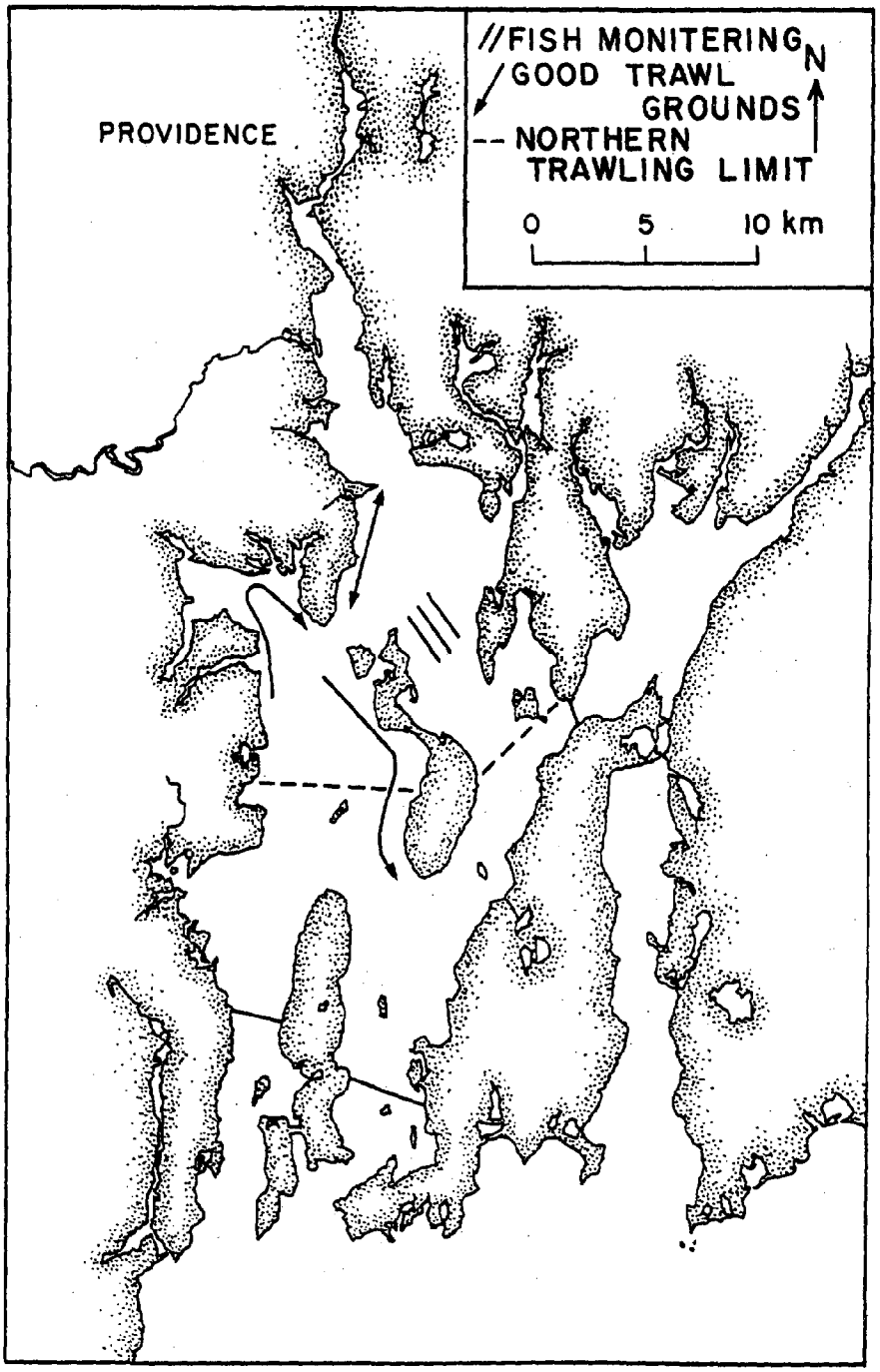


Figure 2-8. Map of Narragansett Bay in which the dashed line marks the area north of which no commercial trawling is permitted. The traditionally good trawl grounds that lie north of the line are marked by arrows. The cross hatched area marks the area routinely trawled by DEM to monitor for fish in the Upper Bay.

south of here, abundances and catch fluctuate strongly year to year. As can be seen in Figure 2-9, in good years 20 million pounds may be landed and in bad years, none. Although they are fished throughout the Bay and offshore, the Upper Bay appears to be the most important spawning area. Menhaden larvae are found in great abundance here and in Mount Hope Bay (Figure 2-10). The Bay is considered to once have been an important spawning site for the northeast menhaden stock. It may well be that poor water quality in the Upper Bay is toxic to the pelagic eggs and larvae and that this may have damaged menhaden stocks.

There is strong and apparently unjustified animosity between sportfishermen and menhaden fishermen in the Bay, to such an extent that the sportfishermen tried to close the entire Bay north of the Jamestown and Newport bridges to menhaden seining. The sportfishermen contend that menhaden are a vital food source for bluefish and striped bass, the major sportfish in the Bay. Since the menhaden seiners drastically deplete this baitfish stock sportfishermen believe the bass and bluefish must decline in the Bay as a consequence. However, there has never been any conclusive evidence that sportfish depend on menhaden. On the contrary, since 1945, bluefish and striper landings have steadily increased and show no correlation with the wide fluctuations in menhaden landings. The mid 1960s were particularly bad menhaden years, yet bluefish and bass landings did not decline. In fact, when menhaden landings were very high in the mid 1950s bluefish and striped bass were comparatively low (Figure 2-11). In a study by Oviatt (1977) on the relationship of the menhaden to their predators, it was found that striped bass and bluefish feed on a variety of bait fish in the Bay, but primarily on menhaden and sand lance. However, it appears that even when menhaden abundances are so low that it is no longer commercially viable to catch them, they are still abundant enough to be an important food source for their predators.

Sportfish

The finfishery in the Upper Bay is predominately recreational and dominated by striped bass and bluefish fishing. They are taken primarily by hook and line from small boats in the summer and early fall when they migrate into the Bay. They are also fished from bridges, wharves, or almost anywhere that fishermen can get access to the water. Tautog and blackback flounder are also important sportfish. However, there are no annual statistics available on the catches of recreational fishermen for the Bay as a whole or for the Upper Bay. In one study by Oviatt in 1977, buyer's records indicated that the greatest statewide landings for striped bass occur in June and July and from July to October for bluefish. Striped bass apparently follow the menhaden schools north, arriving in the Bay in May, and then leave in mid summer when the bluefish become most abundant. The Oviatt study estimates a total Bay catch for 1976 of 474,000 lbs. of striped bass and 397,000 lbs. of bluefish, most of it recreational. Oviatt calculated that this amounts to harvesting 65 percent of the total Bay population of bluefish and 26 percent of the Bay population of striped bass.

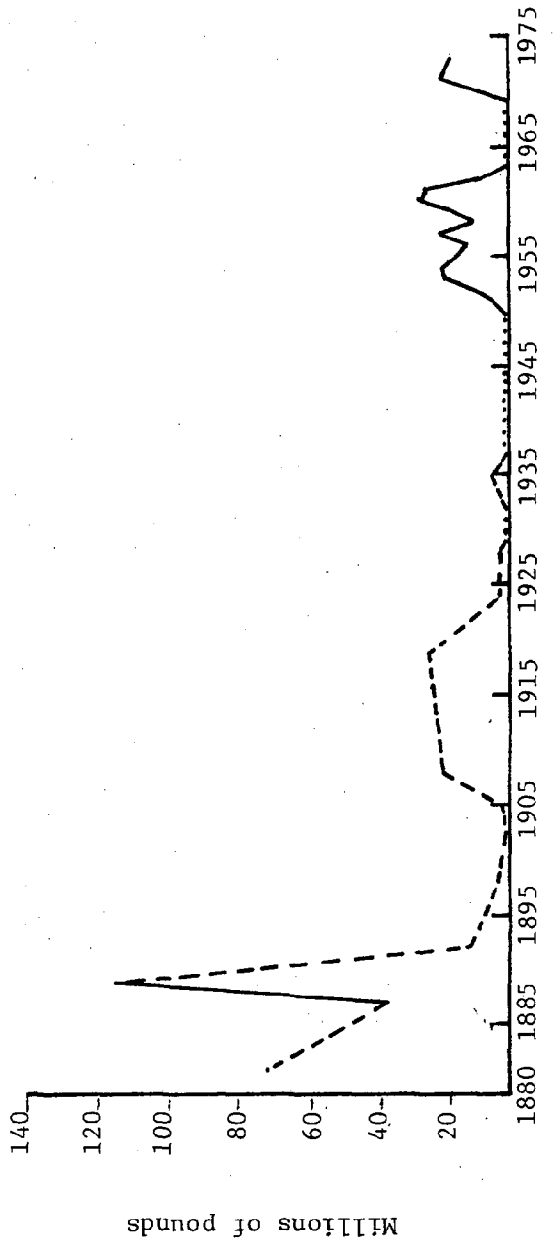


Figure 2-9. Menhaden landings over time.

Olsen and Stevenson, 1975.

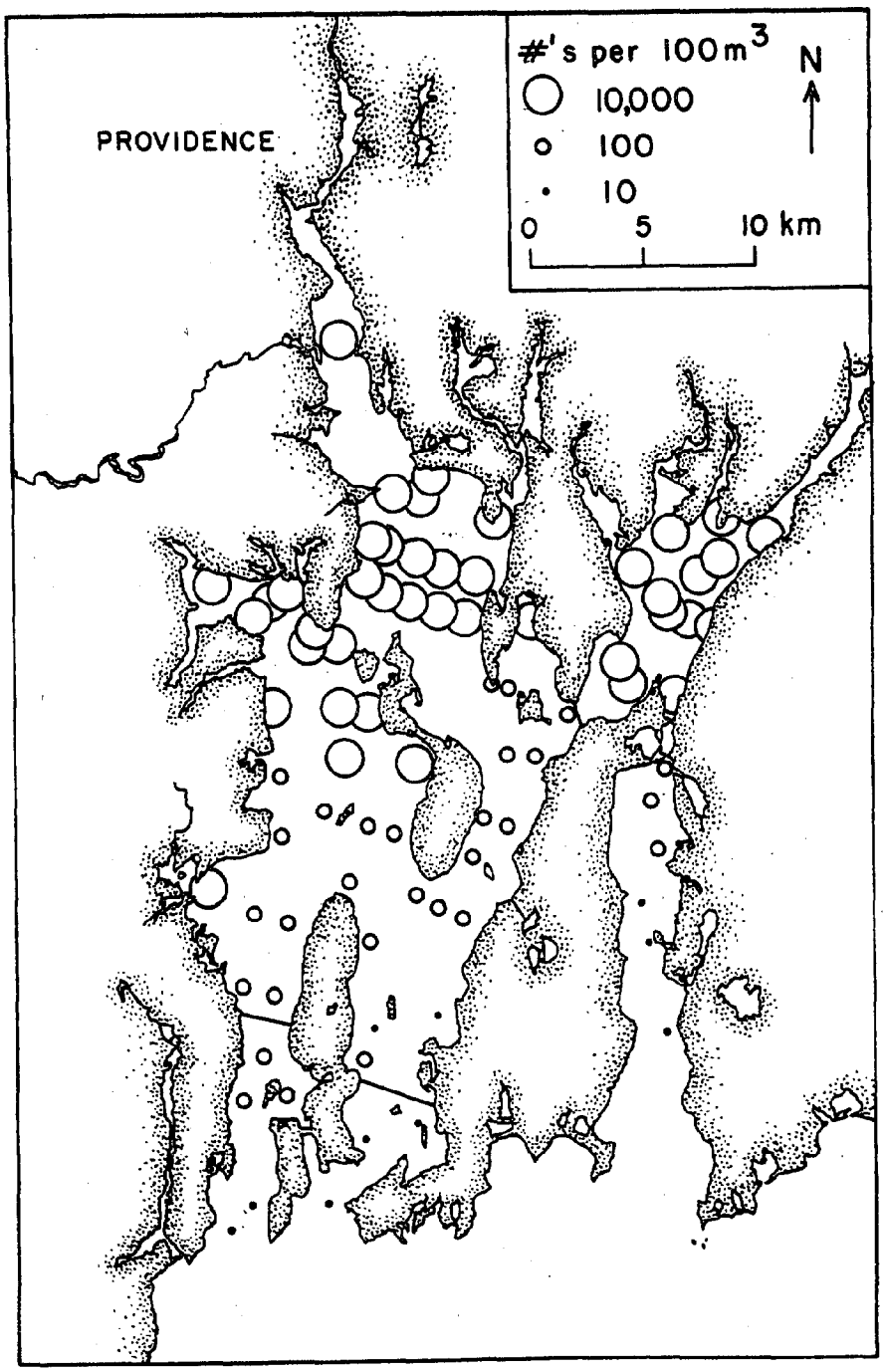


Figure 2-10. Map of Narragansett Bay showing density of menhaden larvae, July 1972. Note that greatest densities are in the Upper Bay and Mount Hope Bay. Adapted from Matthiessen 1973.

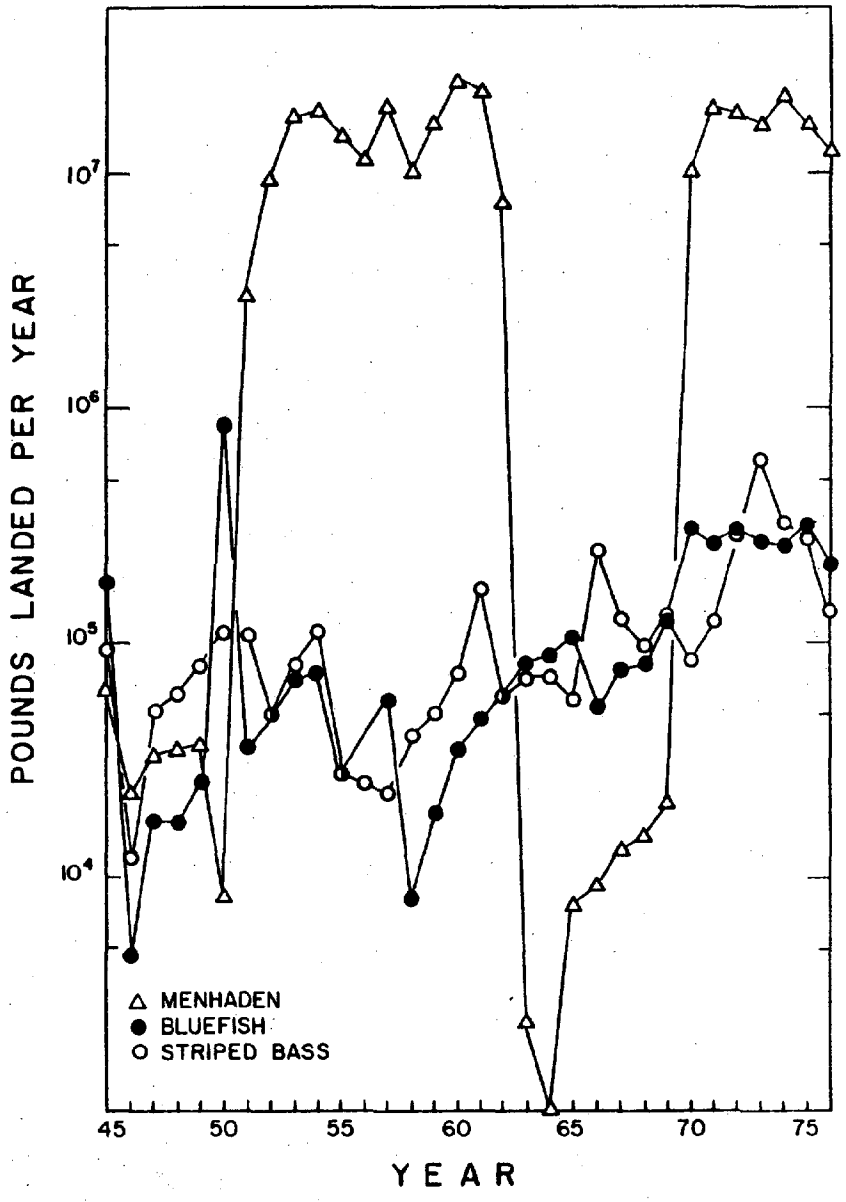


Figure 2-11. Rhode Island landings of menhaden, bluefish, and striped bass. Note that when the menhaden are not abundant there are no corresponding decreases in the numbers of bluefish and striped bass landed. Graph from Oviatt 1977.

In the most recent creel census survey made of the sportfish catch in Rhode Island (McConnell and Smith, 1978), there were an estimated 61,132 bluefish, 79,000 striped bass and 101,506 winter flounder caught in the Upper Bay. These numbers can be converted to approximately 470,438 lbs., 1,081,750 lbs., and 136,530 lbs., respectively. This would indicate that 37 percent of the bluefish and 33 percent of the blackback flounder and 99 percent of the striped bass caught by sportfishermen in Narragansett Bay are caught in the Upper Bay.

The sportfishery is obviously very important in the Upper Bay. A 1978 telephone survey by NMFS indicated that 10 percent of total Rhode Island households participated in summertime sportfishing throughout the state. Close to 300,000 salt water fishing trips were made by Rhode Islanders in a year, catching a total of 1.2 million fish (McConnell et al. 1978). A significant amount was taken from the Upper Bay.

Government Policies and Regulations

A combination of depleted stocks and government regulation has virtually eliminated commercial fishing from the Upper Bay. Trawling and fish traps are prohibited from the area. It is generally considered that fish stocks are not sufficient to support commercial fishing. Even in the trapping heyday, there were very few fish traps located here compared to the rest of the Bay. Menhaden seining is permitted in the Upper Bay and river up to Sabin Point, excluding the mouth of the Warren River. But again, the supply only supports two Rhode Island boats and is highly variable year to year. As previously mentioned, fishing by fyke nets, seines, drift nets and hook and line are all permitted.

The State Department of Environmental Management maintains a program to revitalize the anadromous fisheries. In the 1960s they stocked streams around the Bay with alewives and the 1970s were good years for alewife runs. The DEM has installed a series of fish ladders in many locations where dams blocked migration around the state. Future construction of fishways are proposed for the Upper Bay at Gorton Pond, Warwick; Hunts River, East Greenwich; Seekonk and Ten Mile River, East Providence; and Brickyard Pond, Barrington; there are existing fish runs in the Warren River, Palmer River and Barrington River, as well as other Rivers in the lower Bay and Sakonnet Passage. As a result of these efforts it appears that the buckie runs have stabilized. They are not up to the carrying capacity of the rivers, but at least the populations are no longer declining. Buckies are an important bait fish and are pursued by striped bass and bluefish throughout the Bay up to the mouths of these rivers. Continued efforts to remove obstructions from tributaries to the Upper Bay and to keep the runs stocked may contribute significantly to keeping sportfish in the Upper Bay.

Pollution Effects on the Finfishery

It is more difficult to assess the effects of pollution on the finfishery than the quahog fishery since fish are not regularly monitored for contaminants. There is a prodigious literature documenting the toxic effects of various trace metals, pesticides and solvents on eggs, larvae and adult

life stages of different types of fish. There are elevated levels of many of these compounds in the Providence River. However, there is very little data on finfish response to the conditions in the study area.

It is apparent from various sources that there is a large variety of finfish in the Upper Bay, even in the upper reaches of the Providence River. Records of fish impinged on the Narragansett Electric power plant's intake screens near Fox Point indicate that from 1975 to 1977 20,500 to 68,400 fish representing 35 species were caught on the screens each year. The thousands of each of menhaden, alewives, silversides, mummichogs, silverhake, weakfish, and winter flounder that are caught on the screens indicates that many more must frequent the length of the Providence River. The few studies done in the River indicate that there are populations of small worms, crustaceans and bivalves living in the bottom of the upper river (although not in the channel bottom) that probably serve as a food source for finfish. It is generally hypothesized that depleted oxygen levels due to bio-oxidation of organic loadings discharged primarily by the sewage treatment plants are the most detrimental to passage of finfish up the Providence River. Almost every year schools of menhaden die in the upper Providence and Seekonk River due to elevated temperatures and depleted dissolved oxygen. Increasing the efficiency of BOD and settleable solids treatment by the sewage treatment plants, most particularly the Fields Point plant, may substantially alleviate this problem.

Since 1969, DEM has taken monthly trawls in the Upper Bay off Ohio ledge (See Figure 2-8) and regularly catches about 10 species of commercially valuable groundfish including winter flounder, tautog, silver and red hake, butterfish, squeteague and scup. Only moderate numbers are caught and they fluctuate from year to year. Nevertheless, valuable finfish are certainly present in the Upper Bay. In a survey completed by Matthiessen in 1973 of fish eggs and larvae in the Upper Bay, it is apparent that the Upper Bay is an important spawning area for a number of fish that inhabit the Bay. Evidently water quality problems are not severe enough to prohibit spawning and larval development. The Upper Bay and lower Providence River are particularly important spawning areas for menhaden, winter flounder, tautog, and anchovy. It is also a spawning area for weakfish, scup, Atlantic herring, and silver hake. Other fish such as striped bass and bluefish do not spawn in the Upper Bay but seasonally frequent the area.

## SUMMARY FINDINGS: UPPER BAY FISHERIES

1. Information Sources

   (a) Sufficient historical information is available to characterize Upper Bay fishery resources in general descriptive terms.
   (b) There are few data on shellfish or finfish catches by recreational or commercial fishermen in the study area.
   (c) Estimates have been made of the size of the quahog population in the Upper Bay and lower Providence River (Stringer, Saila, et al., Sisson, DEM). The estimates vary widely depending on the methods used. No population estimates exist for finfish resources although DEM has been sampling routinely for bottom fish at a station in the Upper Bay since 1969.

(d) The levels of major pollutants in quahogs are sampled monthly by DEM at several stations in the Upper Bay; there is no data on levels of pollutants in finfish from within the study area.

2. Historical Fisheries

(a) The study area was once renowned for its abundant shellfish. It was particularly famous for the managed oyster fishery that flourished in the 1800s. A prolific oyster bed survived in the Seekonk River until the late 1800s and the Bay's most prized oyster growing areas were found in the Providence River. The Narragansett Bay oyster industry began a rapid decline in the 1920s and had entirely disappeared by 1957.
(b) The quahog fishery expanded as the oyster industry declined. Many of the most productive beds in the entire Bay are in the lower Providence River. These beds were closed to fishing due to pollution in the 1950s.
(c) Bay scallops and soft shelled clams were also abundant in the study area. Soft shelled clams are still numerous but bay scallops disappeared from the Bay as a resource capable of supporting a fishery in the early 1950s.
(d) The study area was rich in anadromous fish that declined in the late 1800s because of water pollution and the damming of streams and rivers.

3. Present Status of Shellfisheries

(a) Quahoging is the major commercial fishery in the study area. In 1969, with the conditional area permanently off limits, the entire Rhode Island harvest was 2 million pounds, which is 40 percent of the peak harvest in 1955. It is estimated that permanent closure of the conditional area reduced the fishery by at least 30 percent.
(b) Quahog surveys in the Providence River conducted in the 1960s showed a very large population composed primarily of old "coconut" sized quahogs. In 1975 and 1978, DEM sampled the quahogs in the lower Providence River and found a large population composed primarily of the valuable cherry stones and littlenecks. Differences in sampling technique make it difficult to compare early surveys to more recent ones with confidence. However, it would appear that the mature population found in the 1960s died off and has been replaced by an abundant new population.
(c) DEM estimates that the present quahog population in the conditional area and lower Providence River could support a fishery with an annual harvest of 6 million pounds shellweight. This is a rough estimate based on very limited data.
(d) The impact of water pollution on the quahogs in the lower Providence River and conditional area is not well understood. The scanty data that does exist indicates that, on occasion, quahogs in some areas of the lower Providence River and conditional area contain coliform levels higher than the standard for sale as food without dupuration set by the federal Food and Drug Administration.

Levels of copper and cadmium have also exceeded FDA "alert levels" in areas of the upper Providence River. It appears that in general the quahogs in the lower Providence River and conditional area do not contain excessive levels of pollutants.

(e) Areas are closed to shellfishing primarily on the basis of coliform levels in surface waters. This practice leaves a large safety margin since the waters in the study area behave as a two-layered estuarine system where clean water from the ocean flows up into the estuary along the bottom to compensate for the seaward flow of less saline, more polluted surface water.

(f) Soft shelled clams are more abundant in the study area than is generally recognized. Large beds are present in deep water as well as in the intertidal zone. This resource has potential for a commercial fishery if water pollution problems are solved.

(g) The historic importance of the Providence River oyster fishery cannot be neglected. The area may again be capable of supporting significant oyster-growing activity if water quality improved.

4. Present Condition of Finfisheries

(a) The study area supports a considerable recreational fishery. A recent one-year survey indicates that one third of the total Bay catch of winter flounder and bluefish, and nearly all the Bay catch of striped bass were taken from the study area.

(b) Menhaden are seasonally abundant in the study area and are fished commercially below Sabin Point. The eel population in the study area may be capable of supporting a larger fishery.

(c) Despite occasional die-offs caused by low oxygen levels, the upper Providence River supports a surprisingly diverse population of bottom fish. More information on this population is badly needed.

(d) There appear to be substantial opportunities to improve the status of recreational finfisheries in the study area.

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# 3 Providence Harbor

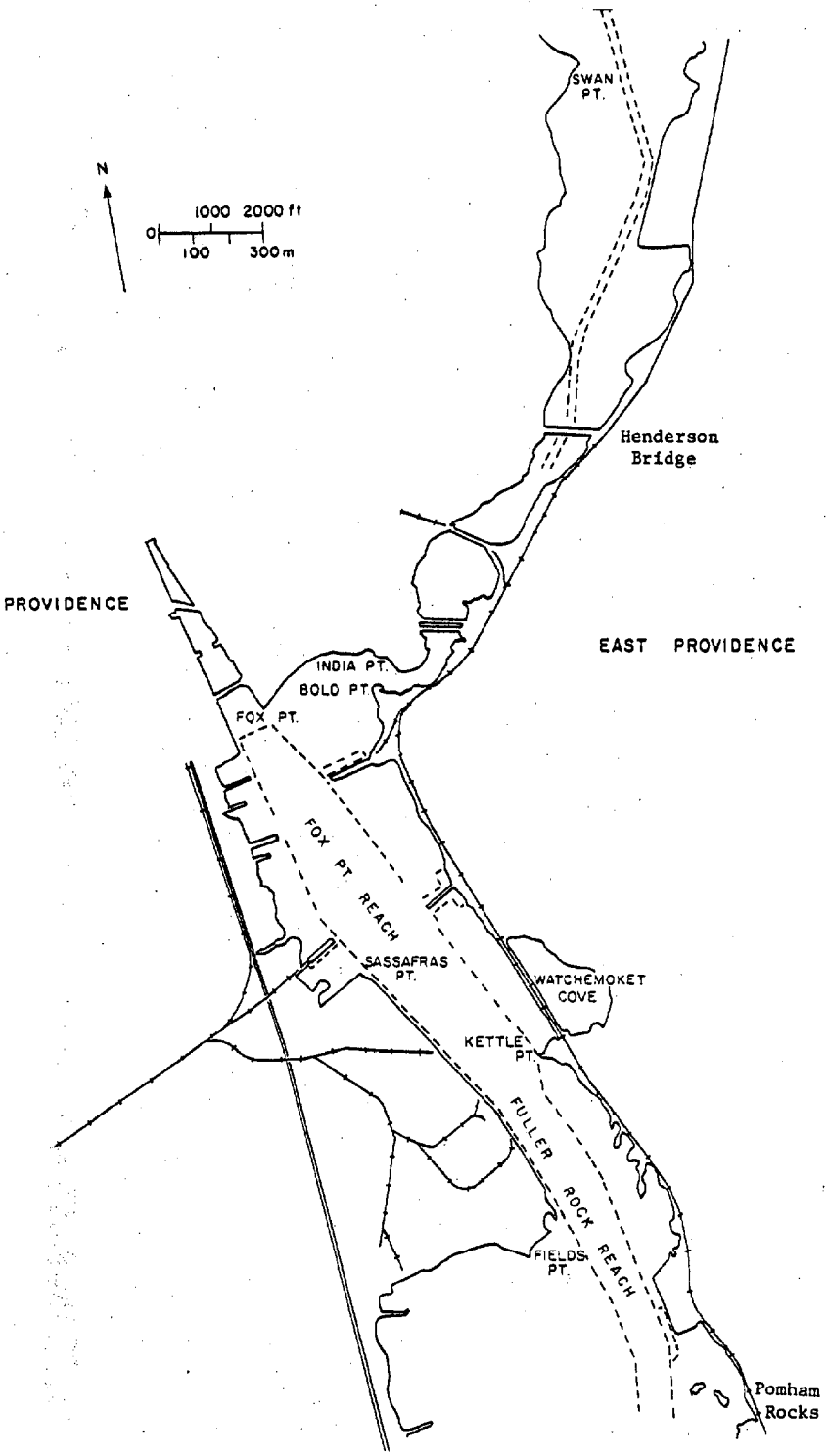
## INTRODUCTION

Providence Harbor stretches from Pomham Rocks Light north to the Henderson Bridge (Figure 3-1). Within the harbor are petroleum terminals, marine service and repair facilities, docks that specialize in bulk, dry, and liquid cargo handling, and the Port of Providence which is a general cargo facility. It is a modest operation by North Atlantic standards, but dominates some ten miles of metropolitan shoreline. The Harbor has grown and changed with the surrounding urban area during the past two centuries, although its history is less known and appreciated than that of nearby residential and commercial districts. For many, the disorderly and rough appearance of the Providence Harbor port facilities symbolizes the worst features of contemporary urban society: decay, ugliness, inefficiency, and economic decline. Accompanying this image is a tolerance for the neglect of harbor problems which is justified by a feeling that port industry has a limited future.

The purpose of this chapter is to test the validity of the image and assumptions which have fostered a cynical view of harbor development and renewal prospects, and to suggest a strategy for achieving new interest, concern, and commitment to the future of the port industry. The analysis presented here is an attempt to characterize Providence Harbor as a geographic entity with both important problems and good prospects. It is also an effort to illustrate the important relationship between urban waterfront revitalization and the broader issues of metropolitan growth and decline.

There is a potential for growth in Providence Harbor during the 1980s. The Port of Providence, which is operated by the Department of Public Works of the City of Providence has made progress in recent years, increasing traffic and revenues, upgrading berths and improving terminal facilities. The Providence and Worcester Railroad is pursuing a plan which would create a major new wharf adjacent to the Wilkes Barre terminal on the East Providence shore. Creation of a new berth at the southern most part of Fields Point is one of the long-range plans for Providence. Some oil terminals have recently announced plans for berth dredging and pier reconstruction. Only the Port of Providence however, has taken advantage of the 40-foot channel dredged for the benefit of petroleum tankers by the Army Corps of Engineers in the early 1970s, by dredging three of its berths to channel depth.

Providence Harbor still lags behind most other ports of its size in new investments. It faces a number of limiting factors, the most important of which is the absence of basic planning and development programs for the Harbor as a whole. The state's approach to the redevelopment of Quonset/Davisville is an example of the coherent and orderly development program so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PROVIDENCE
EAST PROVIDENCE
INDIA PT.
BOLO PT.
FOX PT.
FOX PT REACH
SASSAFRAS PT.
WATCHEMOKET COVE
KETTLE PT.
FULLER ROCK REACH
FIELDS PT.
Pomham Rocks

clearly needed for the Port of Providence. At Quonset/Davisville publicly owned properties are being improved, roads, utilities and services upgraded, and industrial clients provided with a package of services and incentive for locating at the site. Providence Harbor may not be wholly owned by the public, yet it was created by the expenditure of a considerable amount of federal, state and local funds. Consequently the harbor has a similar need for planning, management and public support to insure that as a major public investment it provides a full return to the metropolitan area.

State agency plans and programs must begin to recognize Providence Harbor as a functioning geographic unit with development opportunities and renewal needs not unlike those of Quonset/Davisville. This acknowledgement would in turn provide the impetus for building understanding and cooperation among the many public and private parties concerned about the future of the harbor. Such agency cooperation is a prerequisite for successfully dealing with issues such as dredge spoil disposal, highway improvements, rail service upgrading, debris removal, effective and efficient regulatory review and development planning, promotion and financing. Four basic steps need to be taken to increase public and private commitment to the harbor's future:

Communication: a dialogue among the public and private sectors is needed to increase the level of knowledge and understanding of harbor issues and improve coordination among public agencies with responsibilities important to harbor development.

Commitment: a formal state commitment to harbor development and renewal can begin by refining the policies of the several agencies with responsibilities affecting the harbor and sponsoring more detailed economic and management analysis of port activities and prospects.

Development Projects: state assistance should be provided to municipalities to develop a more sophisticated ability to package those proposals which incorporate an element of public financing as well as private investment, in order to achieve waterfront development and renewal goals. The slogan used by the Port Authority of New York and New Jersey applies here: "activate, energize, and organize."

Structural Changes: improvements in harbor planning and development do not depend upon an immediate move toward creating a new governmental structure to manage the harbor. However, the process involved in taking steps outlined above will help to identify the need and feasibility of a mechanism, such as an expanded Rhode Island Port Authority or Providence Harbor Association that might be formed in conjunction with a reorganization of the Port of Providence.

## GROWTH AND DEVELOPMENT OF PROVIDENCE HARBOR

### Introduction

The character and function of Providence Harbor has changed significantly in the twentieth century, in response to the shifting needs of the Providence

metropolitan area. Except for a brief period in the 1800s it has not, in contrast to Boston and New York, been involved in foreign commerce nor has it served as a major shipping point for goods produced or manufactured inland. Despite the absence in recent decades of a significant state and municipal port development program, substantial taxpayer financed improvements of the harbor and municipal wharf have been achieved, and overall port activity has increased. The present harbor is composed of a mixture of obsolete and new facilities and uses which symbolize both recent public neglect and the longer term fundamental viability of waterborne commerce.

Historical Activity

Providence, like all other settlements on Narragansett Bay was served by coastal trade since its founding in the early 17th century. International trade was important for a few decades after the Revolutionary War when Providence Harbor was a shallow estuary with depths probably no greater than ten feet. In the port's early days ships docked along what is now South Water Street on the east side of the Providence River above Fox Point. The area from India Point to Fox Point had begun to develop as a major part of a growing port by 1800. Trade to China, India and Europe yielded import duties that averaged over $200,000 annually after the first decade of the 19th century. This international trade had essentially disappeared by 1830 due to the increasing risks posed by international conflicts, pirating and the emerging role of the federal government in controlling foreign trade. In its place, coastal trade flourished and expanded during the nineteenth century as Providence entrepreneurs led the nation into an industrial revolution, which was accompanied by the rapid construction of factories, businesses and homes.

Harbor Improvements

The rapid development of Providence in the nineteenth century was accompanied by three important developments affecting the waterfront: filling, dredging, and railroads. A major storm in 1815 had caused considerable damage to the waterfront. Extensive filling created Dyer Street and was accompanied by the construction of slips for steam boats and cargo vessels. The first railroad to open in Providence was the Boston and Providence in 1835 which followed the East Providence side of the Seekonk and across a bridge at India Point. A second company, the New York, Providence and Boston, opened a line between Sassafras Cove just above Fields Point and Stonington, Connecticut. This line was soon extended to Fox Point, where connection could be made with a line to Boston. In 1855, the Providence, Warren and Bristol railroad opened, with its terminal at Fox Point, and track which in effect created a new shoreline between Bold Point and Sabin Point. By then, the Providence and Worcester and other lines had developed a union terminal near the present location of the Union Station, just below the State House. This essentially completed the basic structure of rail service to the port.

In 1790 the River Machine Company was formed to keep Providence Harbor free of obstructions. Major dredging of Providence Harbor by the Army Corps of Engineers began in 1852 and continued with successive project depths of 9,

12, 14 and 23 feet. In 1882, the Corps began dredging a 25-foot deep, 300-foot wide channel that enabled the largest steam vessels of the time to reach Providence. By 1904, general cargo activity was concentrated between India Point to the west, and a large area bounded inland by Dyer Street and Allens Avenue as far south as the present Manchester Street power station.

Present Harbor Configuration

The Providence metropolitan area was in its prime in 1900, a time of strong economy and rapid population and urban growth. It was also approaching its capacity for expansion. During the early decades of the 20th century, Providence Harbor underwent a protracted transformation which, by the end of World War II left Rhode Island with the basic configuration of port uses that exist today. The relocation of general cargo handling to the present municipal wharf operated by the city of Providence began in the early part of this century. The Manchester Street and South Street power stations, began operating in 1902 and 1909 respectively, and pre-empted many acres of the the waterfront previously utilized for general cargo and passengers. The City of Providence began laying a network of more than 63 miles of sewer lines in the late 1890s. The Providence Sewage Treatment Plant was built at what was then Fields Point and began operating in 1901. At the time it was an outstanding example of the state of the art in the treatment of municipal waste water.

Between 1913 and 1914, a major cooperative Providence Harbor improvement project was carried out by the Army Corps of Engineers, the City of Providence and the state of Rhode Island. The shipping channel and harbor were to be dredged to a 30-foot depth at mean low water, including the excavation of the original Fields Point. Shoreside improvements of $2 million accompanied the dredging to meet the local participation required by Congress. These included a state pier along Allens Avenue, and the 3,000 foot long Providence municipal quay adjacent to the sewage treatment plant. Much of the wharf and land north of the plant was leased to private operators.

The growing demand for petroleum products was another force of change on the waterfront. The first storage tanks were built in East Providence near the Red Bridge in 1890. The terminal now occupied by Mobil just north of Pomham rocks was developed in 1917. Gulf Oil located at Kettle Point, just to the north was built in 1920. In Providence, coal offloading operations were gradually converted to petroleum and new sites for fuel storage were built there as well.

The next major dredging project was planned in 1937 and completed in 1949. It widened the channel to its present 600 feet in Narragansett Bay, and increased the depth to 35 feet. The extension of the Municipal Wharf by an additional 1,300 feet was a federal stipulation for this dredging effort. A considerable area of shoals south of the original wharf was filled to create the additional berths in 1941. By 1950, nine tenths of all traffic in Providence Harbor involved the movement of petroleum, a situation which has remained virtually unchanged in the subsequent thirty years. The dredging of

Providence Harbor and channel to 40 feet by the Army Corps of Engineers was planned in 1962 and carried out between 1967 and 1975. The project was justified solely on the basis of reducing the cost of petroleum delivery through an increase in the size of tankers using the harbor and assumption that petroleum consumption in the region would increase steadily

Barges carried petroleum to several piers on the East Providence side of the Seekonk up to the 1970s. These piers are now unused and in disrepair. Highway and railroad bridges, combined with a narrow shallow channel, have rendered commercial traffic uneconomical in this portion of Providence Harbor. Navigation improvements in the Seekonk River, cannot presently be justified by the Army Corps of Engineers.

## PRESENT HARBOR AND PORT INDUSTRY CHARACTERISTICS

Waterborne commerce in Providence Harbor is barely visable at the national level and is overshadowed in the North Atlantic by Boston, New York and several other larger ports. The level of port industry activity in the harbor is influenced by national patterns and trends as well as market conditions in southern New England. The 1970s have seen major fluctuations in total traffic caused principally by declining petroleum consumption. However, between 1969 and 1977 Providence Harbor has performed better than any other New England port in growth of inbound general and dry bulk cargo, and above average in outbound cargo. This section provides a sketch of the national and regional trends in cargo movement and some detail on the performance and trends in Providence Harbor. The information presented has been compiled largely from available published sources which may be out of date or incomplete. A comprehensive economic and operational assessment of the Harbor remains to be made.

### Waterborne Cargo Movement

National and Regional Context: The United States suffers from a trade imbalance. In 1977 import tonnage was 1.6 times exports, due principally to imports of bulk commodities such as petroleum. Exports declined while imports increased between 1973 and 1977. Both North and South Atlantic ports have lost their share of imports to the Gulf Coast, which experienced a three-fold increase in activity in this five-year period. Exports have declined in all port regions except the South Atlantic which has seen a steady increase (Maritime Administration, 1979).

The total import and export activity in North Atlantic ports, which range from Portland, Maine to Alexandria, Virginia, declined 15.3 percent between 1973 and 1977. The greatest changes occurred in imports of bulk fuel and ore, and coal exports (Table 3-1). While Providence Harbor declined in its share of North Atlantic import-export activity, other ports have shown increases. Growth in exports occurred in Baltimore, and Wilmington, Delaware, while imports increased in Portland, Maine; Wilmington and Marcus Hook, New Jersey; and Newport News, Virginia.

TABLE 3-1

EXPORTS FROM ALL UNITED STATES PORTS
(millions of long tons)

| | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|
| North Atlantic | 55.0 | 58.1 | 52.5 | 50.0 | 44.3 |
| South Atlantic | 5.8 | 6.5 | 6.2 | 6.7 | 7.0 |
| Gulf Coast | 96.3 | 87.6 | 84.8 | 97.5 | 95.8 |
| Pacific | 46.5 | 43.5 | 38.8 | 42.7 | 38.9 |
| Great Lakes | 32.7 | 22.9 | 27.9 | 27.8 | 28.7 |
| TOTAL | 230.5 | 218.9 | 215.5 | 225.6 | 214.9 |

IMPORTS TO ALL UNITED STATES PORTS
(millions of long tons)

| | | | | | |
|---|---|---|---|---|---|
| North Atlantic | 209.1 | 194.3 | 171.0 | 174.9 | 179.2 |
| South Atlantic | 25.2 | 23.1 | 15.9 | 18.4 | 18.3 |
| Gulf Coast | 89.8 | 115.6 | 132.4 | 183.5 | 247.5 |
| Pacific | 52.4 | 53.8 | 53.4 | 66.9 | 80.9 |
| Great Lakes | 24.9 | 20.3 | 18.3 | 26.8 | 28.7 |
| TOTAL | 401.6 | 407.3 | 391.3 | 470.6 | 554.8 |

Source: Maritime Administration, 1979.

In the face of generally stagnant waterborne commerce throughout the nation, particularly in foreign trade, it is not difficult to understand why many states have struggled to remain competitive in the handling of general cargo. North Atlantic ports have lost the lead in both investments and activity to the Gulf Coast and South Atlantic states where dramatic economic and population growth is occurring. An increasing proportion of this new development is being financed with public funds (Table 3-2).

Table 3-2. National Trends in Financing Port Development
(percent of new investment)

| Source | 1968-1972 | 1973-1978 |
|---|---|---|
| Federal | 7 | 12 |
| State | 15 | 13 |
| Local | 22 | 25 |
| Private | 56 | 50 |
| Total | 100 | 100 |

Source: Maritime Administration, 1980.

New England also suffers from a trade imbalance. Its ports handle 3.6 times as much inbound as outbound dry cargo. Movement of general and dry bulk cargo declined by more than 9 percent between 1969 and 1977. Inbound movements dropped 10 percent and outbound movements decreased nearly 7 percent during this period. Against this trend, Providence Harbor has shown growth in both areas (Table 3-3).

Table 3-3. Historical Growth Rates* of General and Dry Bulk Cargo Tonnage Moving Via New England Ports
1969-1977
Percentage change ( ) denotes decrease

| Port | Inbound | Outbound |
|---|---|---|
| Searsport, ME | (6.9) | 12.5 |
| Portland, ME | (23.9) | 13.7 |
| Portsmouth, NH | (5.0) | n/a |
| Boston, MA | (2.2) | 5.1 |
| New Bedford, MA | 2.4 | 8.1 |
| Fall River, MA | 1.1 | 32.2 |
| Providence, RI | 3.3 | 10.5 |
| New London, CT | 0.5 | 33.6 |
| New Haven, CT | (1.2) | (5.5) |
| Bridgeport, CT | 0.3 | (3.7) |
| Weighted Average | (1.62) | (0.01) |

*Compound annual growth rates

Source: Temple, Barker, and Sloane, 1980.

Its share of total regional traffic has increased significantly, with a gain of 6 percentage points of inbound traffic and 19 percentage points of outbound traffic.

New England ports do not handle all of the waterborne cargo either imported or exported from the region (Table 3-4).

Table 3-4. Imports and Exports in New England by Customs Region of Shipment and Receipt
1976
(percentage of total weight)

| | General Cargo | | Bulk Cargo | |
|---|---|---|---|---|
| | Imports | Exports | Imports | Exports |
| Boston | 57 | 52 | 97 | 93 |
| New York | 32 | 38 | 2 | 6 |
| Baltimore | 4 | 2 | | |
| New Orleans | 1 | 4 | | 1 |
| Houston | | | | |
| Los Angeles | 2 | 1 | | |
| San Francisco | 3 | 3 | | |
| Chicago | | | | |
| Total | 100 | 100 | 100 | 100 |

Source: Bureau of the Census, 1979.

Bulk cargo imports and export, principally petroleum, almost exclusively enters the Boston region. However 48 percent of general cargo exports and 47 percent of imports by value entered the region through New York.

Trends in regional waterborne cargo movements are associated with land freight transportation. Data available on the movement of international freight in Boston Customs Region 1 (which includes all of New England as well as Western and Northern New York State) show that most imports and exports are moved to and from ships by truck (Table 3-5). Imports and exports in New England declined between 1970 and 1976 and were accompanied by a drop in associated rail and truck freight.

Providence Harbor has witnessed an overall growth in port activity since World War II (Figure 3-2). Receipts of petroleum and petroleum products in 1977 were 24 percent higher than in 1950. However, if coal receipts are included the difference in tonnage is reduced to a 4.5 percent increase over 27 years. Non-energy cargo has shown dramatic growth in the post-war era. Non-coal dry cargo receipts increased from 173 thousand tons to 1,142 thousand tons between 1950 and 1977. Shipments have increased even more dramatically due largely to the export of scrap metal.

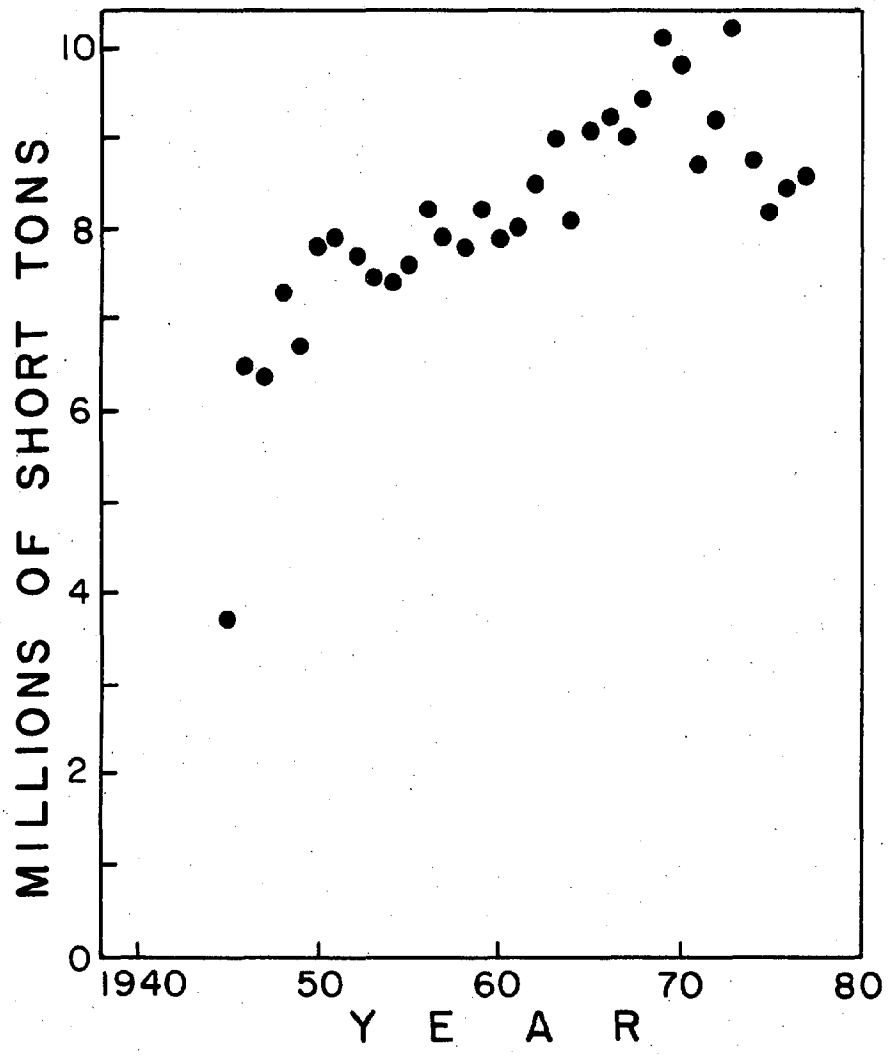



Figure 3-2. Growth in total cargo movements in Providence Harbor.
Source: U.S. Army Corps of Engineers.

Table 3-5. Land Transportation of International Waterborne Commerce to and From New England, 1976 (thousands of tons)

| | Imports | Exports |
|---|---|---|
| TOTAL INTERNATIONAL TRAFFIC | 15,557 | 1,570 |
| General Cargo | 1,477 | 502 |
| Bulk Cargo | 14,079 | 1,068 |
| LAND TRANSPORT MODE | | |
| General Cargo | | |
| Truck | 1,060 | 385 |
| Rail | 61 | 93 |
| Other or none | 356 | 24 |
| | 1,477 | 502 |
| Bulk Cargo | | |
| Truck | 574 | 858 |
| Rail | 0 | 12 |
| Other or none | 13,505 | 198 |
| | 14,079 | 1,068 |

Source: Bureau of the Census, 1979.

During the 1970s, the total tonnage handled in the Harbor has fluctuated, with the peak in freight movement occurring in 1973. The principal cause of this variation has been declining petroleum receipts. Table 3-6 and 3-7 and Figure 3-3 show data from two sources, annual reports covering fiscal year activity (July 1 - June 30) compiled by the Port of Providence and data collected annually by the U.S. Army Corps of Engineers. The data reported by the Port of Providence show two peaks of freight movement, preceeding the OPEC oil embargo of 1973, and preceeding a reported shortage of gasoline and the Iranian revolution in 1978. Both periods saw significant petroleum price increases. General non petroleum dry and liquid cargo movement has shown an overall increase during the decade (Figure 3-4). Receipts have remained stable, while exports of scrap metal were 2.4 times higher in FY 1978 than FY 1972. Automobile receipts increased 63 percent between FY 1976 and FY 1978, declining somewhat in 1979.

Inbound harbor vessel traffic has fluctuated between 2,000 and 4,000 movements annually, declining from 3,739 inbound trips in 1973 to 2,688 in 1977. Petroleum tankers and barge traffic declined because of lower volumes and increasing vessel size. Passenger and dry cargo traffic on the other hand increased 64 percent between 1970 and 1977 (Table 3-8).

Table 3-6. Historical Cargo Flows, 1969-1977
Providence, Rhode Island (000s short tons)

| | | Foreign | | Domestic | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Coastwise | | Local | | |
| | Total | Imports | Exports | Receipts | Shipment | Receipts | Shipment | Local |
| 1969 | | | | | | | | |
| Total | 10,153 | 2,220 | 171 | 6,190 | 722 | 116 | 565 | 166 |
| Pet. Prod. | 9,505 | 1,972 | 0 | 5,968 | 716 | 109 | 565 | 166 |
| Other | 648 | 247 | 171 | 221 | 6 | 6 | 0 | 0 |
| 1970 | | | | | | | | |
| Total | 9,872 | 2,388 | 286 | 6,106 | 495 | 100 | 412 | 81 |
| Pet. Prod. | 9,116 | 2,149 | 0 | 5,878 | 495 | 98 | 412 | 81 |
| Other | 754 | 238 | 286 | 228 | 0 | 2 | 0 | 0 |
| 1971 | | | | | | | | |
| Total | 8,762 | 1,863 | 212 | 5,936 | 448 | 51 | 205 | 43 |
| Pet. Prod. | 7,812 | 1,509 | 0 | 5,710 | 432 | 51 | 205 | 43 |
| Other | 949 | 353 | 212 | 225 | 16 | 7 | 0 | 0 |
| 1972 | | | | | | | | |
| Total | 9,200 | 1,908 | 261 | 6,097 | 447 | 92 | 278 | 113 |
| Pet. Prod. | 8,324 | 1,549 | 0 | 5,643 | 434 | 92 | 278 | 113 |
| Other | 875 | 358 | 261 | 554 | 13 | 0 | 0 | 0 |
| 1973 | | | | | | | | |
| Total | 10,236 | 3,084 | 408 | 5,728 | 452 | 132 | 343 | 35 |
| Pet. Prod. | 9,125 | 2,663 | 0 | 5,455 | 445 | 132 | 343 | 35 |
| Other | 1,110 | 421 | 408 | 273 | 6 | 0 | 0 | 0 |
| 1974 | | | | | | | | |
| Total | 8,856 | 2,246 | 369 | 5,399 | 368 | 103 | 309 | 59 |
| Pet. Prod. | 7,705 | 1,842 | 0 | 5,027 | 362 | 103 | 309 | 59 |
| Other | 1,150 | 403 | 369 | 371 | 5 | 0 | 0 | 0 |
| 1975 | | | | | | | | |
| Total | 8,266 | 1,135 | 294 | 5,839 | 239 | 234 | 459 | 63 |
| Pet. Prod. | 7,453 | 852 | 0 | 5,604 | 239 | 234 | 459 | 63 |
| Other | 812 | 350 | 297 | 234 | 0 | 0 | 0 | 0 |
| 1976 | | | | | | | | |
| Total | 8,678 | 1,104 | 509 | 6,202 | 241 | 185 | 250 | 83 |
| Pet. Prod. | 7,468 | 754 | 0 | 5,952 | 241 | 185 | 250 | 83 |
| Other | 1,109 | 350 | 509 | 249 | 0 | 0 | 0 | 0 |
| 1977 | | | | | | | | |
| Total | 8,624 | 1,246 | 408 | 6,220 | 317 | 351 | 53 | 26 |
| Pet. Prod. | 7,498 | 796 | 0 | 5,470 | 299 | 351 | 53 | 26 |
| Other | 1,125 | 449 | 408 | 249 | 17 | 0 | 0 | 0 |

Source: Waterborne Commerce of the United States, Annual,
U.S. Army Corps of Engineers.

Table 3-7. Traffic in Providence Harbor
Fiscal Years 1972-1979
(thousands of tons)

| | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 |
|---|---|---|---|---|---|---|---|---|
| Total Traffic | 8,660 | 15,370 | 9,008 | 7,842 | 8,931 | 10,941 | 6,642 | 7,767 |
| Total Receipts | 7,789 | 13,568 | 7,844 | 7,089 | 7,703 | 9,731 | 6,003 | 6,914 |
| oil | 7,174 | 13,035 | 7,258 | 6,482 | 7,318 | 9,140 | 5,447 | 6,336 |
| other | 615 | 533 | 586 | 607 | 384 | 591 | 556 | 548 |
| Total Shipments | 870 | 1,801 | 1,164 | 752 | 1,227 | 1,209 | 638 | 852 |
| oil | 606 | 1,518 | 867 | 419 | 782 | 782 | 212 | 222 |
| other | 264 | 283 | 296 | 332 | 444 | 427 | 426 | 630 |
| Total Oil | 7,780 | 14,553 | 8,126 | 6.902 | 8,101 | 9,922 | 5,659 | 6,588 |
| Total Other | 879 | 817 | 882 | 939 | 829 | 1,018 | 982 | 1,178 |

Source: Rhode Island Department of Economic Development, various dates, and Rhode Island Statewide Planning Program, 1979.

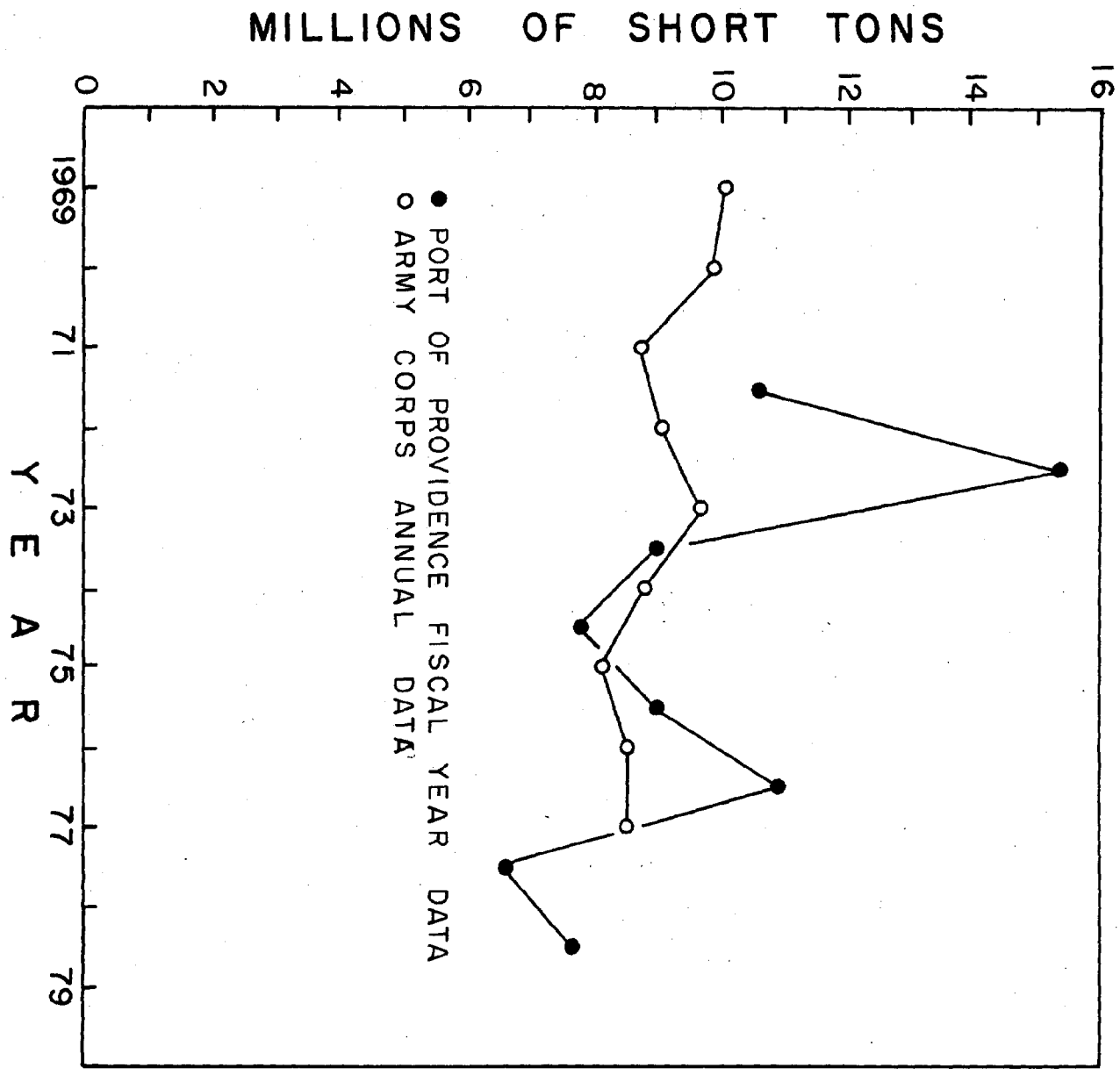



Figure 3-3. Total waterborne commerce in Providence Harbor.

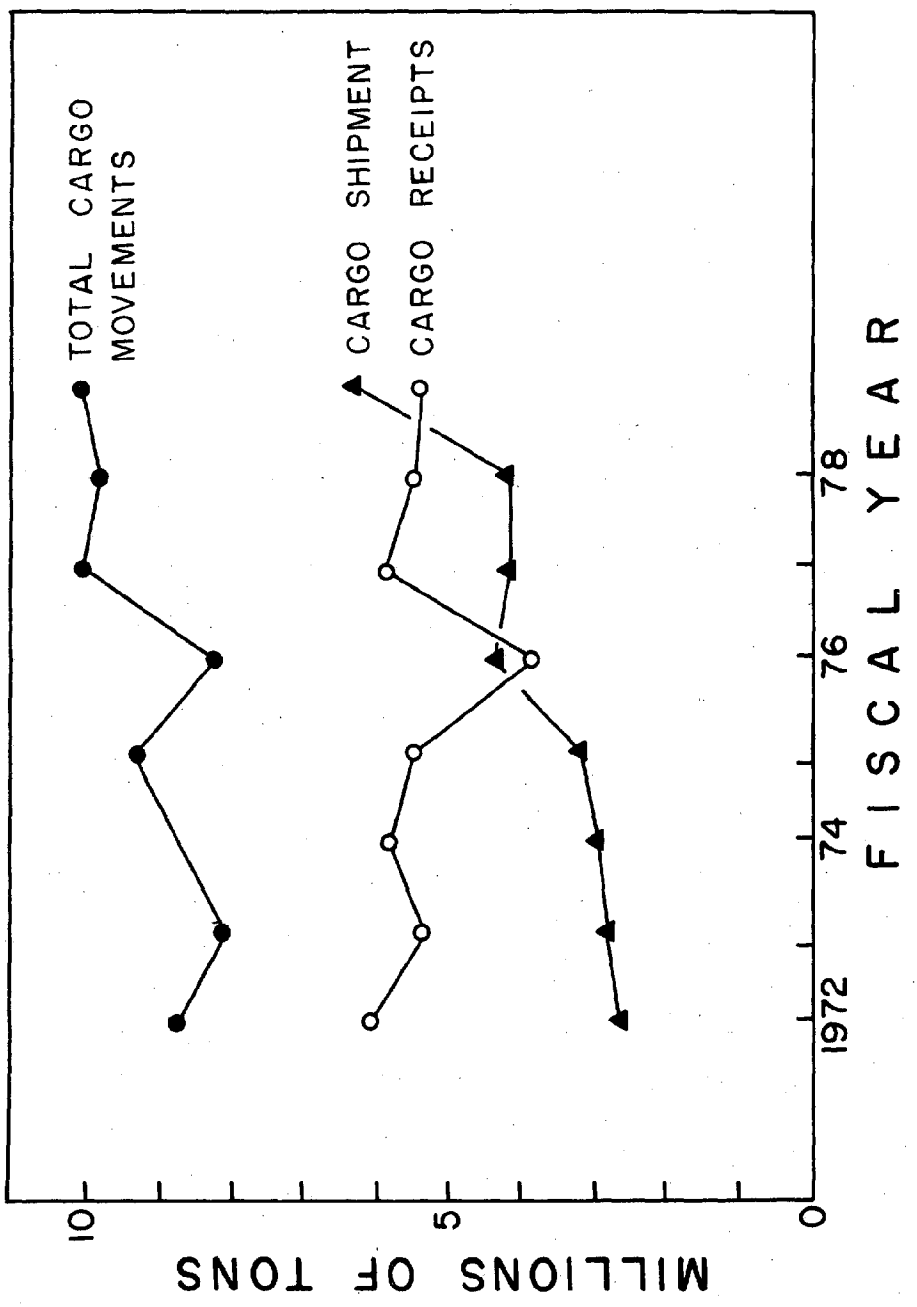



Figure 3-4. Shipments and recepts in Providence Harbor Annual Reports
Source: Port of Providence

Table 3-8. Inbound Vessel Traffic in Providence Harbor

| | Self propelled | | | Not self propelled | | |
|---|---|---|---|---|---|---|
| Year | Passenger, Dry Cargo | Tanker | Tug/tow | Dry | Tanker | TOTAL |
| 1955 | 436 | 821 | 992 | 73 | 307 | 2,631 |
| 1960 | 368 | 762 | 784 | 33 | 308 | 2,219 |
| 1965 | 226 | 825 | 901 | 81 | 421 | 2,454 |
| 1970 | 283 | 579 | 1,224 | 74 | 573 | 2,371 |
| 1973 | 403 | 707 | 1,899 | 109 | 621 | 3,739 |
| 1975 | 269 | 600 | 1,402 | 74 | 562 | 2,907 |
| 1977 | 465 | 413 | 1,253 | 72 | 485 | 2,688 |

Source: U.S. Army Corps of Engineers, New England Division.

Providence Harbor is used by a mixture of public and private operators. Of 23 active terminals and berths, 9 are used principally for receiving petroleum products, including the Manchester Street power plant. The Port of Providence has 6 berths for handling cargo and petroleum products. The eight remaining active wharves and piers are privately operated for a mixture of marine transport uses including passengers, chemicals, general cargo, marine repair, and tugboat service. The Army Corps of Engineers project completed in 1975 created a 40-foot channel to Providence Harbor that was designed to accommodate the anticipated growth in regional petroleum consumption and transport of oil through the harbor, an expectation which has not materialized.

In 1960, petroleum tankers experienced delays on 45 percent of trips. Virtually no vessel greater than 35 feet in draft was used. Tankers with drafts of 31 and 32 feet respectively accounted for half of vessel trips by ships drawing more than 27 feet. Shifts in the fleet of tankers was noticeable in data for 1977. Tankers of 28- to 32-foot drafts accounted for only a third of trips, the remainder were made by larger ships.

Shorefront Land Use

The establishment of better uses for vacant and underutilized property in urban areas is an old and difficult problem. Planning, acquisition, and financing are time consuming and expensive, particularly when many small lots must be incorporated to make a workable parcel. Waterfront redevelopment is even more costly because of the additional problems of stabilizing the shore and flood hazards, as well as its normal higher value. However, these costs are offset by corresponding higher use values which result from well developed urban waterfront property.

Commercial and industrial shorefront land use in upper Narragansett Bay is confined chiefly to Providence Harbor and the Seekonk River, but includes small areas in Warren and Bristol. The east side of the Seekonk

River, known as Phillipsdale, is occupied by manufacturing and commercial firms. Land use along the Providence River is dominated by waterborne transport uses, principally petroleum and liquefied gases, marine services, general cargo handling at the Port of Providence, bulk cargo, and various other uses such as warehouses, wholesale and retail businesses, and power generating stations.

Land use in the vicinity of Providence Harbor, as defined by the irregular band of coastal census tracts (Figure 3-5) indicates some important differences from the metropolitan area as a whole (Table 3-9). Vacant land comprises 13 percent of the total, most of which exists on the East Providence side. Two categories, Transportation and Utilities, and Culture and Recreation are higher in the coastal area.

Table 3-9. Land Use in Shoreline Census Tracts (excluding Pawtucket)

| | Land Use in Shoreline Census Tracts of Providence and East Providence | | | | Providence Waterfront Project Area Analysis | |
|---|---|---|---|---|---|---|
| | Percent | Total Acres | Prov. Acres | E. Prov. Acres | Percent | Acreage |
| Residential | 31 | 2391 | 940 | 1451 | 1.1 | 6.8 |
| Manufacturing | 6 | 489 | 145 | 344 | 1.3 | 8.1 |
| Transportation, Communication & Utilities | 12 | 951 | 370 | 581 | 3.78 | 233.5 |
| Trade & Services | 8 | 642 | 330 | 312 | 33.3 | 207.5 |
| Institutional & Governmental | 8 | 641 | 529 | 112 | 14.0 | 86.3 |
| Culture & Recreation | 21 | 1590 | 449 | 1141 | --- | -- |
| Extraction & Farming | 1 | 66 | 0 | 66 | 0 | 0 |
| Vacant | 13 | 1016 | 144 | 872 | 12.5 | 76.8 |
| Total | 100 | 7786 | 2907 | 4879 | 100 | 617.2 |

Note: See Figure 4-5.

Most of the Providence Harbor shoreline is zoned for industrial use, with the exception of the west bank of the Seekonk River, and other scattered open and residential zones (Figure 3-6). A survey of industrial zoned property in 1978 indicated that about 30 percent of shorefront industrial sites were vacant and suffering from various site deficiencies including hazards, small parcel size, topography and poor soils (Table 3-10).

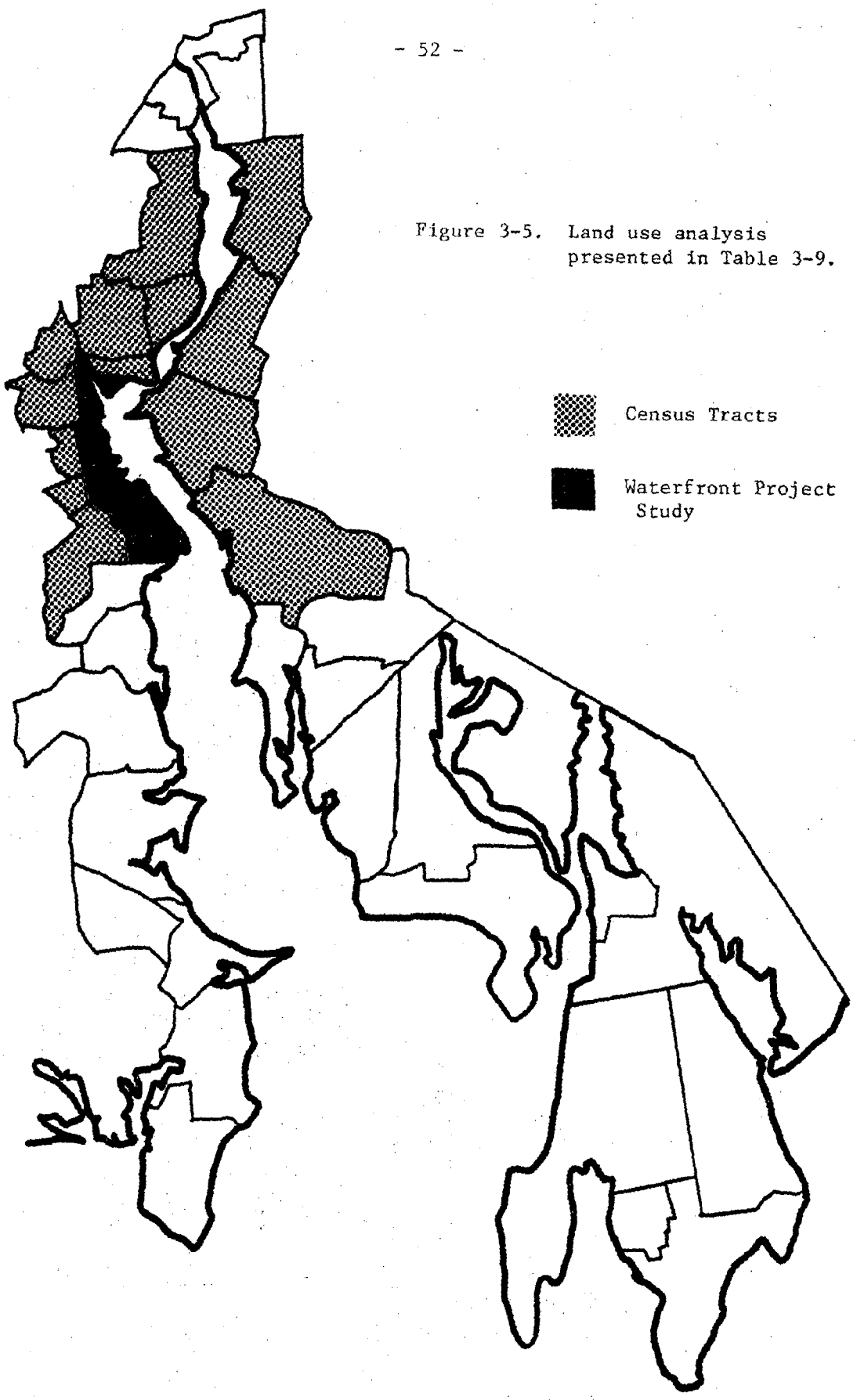



Figure 3-5. Land use analysis presented in Table 3-9.

Figure 3-6. Land zoned for industry
(See Table 3-10)

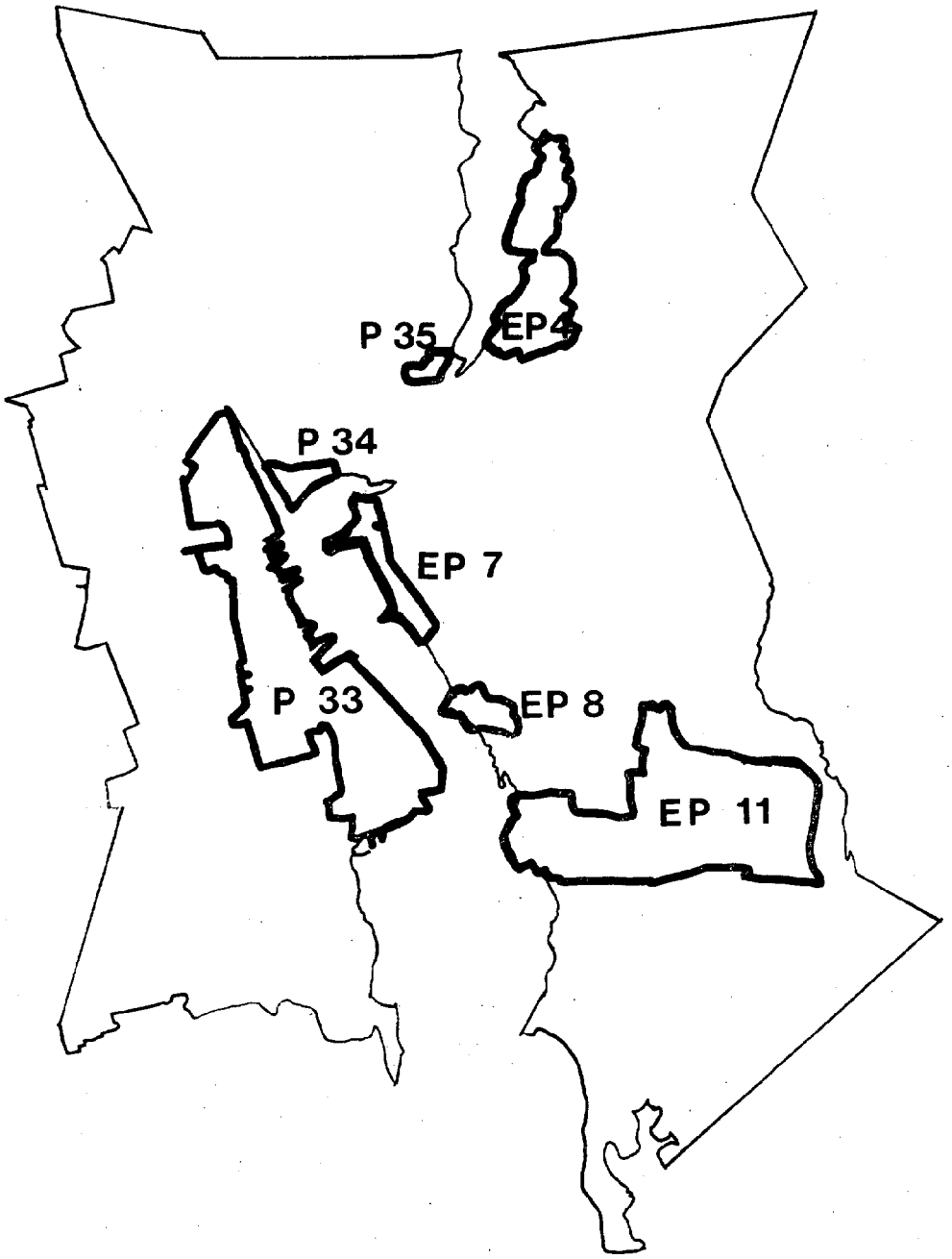


Table 3-10. Character of Industrially Zoned Land

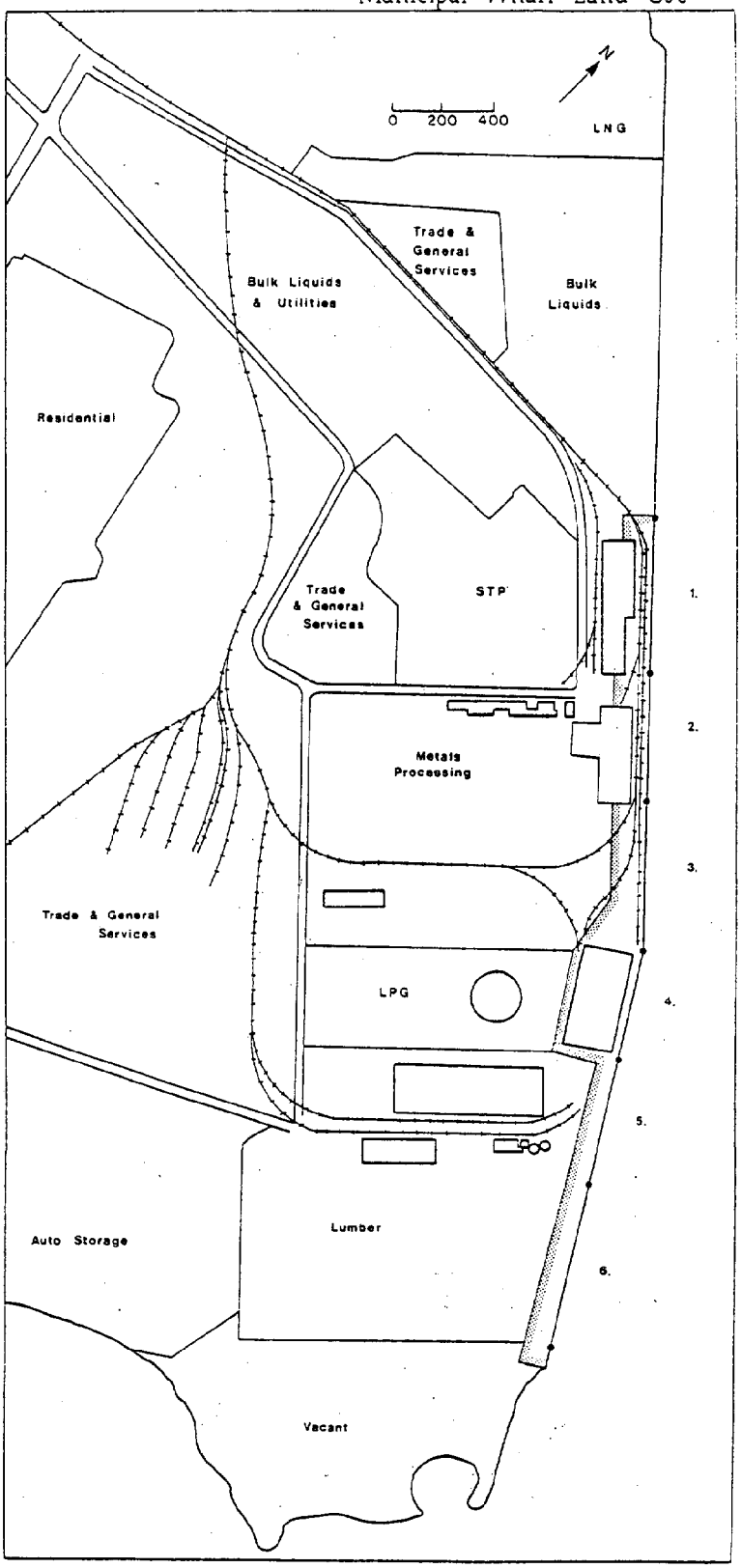
| # | Area | Size | Industrial Uses | Other Uses | Vacant | SWP Commentary |
|---|---|---|---|---|---|---|
| PROVIDENCE | | | | | | |
| 33 | Prov. River | 762 | 492 | 173 | 87 | flood hazard, small parcels |
| 34 | Fox Point | 69 | 17 | 38 | 14 | flood hazards |
| 35 | Waterman Ave. | 13 | 5 | 4 | 4 | small parcels |
| CRANSTON | | | | | | |
| 8 | Naval Reserve | 36 | 17 | 18 | 1 | occupied |
| EAST PROVIDENCE | | | | | | |
| 4 | Seekonk | 208 | 186 | 4 | 18 | restricted access |
| 7 | | 67 | 47 | | 20 | steep slope, flood hazard |
| 8 | | 28 | 28 | | | occupied |
| 11 | Mobile Pier | 749 | 309 | 68 | 372 | mixed character: steep slope, poor soils, flood hazard in some parts, other portions have few restrictions |

Source: R.I. Statewide Planning Program, 1978.

A major example of some of the difficulties in utilizing industrially zoned waterfront land is the city operated Municipal Wharf, which is reaching the limits of its expansion and operating possibilities due to the awkward lay-out and development of facilities. The use and control of municipally owned property in the area is complex, resulting in costly delays for new projects such as the new transit terminal, and limits to the growth of operations such as container service. The pattern of development has led to a mix of uses, many of which are not directly related to shorefront port activity that constructs present operations and limits future expansion. Figure 3-7 shows the general layout of uses, and identifies operations directly linked with shipping. Creation of the proposed berth 7 and permanent usage of the filled land behind it will be the last step in a fifty-year long development phase for the Port of Providence. Future opportunities will require the redevelopment of currently leased parcels, as well as upgrading the uses of adjacent property.

Figure 3-7.

Municipal Wharf Land Use



Unfortunately, the urban waterfront must compete for attention with many other municipal priorities. The Providence waterfront is separated from the downtown business center by I-195, the Hurricane barrier, two power plants and history. For most urban residents, the Providence River cannot serve as a dramatic open space similar to the Charles River or Boston Harbor because of limited physical and visual access, which in turn reduces the commercial potential of the waterfront.

Compounding these difficulties is the declining federal financial participation in urban redevelopment efforts in an era of skepticism about the role government should play in solving urban problems. Many states and municipalities concerned about their future have become sophisticated in packaging development proposals which mix private and public funds in a carefully planned manner. Rhode Island must look to states such as Massachusetts for models in improving its capability for fashioning such packages.

Development Plans and Programs

From the national perspective, Providence Harbor has lagged far behind both other North Atlantic Ports and the nation as a whole in expenditures for port physical improvements. According to a survey published in January 1980, $1,600 million in new development, maintenance and repair was spent in all U.S. ports between 1973 and 1978. Proposed port improvements of $3,300 million were planned for the period 1979-1983. North Atlantic ports contributed $285 and $293 million to these past and future efforts respectively. Providence Harbor did not appear in the inventory for either past of future development plans. This, however, is not an accurate portrayal of local activity and initiative.

State Plans: A general economic development study prepared for the state in 1976 by Harbridge House, Inc. concludes:

> In essence, we cannot see any real growth for cargo movements of all kinds in Narragansett Bay, and in consequence, no potential for stevedoring activity.

This analysis has had a dominant influence on Rhode Island economic policy. In the recent past, few state level initiatives have been made to support port and waterfront development in Providence Harbor. Modest municipal efforts to improve port operations, stimulate redevelopment and increase port industry activity have been accompanied by some growth, but fall short of meeting current needs and stimulating major new developments.

The most recent analysis and articulation of Providence Harbor development issues and concerns is found in the Rhode Island Coastal Management Program adopted in 1977. The Program concludes:

- Port expansion and redevelopment is extremely costly.
  - . The Providence-East Providence waterfront is heavily developed and land values are extremely high.
  - . Local funds for redevelopment and shoreline protection are limited and state assistance may be necessary.

- Long-range port planning is an extremely complicated and time consuming process.

  . Planning for the Port of Providence as broadly defined is complicated by the number of governments involved--four cities, the state and the federal government.
  . Planning must be placed in the overall context of urban development. It must consequently address transportation, public access, recreation, housing and general commercial-industrial issues in addition to narrowly defined port priorities.

- The Coastal Resources Management Council recognizes an obligation as the state's principal agency for coastal planning and management to participate in the solution of these problems.

State land use, economic development and transportation policies and plans do recognize Providence Harbor and the urban waterfront in a limited way. General goals of the State Guide Plan include stimulating "industrial and commercial interest in central cities through promotion, financial assistance, and provision and renewal of public facilities." Within the broad goal of planning transportation systems to shape and serve development in accordance with the state land use plan, Rhode Island has adopted policy statements such as:

> Expand the hinterland of the port of Providence through improved transportation facilities and reduced ground transportation changes.
>
> Support efforts to diversify the products shipped through the port of Providence, emphasizing package cargo.
>
> Plan transportation facilities as contributing parts of an overall statewide multi-model transportation system within a regional setting.

The state transportation plan, however, devotes little attention to the port industry in the Providence Harbor, listing as development recommendations only the repair of Port of Providence facilities, which the City already is completing, and debris removal throughout the harbor, a project given little chance for funding. State plans as a whole fall short of the strong initiative needed to solve harbor problems and improve its development prospects.

Municipal and Private Programs: Municipalities have found Harbor development a difficult topic to tackle on their own. The City of Providence abandoned its Waterfront Development Project in the late 1970s prior to the publication of a single report. Improvements to existing facilities have been costly and often controversial. The City of East Providence has recently prepared a waterfront plan (February 1980) which criticizes regulatory delays and proposes the development of a port agency or authority to coordinate and supervise activities within Providence Harbor, including fire prevention and safety, traffic control, navigation aids and port development.

However, both private and public investments in facility upgrading are occuring in Providence Harbor. The Providence municipal wharf is operated by the Municipal Dock section of the Department of Public Works and is the largest cargo facility in the Providence Harbor. It is a major source of revenue for the city. Fees, charges and leases of $1,051,290 were collected in FY 1978 comprising 1.3 percent of all city generated revenues (excluding the water department) in FY 1978. However, only $145,782 was spent for wharf operating and maintenance expenses. Capital improvements are financed by general obligation bonds floated by the City, after City Council and voter approval, reflecting the lack of independence exercised by the Port. In 1975, a $2.1 million bond was approved for improvements to the Municipal Wharf, principally dredging and dock repairs to berths 4, 5, and 6. An additional $6.5 million, is being used to build a new transit shed. The City passed an additional $5 million bond in April 1980 to meet its obligation to provide a deeper berth 3, which includes substantial rebuilding of the bulkhead.

The immediate challenge faced by the City of Providence, as defined by its Office of Economic Development, is to change the status of the Municipal Dock section of the Public Service Division of the Department of Public Works by creating a Port Authority independent of the City's administrative and political process. Port operating and maintenance costs would be taken from port revenues rather than the City budget. Major capital improvements would be financed through tax exempt revenues bonds authorized by a Board of Directors, rather than city-wide referenda. The Port Authority would hire its own staff and have greater ability to accommodate and follow through inquiries and implement management recommendations. In addition, a Port District is recommended which would be granted power of eminent domain in order to achieve a more rational land use pattern along the waterfront. Legislative approval will be required to create these organizational improvements in the event that a home-rule charter is not adopted by voters.

Several petroleum terminal operators have recently completed or proposed pier maintenance and rehabilitation projects. However, the 40-foot dredged channel has not yet been used to full advantage by the petroleum industry. None of the eight oil terminals have or are planning for berths equal to channel depth. The Port of Providence, on the other hand, has dredged its three southern berths to below 40 feet as part of a wharf rehabilitation project in 1977. Cargo vessel size has been increasing in Providence Harbor during the 1970s, which is an unanticipated result of dredging a 40-foot channel.

Future Development: The major new port development proposals for the 1980s would make use of rail links between the Harbor and shippers as far as the midwest, and consumers in New England and New York. The Providence and Worcester Railroad proposal, has already obtained state and federal permits. It would create an efficient wharf and marshalling area for containers, bulk or general cargo which could easily be moved by rail to their final destination. Another project which was in the planning stage at the Port of Providence until recently involved receipt of unit trains from the midwest by Italgrani, a grain company, to a mill on the southern side of Fields Point that would produce flour for a pasta manufacturer,

Prince Macaroni. A later phase would have entailed shipping grain from a newly created berth at the southern end of Fields Point to foreign destinations. In June of 1980 a former Navy fueling pier at Melville, located on the west shore of Portsmouth, was favored by the Italgrani-Prince group. Although neither project has begun construction, both serve as examples of a logical direction for port revitalization in Providence Harbor. It must be noted that in addition to large, rapidly escalating site development costs, such proposals face the fundamental test of feasibility in competing against other North Atlantic ports.

The other principal development effort presently foreseen for the '80s entail more intense use of the Municipal Wharf. Harborside Park is a privately owned facility which is presently used for port related business such as automobile importing and a fledgling container service. The acquisition of costly gantry cranes for use along berths 4, 5 and 6 of municipal wharf would make the handling of containers much more efficient, increasing the likelihood of a successful container service. In addition, the dredging and constructing of a new berth will be required to enable port operations to grow, since shorefront land is scarce. Any of these improvements will cost millions of dollars not presently available to the port director.

## CONDITIONS FOR RENEWAL AND FUTURE GROWTH

### Introduction

Port development is not a panacea for the ills of the metropolitan economy nor is its future free of obstacles to expansion and increased productivity. Market conditions play the dominant role in establishing the viability of the harbor. Rhode Island cannot influence the world economy or shipping industry directly. However, it can adopt waterfront policies and programs which would make possible the cooperation necessary for solving some of the Harbor's physical, financial, organizational and developmental problems.

### Public Commitment and Guidance

Providence Harbor does not receive full recognition as an important economic district and transportation center which provides an essential function for the metropolitan area. This is illustrated by the sharp difference between Providence Harbor and Quonset Point/Davisville (QP/D) in both the nature of operations and redevelopment planning. At QP/D the state has followed a logical and orderly process for planning and is undertaking a full range of site improvements including land, waterfront, rail and highway access and provision of services such as sewage, water, fire protection, security, power and steam. Prospective clients deal with an integrated organization which includes the director of QP/D operations, the Department of Economic Development and its professional planning staff, and the Port Authority, which makes decisions on land use and financing.

Unlike state and Port Authority operations at QP/D, no office can be located which takes responsibility for seeing that the needs of Providence Harbor are met, essential services are provided, potential clients given 'one-stop' service, and that future development is fostered. There are

several reasons for this striking contrast. Providence Harbor does not posses an identify sufficient to foster the governmental cooperation necessary to insure the development or upgrading of rail service, highways, channels, piers and wharves, and compatible land use. Statements of goals for Providence Harbor, information on its operation and debates on its prospects for the future are scarcely heard and not widely shared.

Providence Harbor is a mixture of private and public ownerships and interests located in Providence, East Providence, Pawtucket, and Cranston. The responsibility for the condition and use of individual shorefront parcels and berths is with these owners, even though federal, state and local government exerts control over activities and property improvements. The value of the Harbor waterfront, though largely enjoyed by private and municipal interests, has been created by the millions of federal dollars spent for dredging and maintaining the deep channel. The public trust in Providence Harbor does not derive from government ownership as with the excessed Navy property, but exists because of the need for an economically viable port industry which can provide a full return for public investments in port facilities.

Fostering cooperation among the numerous parties concerned with Providence Harbor's future is difficult but necessary for improving the strength of the port industry and creating the additional tax flow needed to support other urban environmental quality goals. More active participation by government in Harbor issues and development planning could insure that environmental concerns are addressed early on to avoid costly delays in regulatory procedures which do not serve any function in protection of public values. More important, deeper agency and municipal understanding of Harbor problems is essential for the coordinated and timely improvement of state-planned supporting services, and creating a climate more favorable to well planned private and public development initiatives.

Physical and Environmental Improvements

There are a number of physical development issues which present difficulties for port operation and growth. Solutions to some of these, such as debris removal, would result in visual improvements that can have broader urban redevelopment benefits. Others, including berth and channel dredging, will be required simply to permit normal port operations. Improving the on-land transportation network is a long term concern for improving the competitive position of the Harbor.

Dredging and Dredged Materials Disposal: A recent study by Seavey and Pratt (1979) reports that 2.6 million cubic yards of material from a dozen proposed Army Corps projects in Narragansett Bay await dredging and disposal. Disposal sites must also be found for material from many smaller private projects. A considerable amount of dredging has been delayed in recent years due to the lack of acceptable disposal sites. The creation of the channel up the Bay to Providence, which has taken more than a century, has

produced 20 million cubic yards or more of material which was used to create land now occupied by the Port of Providence, and fill deep spots in the Bay. About 9.8 million cubic yards were dumped at Brenton Reef in Rhode Island Sound.

Since completion of the channel, no maintenance dredging has taken place, and none is anticipated until 1985 at the earliest. Estimated sedimentation rate for the channel are 1-3 cm per year (Army Corps of Engineers, 1959; Goldberg, 1977). Private operators have completed or proposed berth maintenance for various depths less than 40 feet. The difficulty in proceeding with berth maintenance is the polluted condition of much of the sediment in the upper Providence River. In several cases it is sufficiently contaminated to raise concerns about the safety of land or water disposal.

Private operators have complained of the difficulty and expense in utilizing piers requiring maintenance dredging. Without sites for spoil disposal, permits for maintaining or upgrading berths are difficult to obtain. Controversy over the impacts of dredged material disposal has delayed the designation of offshore disposal sites for several years. Although an immediate resolution to the problem is not forthcoming, Rhode Island has renewed its efforts, in conjunction with Massachusetts and the Army Corps of Engineers, to find a solution for dredging problems in the bay area.

Supporting Transportion Service: The ease in which cargo can be moved between a ship in port and its inland origin of destination is an important aspect of the economic viability of waterborne transportation. For trucking, a well designed and maintained road system is sufficient. Rail service requires not only usable track but frequent service to the port for both shippers and receivers. Both state and federal government has a major role to play in determining the level of service provided to Providence Harbor through long range highway planning and construction programs, track rehabilitation and participation in the national debate over the future of Conrail.

The west side of Providence Harbor is served by I-95 a north-south limited access route, and I-195 an east bound route. Improved access to western Rhode Island and Connecticut would be provided by proposed Route I-84 which has been the subject of considerable controversy and delay for several years. The industrially zoned eastern side of the Harbor presently lacks adequate highway service. A proposed industrial highway, parallel to the Providence and Worcester rail line between Pawtucket and Wilkes Barre Pier is presently in the earliest planning stage at the Department of Transportation. Its construction is favored by a draft waterfront plan prepared by the City of East Providence. At the current pace, construction would not commence for several years.

Rail service is provided to the western Harbor by Conrail through its Harbor Junction spur, and along the east bay by the Providence and Worcester Railroad. Throughout New England, rail freight has declined, largely due to losses to other modes of transport, principally trucking.

A decline in rail service quality, for example the lower frequency of trips and larger minimum shipment sizes, forces shippers to use other more expensive modes which has resulted in a drop in demand for rail freight forcing the rail road to cut service further, including track maintenance. The long-range picture for Providence Harbor could include the creation of new activity, in goods moved in and out of the port via rail links to a hinterland extending as far inland as the midwest. Conrail presently operates major east-west routes between New England and the midwest which runs through the midsection of Massachusetts. The Providence and Worcester Railroad provides a separate link to that route via Worcester, and in addition can bypass Conrail through the Boston and Maine track running through the upper section of Massachusetts to New York. This means that with the construction of the wharf below Wilkes Barre Pier competitive direct access to a large hinterland would exist through Providence Harbor.

The resolution of several near-term difficulties clouds this possible future. The P & W proposal to build a new wharf has received regulatory approval but financing and construction remains uncertain while project costs escalate. Without the facility, the rail link remains only potentially valuable. P & W's reputation as a well-run and profit-making railroad has served to highlight the problems Conrail faces both at the National and local level. Currently, Conrail depends on federal subsidies administered through the U.S. Railway Administration. The entire operation is now under scrutiny by Congress, which will have a major role in deciding the company's future and the level of service provided to New England. The outcome of this process is not at all clear. In addition, members of the Rhode Island Congressional delegation and the director of the State Department of Transportion are promoting legislation that would speed the transfer of Conrail operated spur lines to a private firm, generally presumed to be P & W. Officials responsible for Conrail operations in Rhode Island have stated that the company has no intention of giving up these spur operations, and would be interested in upgrading service to the Port of Providence if a large user of rail service existed.

The transportation needs of Providence Harbor must be carefully defined and articulated so that they will guide and perhaps expedite transportation improvements. Harbor interests must be considered in the development of a state position on both the oversight of Conrail and the performance of the rail roads in the state. Highway improvements should likewise be viewed as an economic development investment.

Debris Removal: As the urban waterfront developed and changed in this century, a legacy of abandoned piers, wrecked vessels, rubbish, fill and other debris was left behind. The Army Corps of Engineers estimates that 26,000 cubic yards of material require removal. About 43 percent would be produced by dilapidated waterfront structures and 35 percent would be wrecked vessels (Army Corps of Engineers, 1978). Although debris is not a major problem for port industry development it creates an unsightly and ultimately important obstacle for many potential commercial, residential, or recreational uses. Any solution to this issue will require port participation as well as the state and federal efforts as discussed in more detail in Chapter 4.

A Development Strategy for Providence Harbor

State government has an important responsibility for assuring that public economic and urban environmental quality goals are achieved. State participation cannot solve fundamental financial and market problems, which are the domain primarily of the private sector. However, government is well suited to overcoming many other obstacles by creating an improved environment where conflicting public priorities can be resolved, action can be taken on areas of public responsibility which affect the private sector and legitimate needs for improved supporting services met. The following steps would expand public involvement in Providence Harbor for the purpose first of building a degree of mutual understanding and trust among various actors which then can be translated into a more specific agenda for action.

1. Establishing a Climate for Progress in Harbor Development. Considerable misinformation and misunderstanding impedes the initiation of cooperative action among municipalities, state agencies and private interests. Some fundamental disagreements may exist which no amount of information or discussion will overcome. However, the boundaries of common interest and concern have barely been tested. The private sector is ill equipped to resolve public disputes which introduce additional uncertainty to their financial plans. Municipalities may have so much difficulty in finding agreement on how to cope with their own problems that cooperative initiatives are precluded. The state, which has already recognized its own responsibility as well as some of the needs for Harbor planning, is strategically in the best position to provide the initial guidance in strengthening the economic potential of the Harbor through public and private discussion sessions that would develop, in greater depth and precision than presented here, a full understanding of Harbor needs and opportunities. Appropriate roles for the state would be identified in this process.

2. Establishing a Framework for Progress. Following an initial effort to demonstrate concern, identify needs and select areas where state involvement would be most valuable, a more formal public commitment to Providence Harbor should be developed. The first element should be a carefully executed economic and operational analysis of port activity in the Harbor by a well-qualified organization in conjunction with ongoing work on institutional considerations by the Intergovernmental Policy Analysis Group, the New England River Basins Commission and the traffic safety study by the Coast Guard. A coordinated program to revise and expand state policy on Providence Harbor should be initiated parallel to analytical efforts to serve as a focal point for constructive public attention to Harbor needs.

3. Development Tools. Initiatives for shorefront land redevelopment must come from municipalities. However, the changing role of the federal government in supporting such efforts has both increased competition for funds and pointed out the need for developing more sophisticated proposals which are in fact a mix of public and private funds. The state can encourage and and support such efforts by helping municipalities develop their ability to engage in Harbor related redevelopment efforts. Several specific steps should be considered at the state level to enhance the efforts of Upper Bay municipalities. Funds from the New England Regional Commission economic

grant could be targeted to Harbor needs. The Providence-Pawtucket-East Providence area could pursue the creation of an Economic Development District, which would qualify it for an additional 10 percentage points on public works funding from the federal Economic Development Administration. The establishment of an office of federal-state relations, which has been very successful in Massachusetts, would improve the ability of communities to obtain a fair share of funds from federal programs. Finally, legislation could be introduced enabling communities to suspend property taxes, similar to the Massachusetts 121-A program, to streamline the process of relieving the initial burden of real estate taxes for costly new private developments.

4. A Management Structure for the Harbor. The concept of a Harbor Authority is not new and receives some support in both the public and private sector. It is an outgrowth of the widely recognized need for more autonomy for the Port of Providence which is presently operated by the City of Providence. Some of the functions of an authority or association would be to coordinate fire protection and safety, promote port development and work to improve port facilities and supporting services. The vehicle would be either a new organization or an expansion of the Rhode Island Port Authority. Creating such a mechanism could occur only after the need is demonstrated and broad support obtained. The three steps outlined above would provide the essential groundwork for this final development.

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# 4 Recreation

## INTRODUCTION

The shortage of outdoor recreation opportunities in Upper Narragansett Bay communities has long been recognized by state and local officials. The lack of funds for acquiring, developing, and maintaining new facilities remains a principal roadblock to filling those needs. The Upper Bay has historically served as a major recreation resource to the burgeoning urban population as well as visitors from out of state, providing hotel accommodations, summer cottages, boating, swimming, shellfishing, camping, restaurants and other amusement opportunities. Urban pollution and the growth of suburbs in this century have greatly reduced the accessability and quality of the urban waterfront. However, in view of the financial constraints upon public recreation planning and development, the renewal of some of these historic opportunities must not be overlooked. Shoreline access in East Providence would be greatly enhanced by reuse of the state owned railroad corridor as a bikeway and linear park. Solutions to the dredging statement will lead to increased private investment in much needed marina and boating facilities. Removal of shoreline debris, greater concern for protecting or restoring natural features and efforts to achieve water quality improvements will all contribute to recapturing recreation opportunities which have been lost. Positive government initiatives which demonstrate commitment to urban needs are an essential part of winning public support for financing improvement programs.

## RECREATION NEEDS OF URBAN RESIDENTS

More than half of the people in Rhode Island live in the eight communities surrounding Upper Narragansett Bay. Like urban residents throughout the United States, the people of metropolitan Providence suffer an acute shortage of close-to-home recreation opportunities. Recent national and state studies have pointed out the extent of this shortfall, and characterize the basic needs which remain unfilled. The emphasis placed on water related activities points out the essential contribution which the Upper Bay could make toward fulfilling unmet demand.

The National Urban Recreational Study released in 1978 by the Department of Interior is the first nation-wide analysis of urban recreation. The major findings of that effort merit reiteration here.

> People in all urban areas want a well-balanced system of urban recreation opportunities which includes close-to-home neighborhood facilities and programs for all segments of the population. A wide variety of open space areas with substantial scenic, cultural, environmental, agricultural, and recreational values remain in and

> near our cities. While threats to remaining open space areas due to continued urban expansion into the countryside are very real, acquisition of these areas can meet only a small portion of total recreation needs. The greatest urban recreation deficiencies for land and facilities exist in the inner cores of the nation's largest cities.
>
> Lack of coordination among recreation providers at every level of government is a serious barrier to more efficient and responsive urban recreation programs. Existing and potential recreation resources are not being fully utilized. Good management, well-trained staff, and adequate financial support are the keys to good recreation services.

Field studies of 17 highly populated urban areas indicated that "most community residents and local park and recreation officials gave higher priority to development and operation of community and neighborhood parks than to acquisition of large acreages on the urban fringe."

The federal government has played an important role in financing recreation. The Urban Recreation Study observes:

> As local dollars for parks and recreation become more scarce, localities have turned for help, not to the States but to the Federal Government. (However) no coherent national urban policy exists that considers urban recreation. Current national recreation programs do not effectively address priority open space and recreation needs of urban areas.

Despite these shortcomings at the federal level, the Land and Water Conservation Fund requires each state to prepare a comprehensive Outdoor Recreation Plan. Municipalities must also prepare local plans in order to be eligible for matching funds for facility acquisition. The Rhode Island recreation plan was based upon survey information about recreation demand and supply in the state. Major shortfalls were noted for the Metropolitan region.

Based on data collected in 1974 by the Statewide Planning Program the five most popular in-state activities were: salt water swimming, fresh-water swimming, sightseeing, picknicking, and outdoor games. The level of participation in recreation activities was found to be restricted by income and accessibility. In addition, people tend to travel to the nearest source of opportunity, a fact confirmed in the nationwide study cited above. Estimates have been made by Statewide Planning of the balance of demand with supply of facilities in Rhode Island. Demand greatly exceeds supply in the East and West metropolitan regions, which includes the Upper Bay communities plus North Providence, Johnston and West Warwick (Table 4-1). Shortgages exist for all activities except golf. However, on a statewide basis, only two of fourteen surveyed activities showed a deficiency (picnicking and tennis).

Table 4-1. Deficiencies in Recreation Opportunities Expressed by Total Demand as a Percentage of Supply

| | East Metropolitan | West Metropolitan |
|---|---|---|
| Salt water swimming | 95 | 118 |
| Picnicking | 200 | 544 |
| Freshwater swimming | 267 | 225 |
| Tennis | 69 | 202 |
| Golf | 30 | 80 |

Source: Statewide Planning Program, 1976.

The state's approach to meeting these needs in the metropolitan region is the eventual completion of a ring of major parks on the urban fringe (Figure 4-1). These include developed parks such as Goddard, Colt and Lincoln Woods which are slated for upgrading, and undeveloped properties such as Snake Den, and Curran. The parks vary in distance from five to fifteen miles away from the center of Providence. In addition, the state owns and maintains a number of smaller parks and reservations within the metropolitan area, for example Ten Mile River, Squantum Woods, Haines Memorial and Salter Grove. The Bay Islands Park is expected to draw patronage from urban communities.

Municipalities also have prepared recreation plans which define problems and develop strategies for meeting local needs. The recreation plans of Upper Bay communities identify municipal needs in part by comparing a modified national or state acreage standard with an inventory of local facilities. Recommendations are then made for a program of acquisition, rehabilitation and maintenance. An important concern of all cities is the adequacy, distribution and condition of neighborhood parks, playgrounds, playing fields and major parks. Attention is usually given to the availability of a range of activities including fishing, swimming, and boating and the needs of special groups such as the elderly and handicapped. Less densely populated cities such as Warwick and East Providence have also exhibited concern for protecting conservation and open spaces.

One indicator of the seriousness of public commitment to recreational goals is government expenditures for parks and recreation programs. State and local spending on parks and recreation in Rhode Island was $14.22 per capita in fiscal year 1977, 37 percent lower than the national average (Bureau of the Census, 1979). As a result the state ranked 42 out of the 50 states in a total government expenditures. The proportion of direct general expenditure for recreation places Rhode Island in the middle of northeastern coastal states (Table 4-2).

Figure 4-1. The Metropolitan Park System

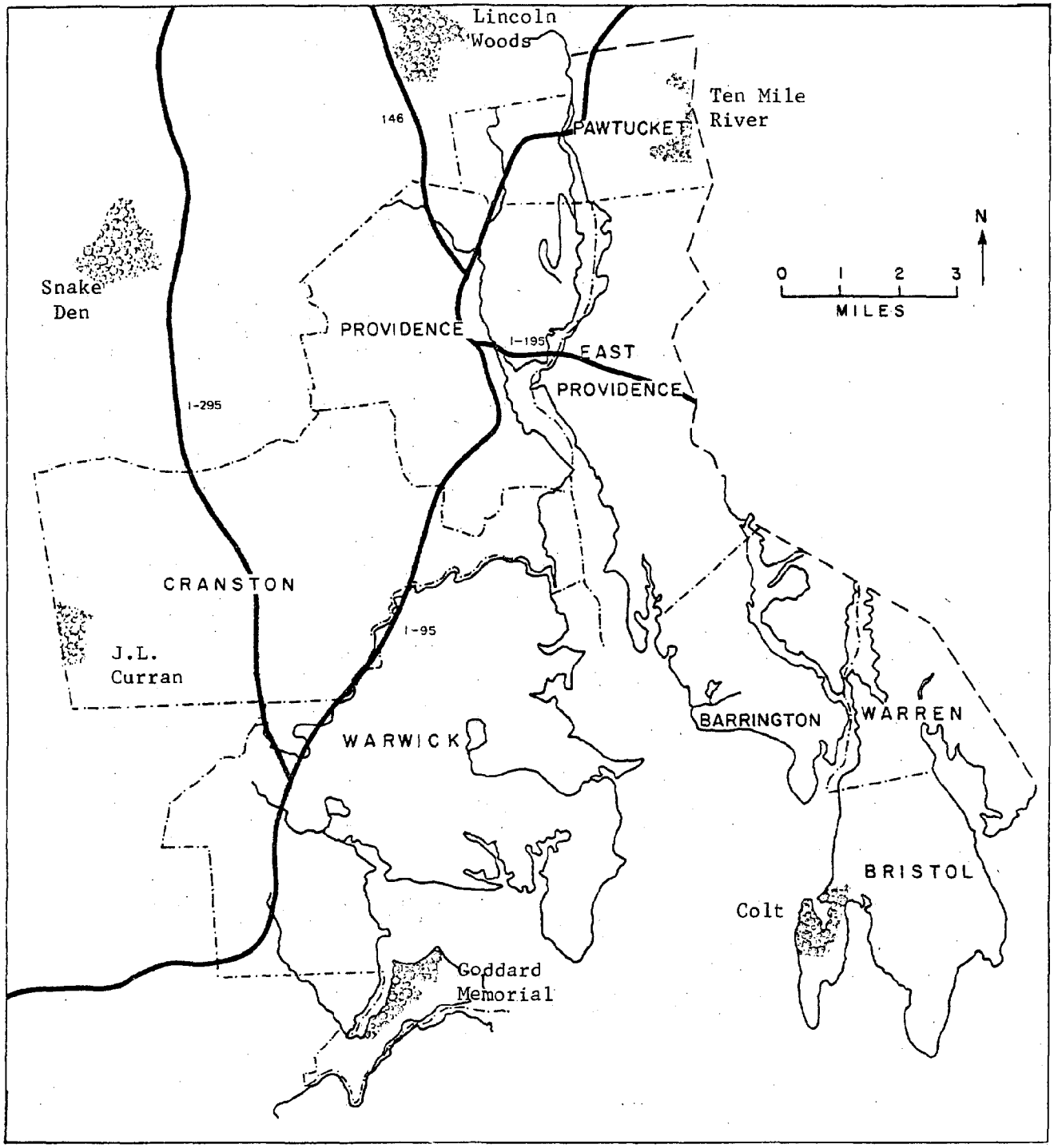

Table 4-2. Comparison of Recreation Spending of Northeastern States, FY 78

| | Recreation as a percentage of a state's direct general expenditures |
|---|---|
| New York | 2.8 |
| Maryland | 1.4 |
| New Hampshire | .99 |
| Rhode Island | .79 |
| Maine | .66 |
| Massachusetts | .62 |
| Connecticut | .25 |

Source: Bureau of the Census, 1979.

However, Upper Bay municipalities are well below the national average for cities of their size in parks and recreation spending (Table 4-3).

Table 4-3. Comparison of Municipal Recreation Spending With National Averages for Cities of Similar Size, FY 1978

| | Per Capita | | Percent of Direct Expenditures | |
|---|---|---|---|---|
| | National Average $ | Actual $ | National Average $ | Actual $ |
| Providence | 24.92 | 13.08 | 5.63 | 2.04 |
| Pawtucket | 22.07 | 12.67 | 5.78 | 1.98 |
| Warwick | 22.07 | 7.36 | 5.78 | 1.16 |
| Cranston | 22.07 | 6.30 | 5.78 | 1.07 |

Source: Bureau of the Census, 1979.

Some municipalities, such as Warwick, have had success in gaining approval for local recreation bond referenda. However, the state has not had a major recreation bond issue approved since 1965 when the Green Acres program was authorized.

The challenge of supplying adequate urban outdoor recreation is heighted by the general lack of financial support for both existing and new programs. Many opportunities do exist, but their success will depend on greater cooperation by the state, municipalities and the private sector. In addition, a more energetic approach to addressing urban recreation concerns can only help build the interest and enthusiasm required to attract public and private funds.

## RECREATION ALONG THE UPPER BAY SHORE

Providence is a center of recreation simply by virtue of the diversity of services and activities located in a compact area. Providence provides theatre, art, music, shopping, museums, athletic clubs, special events, restaurants, ethnic neighborhoods and historic sites and districts which are enjoyed by residents of the city and the state. However, urban dwellers also require active and passive recreation in an outdoor setting which is difficult to provide due to acquisition, development and maintenance costs.

Upper Narragansett Bay and the Seekonk and Providence Rivers form the largest expanse of open space in the Providence metropolitan region. During the late nineteenth and early twentieth century, the Upper Bay was heavily used for recreation. Excursion boats travelled the Bay landing passengers at several locations, including Fields Point, for shore dinners. Restaurants, dinner halls, amusement parks, casinos, hotels and clusters of summer cottages were prominant features of the shore. In this century, urbanization has overtaken many of these facilities. The demise of the steamboat cruise was precipitated by the rapid adoption of the automobile as a means of transport and recreation.

The Rhode Island Coastal Resources Management Program identified four principal coastal recreation opportunities: shoreline access, parks, beaches, and recreational boating. All of these exist in the upper Bay. Half of the sites are privately owned, although they incorporate only 31 percent of waterfront recreation land area. The state owns nine sites comprising about 41 percent of all recreational land, while municipalities control 20 sites representing 28 percent of land area. The distribution of coastal recreation sites is heavily weighted toward the lower half of the Upper Bay. The four most heavily developed communities, Providence, East Providence, Pawtucket and Cranston, possess only about one fourth of the total recreation acreage. The problems of inadequate distribution appears to be an important concern for each type of outdoor recreation.

### Shoreline Access

The state holds title to the foreshore, defined as land seaward of the mean high water line, and privdes its residents with a constitutional guarantee to lateral access along the shore. This is to insure that Rhode Islanders can "enjoy and freely exercise all the rights of fishery, and the privileges of the shore" (Article I, Section 17, R.I. Constitution). As a practical matter, however, there must be access across the upland to the water's edge in order to make shorefront recreation possible. Upper Bay communities vary considerably in the amount of access which the public has to the shoreline. According to work conducted by the Public Rights of Way Commission in 1971, only 34 state owned rights of way, in addition to state parks, were known to exist, with none present in Cranston, Providence, Pawtucket, and the upper half of East Providence.

The Rhode Island legislature gave the Coastal Resources Management Council the task of researching and designating state-owned points of access to tidal waters in 1977. Since then, the CRMC subcommittee on Rights of Way

has been directing legal research and conducting public hearings to develop the necessary documentation, a process that occasionally uncovers local controversy. Thirteen rights of way have been officially designated in the Upper Bay communities of East Providence, with Warwick, Barrington, Bristol and Warren in earlier phases of the program.

Municipalities also own rights of way. These consist of parks and beaches, the platted but undeveloped ends of streets which intersect the shoreline, and lots obtained due to non-payment of taxes. The amount of access varies among communities. Warwick, with a shoreline of 38 miles, has identified 319 access points while East Providence, has counted only 50 locations for public access along its 14.4 miles of shore. The number of designated and developed access ways is considerably less than these totals.

Shore access in Upper Bay communities is confronted by several difficulties. The distribution of presently known sites is uneven and does not match neighborhood needs. Many of the known sites may not have been reached, publicly identified or physically established. Proper development and maintenance of state and local rights of way requires the commitment of capital and operating funds which are not easy to obtain. Abutting property owners, rather than cooperating to maintain them, often choose to obstruct rights of way to limit pedestrian traffic near their property or prevent people from parking along the street near the access point.

Parkland

There are approximately 1500 acres of parkland along the Upper Bay shore, three-fourths of which is publicly owned (Table 4-4) (Figure 4-2). Colt State Park in Bristol, Rhode Island Country Club in Barrington, and Max Read Field in Pawtucket are the only parcels over 100 acres each, and comprise 54 percent of the total. The nature of shorefront parks varies considerably, including totlots, linear parks, picnic groves, scenic overlooks, playing fields, and private clubs. The most notable features of their distribution are irregularity and scarcity. A large portion of the west shore of the Seekonk River is protected as open space for public access and as cemetary and hospital grounds. The eastern shore is largely industrial and presently has no significant facility except in Pawtucket. The Providence River, which enters Upper Narragansett Bay at Conimicut Point has very little park land on either shore. The port industry and private residences occupy the western shore, and oil terminals, a rail line and residences are crowded along the eastern shore. A few large facilities exist around the Upper Bay, including Conimicut Point, Rocky Point Park, and Colt State Park. Rumstick Point is a conservation area which is, for practical purposes, inaccessible to the public.

Beaches

There are eleven recreational beaches along the urban waterfront (Table 4-5). Nearly all of these are south of Conimicut Point or along the Barrington and Warren Rivers (Figure 4-3). Narragansett Terrace, also known as Bullock Neck, contains a private beach. Although only 6 of the

Figure 4-2. Parkland

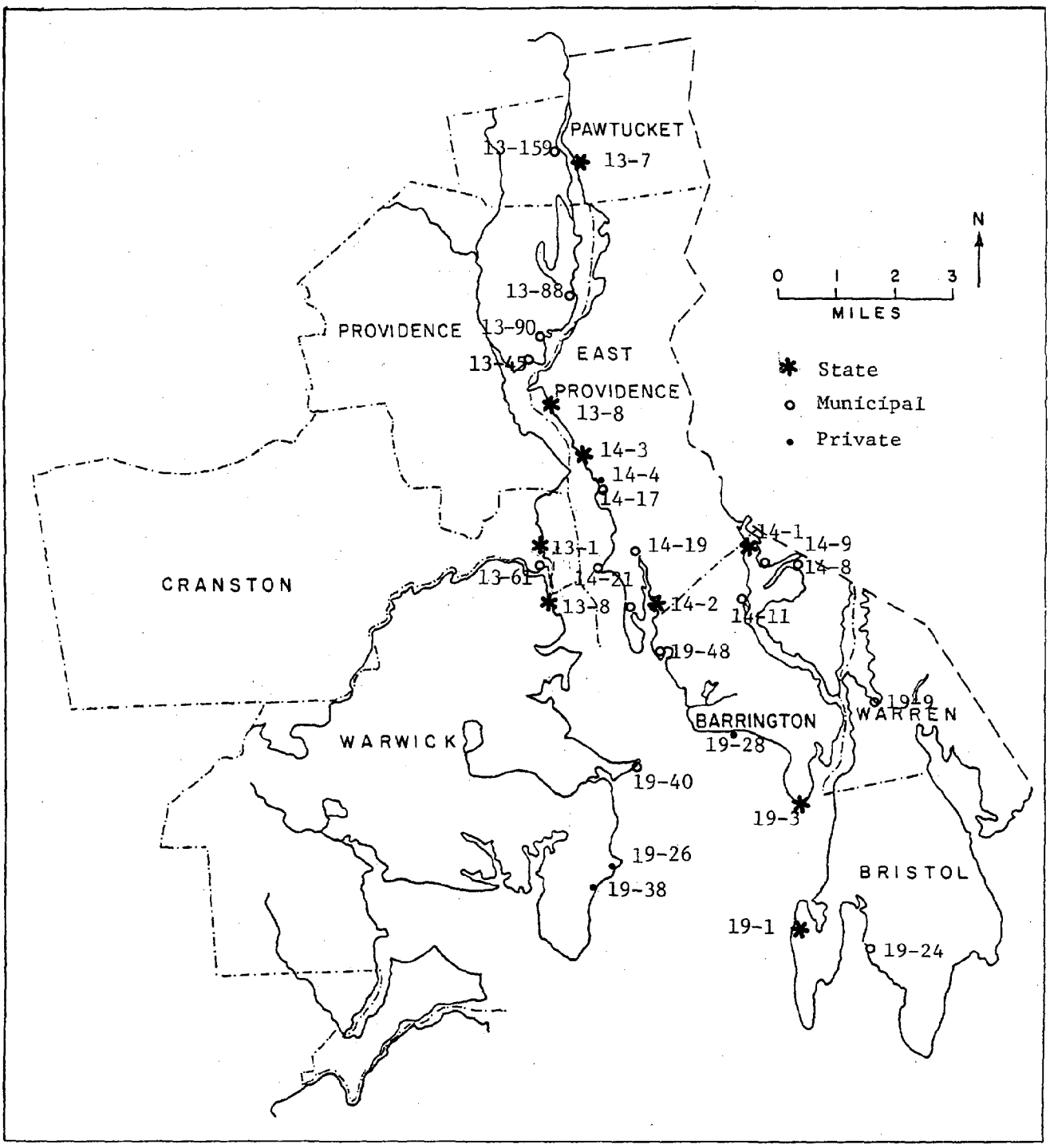

Table 4-4. Parks and Open Space Along the Upper Narragansett Bay Shore

| | Acreage | Percent of Total |
|---|---|---|
| **Barrington** | | |
| 19-28 Rhode Island Country Club (P) | 227 | |
| 14-9 Knuckum Hill (M) | 75 | |
| 14-2 Haines State Park (S) | 73 | |
| 19-3 Rumstick Point (S) | 33 | |
| 14-1 Hundred Acre Cove (S) | 23 | |
| 19-48 Latham Avenue Park (M) | 4 | |
| 14-8 Ormond Drive Park (M) | 1 | |
| 14-11 Walker Farm (M) | 62 | |
| | 498 | 32.4 |
| **Bristol** | | |
| 19-1 Colt State Park (S) | 459 | |
| 19-24 Rockwell Park (M) | 1 | |
| | 460 | 30.0 |
| **Cranston** | | |
| 13-1 Stillhouse Cove (S) | 2.7 | |
| 13-61 Pawtuxet Cove (M) | 1.2 | |
| | 3.9 | .3 |
| **East Providence** | | |
| 14-20 Crescent Park (T) | 50 | |
| 13-18 Veteran's Memorial Parkway (S) | 44.1 | |
| 14-3 Squantum Woods (S) | 29 | |
| 14-19 Bullocks Point Park (M) | 14 | |
| 14-17 Boyden Heights (P) | 10 | |
| 14-14 Squantum Cliff (P) | 7.5 | |
| 14-21 Sabin Point Park (M) | 4 | |
| | 152.6 | 10.6 |
| **Pawtucket** | | |
| 13-59 Max Reed Field (M) | 153.0 | |
| 13-7 Seekonk River Reservation (S) | 15.8 | |
| | 168.8 | 11.0 |
| **Providence** | | |
| 13-88 Blackstone Park (M) | 45.4 | |
| 13-90 India Point Park (M) | 13.0 | |
| 13-69 Gano Street Field (M) | 4.1 | |
| | 62.5 | 4.0 |
| **Warwick** | | |
| 19-26 Rocky Point Park (P) | 76.0 | |
| 19-40 Conimicut Point (M) | 14.4 | |
| 13-8 Salter Grove (S) | 8.5 | |
| 19-38 Our Lady of Providence (P) | 70 | |
| | 168.9 | 11.0 |

Source: R.I. Statewide Planning Program; 1976.

Figure 4-3. Beaches

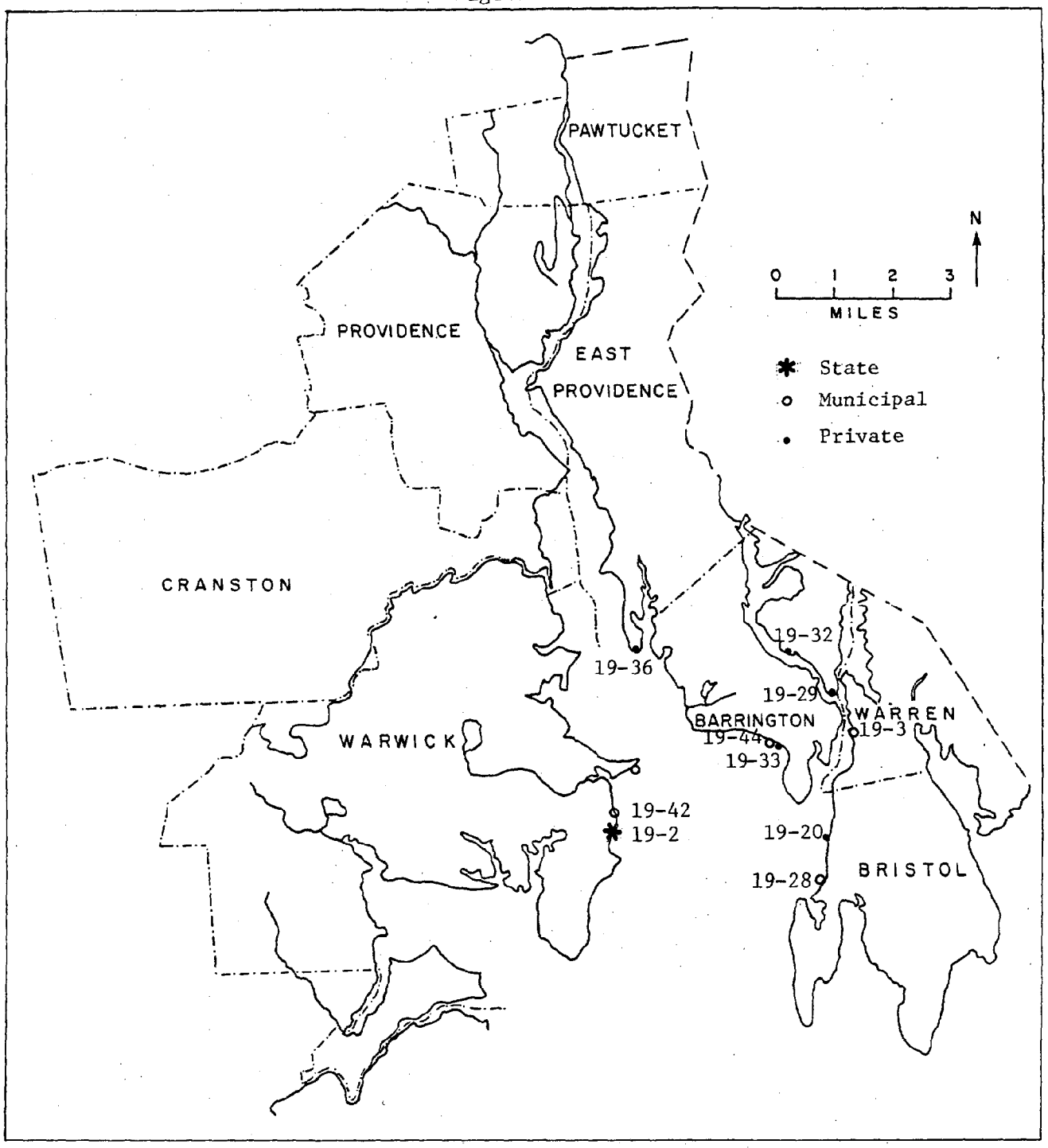

TABLE 4-5

BEACHES

| | Linear Feet of Beach | Acreage |
|---|---|---|
| **Barrington** | | |
| 19-44 Town Beach (M) | 1000 | 1.3 |
| 19-33 Beach Road (P) | 500 | |
| 19-29 Barrington Yacht Club (P) | 300 | |
| 19-32 Meadowbrook (P) | 300 | |
| | 2100 | |
| **Bristol** | | |
| 19-28 Town Beach (M) | 695 | 27 |
| 19-20 Narragansett Heights (P) | 115 | |
| | 710 | .2 |
| **East Providence** | | |
| 19-36 Narragansett Terrace Park (P) | 550 | |
| **Pawtucket** | | |
| **Providence** | | |
| **Warren** | | |
| 19-3 Warren Town Beach | 500 | 2.3 |
| **Warwick** | | |
| 19-40 Conimicut (M) | 1000 | |
| 19-26 Rocky Point (P) | 200 | |
| 19-42 Bay Side Beach | 2800 | |
| 19-2 Longmeadow Beach Access | -- | |
| | 7860 | .6 |
| Public | 5895 | |
| Private | 1965 | |

Source: R.I. Statewide Planning Program, 1976.

11 sites are publicly owned, they comprise 75 percent of the 7860 linear feet of sandy beach in the Upper Bay. A geological survey of the Upper Bay shoreline revealed that much more of the shore can be classified as beach. However, relatively little is maintained for recreation, in good part because of the poor quality of the water which makes swimming unsafe or aesthetically unpleasing.

Recreational Boating

Boating ranked fifth in participation out of eighteen activities surveyed by Statewide Planning and is expected to exhibit the greatest increase in participation between 1980 and 2000. It is difficult to determine the number of boats used in coastal waters, since much of the fleet is unregistered and is transported by trailer. An estimate by Collins and Sedgwick (1979) indicates that in 1978, the Rhode Island fleet was composed of 33,247 boats. They observe that a major part of boating takes place in Rhode Island's coastal waters, since access to lakes, ponds and streams is limited. One third of the fleet is stored in the water, while most boats larger than 18 feet occupy space at marinas.

Of the approximately 7500 marina slips identified in 1978, only 18 percent were located in Upper Narragansett Bay. Most of these are clustered in a few areas, principally Edgewood, Pawtuxet Cove, Bullock Cove, Warren River, and Bristol Harbor. Table 4-6 is a list of marinas and yacht clubs and the approximate number of slips at each operation. Figure 4-4 indicates the location of these facilities as well as state and municipal boat ramps. Only three of these operations provide a full range of services. It is not possible to develop accurate data on marina capacity for several reasons. A marina expands or loses slips depending on development plans, permits, and storm damage. For example, a marina located in Cranston at the Providence border suffered such extensive storm and ice damage that the operator was forced to abandon the site. Marina capacity can also vary depending on the clientel being served. Larger sail and power boats may occupy dock space that conceivably could service a greater number of small boats. Some facilities allocate space to commercial quahoging boats as well. Moorings are also an important way in which boat owners store their craft, but there is no estimate of their numbers. The general location of public boat launching ramps is provided in Figure 4-4. Most marinas and yacht clubs also have one or more ramps for private use.

Growth in the number of recreational boats has been substantial, with an annual rate of 7 percent overall. Wet-stored boats have increased at 3.5 to 4 percent annually with growth of 8.6 to 9 percent occurring in the trailerable fleet (Collins and Sedgwick, 1979). However, slips and ramps have not been developed or maintained to adequately service this demand. The Providence and Seekonk Rivers have the potential for filling some of the unmet demand. In addition, several Upper Bay locations have sufficient land and water to accommodate expanded marina operations.

Figure 4-4. Recreational Boating

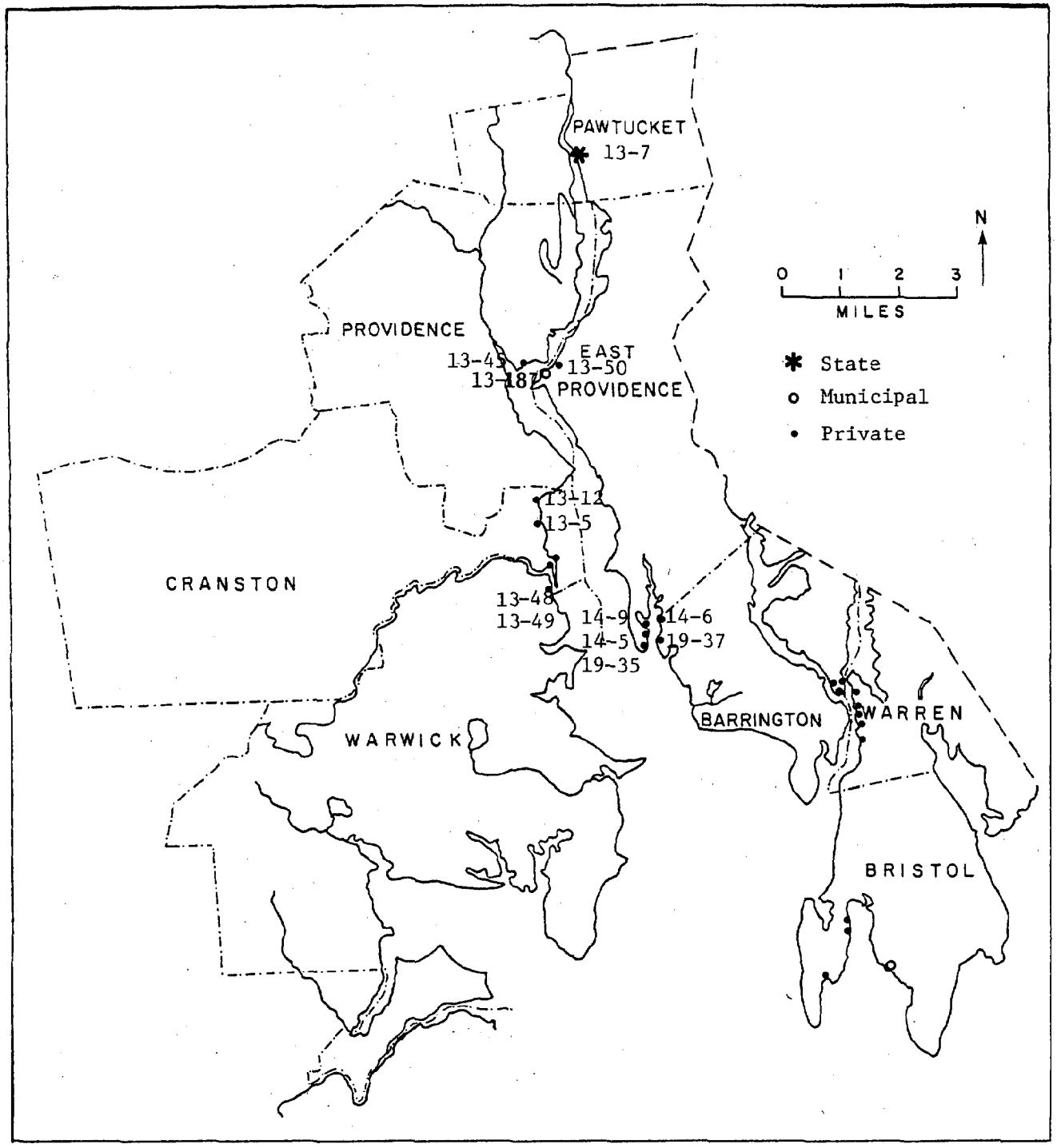

Table 4-6. Recreational Boating

| | Slips | Ramps | Acreage |
|---|---|---|---|
| **Barrington** | | | |
| 14-6 Cove Haven Marina | 250 | | 6.0 |
| 19-37 Lavin's Marina | 168 | 1 | 2.3 |
| 19-31 Stanley's Boatyard | 140 | | 5.3 |
| 19-30 Striper Marina | 116 | 1 | 3.5 |
| 19-29 Barrington Yacht Club | 18 | 1 | 84.0 |
| **Bristol** | | | |
| 19-32 Municipal Dock | 70 | 1 | 3.0 |
| 19-16 Bristol Marine | 18 | 1 | |
| 19-13 Bristol Yacht Club | | 2 | |
| 19-17 Usher Cove Marsh | | 2 | |
| **Cranston** | | | |
| 13-12 Port Edgewood | 120 | 1 | |
| 13-7 Pawtuxet Cove Marina | 107 | 1 | .3 |
| 13-11 Pawtuxet Yacht Club | 85 | 1 | |
| 13-6 Rhode Island Yacht Club | 50 | 1 | .2 |
| 13-5 Edgewood Yacht Club | 40 | 1 | .5 |
| 13-8 Edgewood Marine | 22 | | |
| 13-47 Pawtuxet Boat Launch Ramp | | 1 | |
| **East Providence** | | | |
| 19-35 Bullock Point Marina | 73 | 1 | 1.0 |
| 14-5 Narragansett Terace Marina | 37 | 3 | .4 |
| 13-50 Oyster House | 36 | 1 | 1.4 |
| 14-9 Narragansett Terrace Yacht Club | 7 | | |
| 13-87 Bold Point | | 1 | 2.1 |
| **Pawtucket** | | | |
| 13-17 State Pier #2 | 75 | | |
| **Providence** | | | |
| 13-45 Marine Services | 6 | 1 | |
| **Warren** | | | |
| 19-5 Blount Seafood | 11 | 1 | |
| 19-2 Ressker Enterprises | 20 | | |
| 19-3 Booth Marina | 3 | | |
| 19-4 Hitchcock Marina | | 1 | |
| **Warwick** | | | |
| 13-48 Pettis Marina | 32 | 1 | |
| 13-49 Asprey Boatyard | | 1 | |

Source: R.I. Statewide Planning Program, 1976; Collins and Sedgwick, 1979.

## URBAN WATERFRONT RECREATION OPPORTUNITIES

### Introduction

The water and shoreline of the Upper Bay possesses considerable untapped potential for satisfying the outdoor recreation needs of urban residents. State and municipal recreation plans and studies have identified a number of ideas for increasing shoreline access, the quantity and quality of parks and fostering recreational boating facilities. However, recovering the urban shore for recreation is not easy. Several difficulties have slowed progress toward implementing the many plans. The scarcity of suitable shorefront property makes acquisition costs extremely high. State and local governments suffer from a shortage of funds to develop and properly maintain public parks and recreation sites. Environmental problems such as poor water quality and debris along the shore serve as powerful visual detractions in some areas. Several major opportunities currently exist for increasing public access to the waterfront for recreation. These include management and planning for places with recreation and conservation value, the establishment of a linear park from Bristol to Providence along the state owned rail right of way, improvements for recreational boating, and debris removal in the water and slong the shore.

### Protecting Sites with Recreation and Conservation Values

Very little of the Upper Bay shoreline, particularly its natural and landscaped features is available for public use. Private residential and industrial development has made the Bay invisible to most of the people living near it. Yet when viewed from the water, many segments of the Upper Bay shoreline are surprisingly attractive and have retained a great deal of their natural character. This is often in striking contrast to the dense urban development just a short distance inland. Shoreline features which served historically as constraints to development, such as bluffs, coves, tributary streams and wetlands have over time become important amenities to the neighborhoods which they border. Many structures and districts of historic value and cultural interest survive as well. Providing sufficient access to the metropolitan area's principal open space resource, the Bay, protecting neighborhood character and a dwindling stock of natural open areas are critical Upper Bay recreation issues. Unfortunately, they appear to be among the most difficult to resolve.

Acquisition of shorefront land by the state or a municipality is the most direct means of assuring public access to the water. Some major undeveloped parcels still exist along the Upper Bay, which would be suitable for recreational use. Donations and lots forfeited due to unpaid taxes contribute to government acquisition programs. However, broadly based financial support does not exist for acquisition programs. Most of the recreation land obtained by the Department of Environmental Management in Narragansett Bay has been the result of transfers of surplus Navy land. Both state and local agencies suffer from a scarcity of funds for developing and managing land already under their control. The Federal Land and Water Conservation Fund is administered by the Heritage Conservation and Recreation Service and is supported by revenues from Outer Continental Shelf Development. This could be a valuable source of funds,

except that the local matching share requirement is 50 percent of total project costs a proporation which has detered many local initiatives. This program, along with the Urban Park and Recreation Recovery Program are victims of drastic budget recessions in Fiscal 1980, and budget reductions in Fiscal 1981 (Northeast Memo, Spring 1980, HCRS). These federal actions are part of a broad national pattern of retrenchment which is forcing local and state government to either develop new strategies for meeting urban recreation needs, or postpone plans and neglect existing facilities.

Most of the places for summer recreation, including cottages, restaurants, dinner halls, hotels, parks, camps, and open land which had been operating at the end of the 19th century have been replaced by permanent residential developments in this century. Among the last of these to disappear is Crescent Park, a 55-acre facility in the Riverside section of East Providence. The circumstances surrounding its reuse illustrates the complexity of issues involved in urban waterfront planning. The amusement park operated from 1886 until the latter 1970s and is noteworthy for the carousel designed by Charles Laoff which has been well preserved, and the fact that it was one of the few widely accessible recreation sites in the Upper Bay. The Rhode Island Historical Preservation Commission, in its 1976 study of East Providence, was aware of the impending change in the status of the park, and urged that the city seek its inclusion in the Bay Islands Park System. The report states: "circumstances make it quite unlikely that Crescent Park will continue in its present capacity for more than a few years, making it highly probable that East Providence will lose one of its finest recreational facilities."

Crescent Park was purchased by the City of East Providence which is selling the property to a real estate development company seeking to build 200 luxury units and 250 rental units for the elderly. Controversy has surrounded this transaction. Under the plan approved by the City Council, easements on 23 acres on both the eastern and western parts of the site, which abut Bullocks Cove and the Bay respectively, would be granted by the City, including a 3.5 acre parcel where the carousel is located. Land along Bullocks Cove is slated for development as a marina. A citizens group, Save Our Carousel, has pursued legal action to force the City to retain the entire western portion of the property. The citizens plan envisions relocating the Carousel adjacent to the present shore dinner hall and developing the entire 11 acre site for various recreation purposes.

The state is unable to protect any portion of Crescent Park through acquisition even if it wished to do so. Recreation land acquisition is financed by general obligation bonds subject to voter approval. State referenda has been the principal means of funding the state acquisition program. The most recent recreational development bond referendum was narrowly rejected in 1978. The restricted nature of these bonds, and uncertainty about voter approval, makes them a difficult mechanism for implementing state and local recreation plans. According to the Statewide Planning Program, reliance on bonds "contributes to the state's continued inability to match the maximum available federal funds allocated to Rhode Island and has been a major detriment to the progress of recreation, con-

servation and open space activities in the state." The State Comprehensive Outdoor Recreation Plan recommends the creation of a State Recreational Development Fund which would be supported by reallocations of the state park fee system and annual appropriations from the general fund, for use in providing one half of the matching federal funds needed by both municipalities and the Department of Environmental Management. Considerable attention would be given to coordinating state and local efforts, and providing technical assistance to municipalities as part of the allocation process. This proposal has not received legislative approval.

Short of ownership, there are several important ways in which state and local government can participate in protecting and restoring coastal areas with conservation and recreation value. Regulatory programs provide an opportunity to influence the nature and quality of new developments as well as curtail the degradation of established neighborhoods and their associated natural features and cultural resources. Site specific review of proposals for compliance with municipal ordinances, the Coastal Resources Management Program, and federal regulations is an ongoing process which is aimed at insuring private sector conformance with public goals. This approach is most suitable in suburban and rural communities where development pressures are strong and the capability to react quickly and effectively to guide such growth is essential. In the Upper Bay, however, few open parcels remain, consequently resolving conflicts, over their best use, establishing priorities for coastal land and water development, and taking active steps to combat both ecological and urban deterioration are more relevant concerns than growth management and require a different approach.

The Coastal Program contains some important policies which could be used in a systematic way by the Coastal Resources Management Council to promote the preservation and restoration of natural and cultural features in the Upper Bay. The Program itself notes that "The Council finds that it can be highly effective in solving complex problems involving problem definition, the coordination of local, state and federal agencies, and public involvement." Relevant policies and regulations are:

| Topic | CRMC Program Section |
|---|---|
| alteration of tidal waters and coastal ponds (which includes tributary water bodies) | 110.0-2 D |
| alteration of shoreline systems | 120.0-2 C |
| erosion protection measures | 140.0-2 C 3 |
| sewage treatment and solid waste disposal | 310.0-2 C |
| debris removal | 520.1-2 C |
| public beaches and parks | 420.0-2 B |
| conservation and management | 430.0-2 B |
| recreational boating | 440.0-2 F |
| historic preservation | 450.0-2 C |

The key for effective use of these authorities is in defining goals and strategies for specific areas which incorporate a full range of management concerns. General solutions to shoreline debris removal, pollution of tributary streams, dredged material disposal, recreational boating facili-

ties, open space acquisition and shoreline access have thus far eluded us. To be successful in the Upper Bay, the implementation of Coastal Program policies must take advantage of opportunities to coordinate private and public activities and responsibilities when they arise in specific geographic areas. Selecting a place to focus public attention on coastal management concerns should include consideration of the appropriate size to generate community interest and lead to good results within the resources available to the participating agencies.

Bullock Cove, located between East Providence and Barrington on the Providence River, is an example of a residential and recreation center in transition which could benefit from a coordinated management approach. The forth coming sale of Crescent Park will be the basis for a surge of private investment in multiple unit housing which will include shoreline modifications and effects on adjacent residents. The present plans of the City of East Providence would lead to the development of a marina at the head of the Cove. Development of the railroad right of way for use as a bikeway/linear park will increase public interest and access to the Cove and Haines State Park. The Cove presently has a problem with shorefront debris. Within a few years, boating interests are likely to seek maintenance dredging of the channel, particularly if a new marina is developed. Shoreline access, wetland and water quality impacts, dredged material disposal and the cumulative effects of new development upon the community will all be important regulatory issues as applications are received on a piecemeal basis by the CRMC. The opportunity exists, prior to these actions, for the creation of a thoughtful and open process which would guide the planning and development of Bullock Cove as a resource in order to resolve many of the environmental and neighborhood concern which are caused by present conditions and future development.

Municipalities have developed land use control programs through zoning and subdivision ordinances and building inspection which provide tools for local protection of coastal recreation and natural resources. A new tool was proposed in the 1980 legislative session which would enable municipalities to designate and exercise special controls over scenic and recreational rivers. It would provide a resource based approach to reviewing developments within river preservation districts. The bill, 80H7715, was approved by the Joint Committee on the Environment but was referred to the House Judiciary Committee and received no further action in 1980.

East Bay Bikeway and Providence River Linear Park

After the reorganization of bankrupt Northeast railroads begun in 1973, the Rhode Island Department of Transportation (DOT) acquired the Bristol Secondary Track which runs between Bristol Harbor and Wilkesbarre in East Providence. In the past several years, several different sources have proposed the development of a linear park on the rail right of way, which would create a bicycle/running path and greatly increased shoreline access. The DOT is now pursuing this possibility.

The Statewide Planning Program has been studying the feasibility of using the right of way for light rail or commuter bus system serving the communities on the east side of Upper Narragansett Bay, which would preclude its full use as a linear park. The first element of the study, published in April, 1980 estimated the potential demand for an enhanced mass transit in the East Bay. Although no conclusions are drawn in the report, the results of the analysis strongly indicate that a major public investment to make the right of way suitable for a light rail or express bus system is not appropriate.

A baseline forecast shows that in the year 2000, 25 percent of the 10,000 trips to Providence along the East Bay (which extends from Newport to East Providence) will be made by bus. Under conditions of a critical energy shortage the demand for mass transit would increase to about 40 percent of all trips. The study reports that simply expanding existing bus service would increase use of transit compared to the choices involving large public investments in the rail right of way (Table 4-7).

Table 4-7. Projected East Bay Trips to Providence
Year 2000
Energy Crisis Scenario

| | Use of Transit | Subsystem Trips |
|---|---|---|
| Expanded Bus Service | 4190 | |
| Exclusive Bus Lane | 4020 | |
| Bus Way | | 2420 |
| Regular Bus Route | | 1600 |
| Light Rail System | 4020 | |
| Rail Trips | | 1280 |
| Regular Bus Route | | 1740 |

The cost just of making the Bristol secondary track suitable for light rail service, was estimated at $12 million in 1980. The report notes that light rail is suitable for a ridership of 2,000 to 24,000 trips in one direction per hour, but even under a critical energy scenario, only 1280 trips to Providence would be generated in one day.

The rail corridor, once a major barrier to waterfront access by East Providence, could readily become a major new recreation opportunity for the east Bay communities. The Departments of Transportation and Environmental Management are presently working on a plan to create a bikeway from Independence Park in Bristol Harbor through Colt State Park, to Burr Hill Park in downtown Warren. A recent thesis by Suzanne Smith of the Rhode Island School of Design examined the design potential for extending this bikeway to Providence, a concept suggested by the City of East Providence,

in its 1975 Recreation Plan. The DOT is currently preparing to initiate a planning study for use of the corridor as a bikeway.

A fully developed Providence River linear Park could become a major new facility for pleasure and commuter biking, running, skating, and walking, and would also connect several major parks and open spaces with one another and the shore. Sites which could be linked include the proposed Blackstone Canal Bikeway, Blackstone Park, India Point Park, Gano Street Field, Bold Point, Squantum Woods, Bullocks Cove, Haines Memorial Park and Brickyard Pond. Portions of the right of way might be suitable for recreational fishing and boating access.

The most important argument in favor of use of the right of way for recreation is the fact that it is already publicly owned, eliminating land acquisition which is one of the most difficult and costly problems of waterfront park development. Several issues are likely to present difficulties for implementation of a plan for the linear park, including funds for planning and development and concern about conflicting uses of land by abutting residential and industrial property owners and rail interests. Given the high potential recreation value of the resource, these concerns should not be viewed as insurmountable constraints.

Improvements in Recreational Boating

The private sector is the chief source of boating facilities and services for the wet-stored fleet in Upper Narragansett Bay including marinas, yacht clubs, and the numerous docks and private moorings established by shorefront land owners. State and municipal governments have concentrated on providing public or neighborhood access for the trailerable fleet which accounts for three fifths of all boats in the state. State and local government can play an important but limited role in fostering additional private investment in new or expanded marina operations. State and local government, however, has the major responsibility for providing boat ramps and public access, a task which can yield only limited results in the absence of a source of funds for capital improvements and maintenance.

The Providence and Seekonk Rivers were identified by Collins and Sedgwick (1979) as one of the best locations for marina development.

> Improved water quality and the elimination of the eyesores along the shoreline would very likely spark interest in the private sector, since the Upper Bay offers one of the last areas where a significant number of new marinas could be established.

Existing marinas in Bullocks Cove, Edgewood and Pawtuxet Cove were identified by the State "208" water quality program as possessing moderate to high potential for marina expansion in terms of water area and supporting land. Barrington and Bristol were limited to a greater extent by a shortage of land for parking and operations than other Upper Bay sites. However, the expansion or creation of new marinas is a major challenge to the private marina industry because of the high acquisition and development costs and many competing water uses. State and municipal governments can play a role in supporting appropriate marina developments by working to solve some of the problems which the private sector is not in a position

to handle on its own. In particular, the removal of silt in federal navigation channels, and the identification of suitable sites and techniques for disposing of dredged material from the berths of existing marinas require government action. Recreational boating in Pawtuxet Cove is seriously threatened by loss of its channel, and Bullocks Cove will be a candidate for maintenance dredging in the near future. Most new marina construction will require at least some dredging of a channel and berths as well. Governmental assistance in this area is therefore paramount to improve as well as maintain a healthy boating industry which meets the state's recreational demands.

Maintenance dredging of federal navigation channels is the responsibility of the New England Division of the U.S. Army Corps of Engineers. Financing of the proposed Pawtuxet Cove project, to return that basin to its authorized depth of 6 feet below mean low water, would be provided by the Corps of Engineers. However, funding for all recreation dredging has been temporarily withheld in favor of commercial projects by the Carter Administration. The Pawtuxet Cove proposal calls for dredged material to be placed adjacent to state owned property south of the Cove in order to create a salt marsh. Dredging of berths presents marina owners with financial and regulatory problems. The quantities which may require removal are much smaller than for channel maintenance, but the disposal problem is still important. Options include land disposal on the property of the marina, removal by tracking, marsh building, and beach restoration (Seavey and Pratt, 1979). State regulation now requires that dredged material be tested to determine whether it can be classified as a hazardous waste prior to trucking. Marina operators are presently resorting to onsite storage even though land is a major constraint to the growth of their operations. In the cases of both channel and berth dredging, filling the need for greater public access for recreational boating on Narragansett Bay is impeded by a lack of progress in implementing the several dredged material disposal options which have been developed to reduce potential or probable undesired environmental effects.

Access for Sport Fishing

The number and variety of fish caught on the intake screens of the South and Manchester Street power plants demonstrates that despite chronically polluted waters finfish species popular to sportfishermen can and do exist throughout the Upper Bay. The available catch data for the recreational fishery points to considerable activity in the Upper Bay already and it would appear that more fishing could take place if access to the water were improved. The aesthetic values of fishing in the Upper Bay will increase substantially when and if water quality is upgraded.

Access to fishing, however, is severely limited in the Upper Bay. At present most fishing takes place from boats and the Upper Bay is poor both in marinas and public launching facilities. There are at present only seven state owned public launching ramps serving the half million people living in the eight Upper Bay municipalities. Many of these are not sufficiently developed and fall far short of the optimum requirements for ramp facilities which calls for at least one acre for parking and the maneuvering of trailers and cars, good road access and minimal exposure to prevailing winds and seas (Collins and Sedgwick, 1979). In addition,

a dock along side the ramp would make boarding and taking out boats easier and safer. The principal difficulty faced by the Department of Environmental Management is a lack of funds for upgrading and developing new ramps. Property acquisition is the largest factor in the expensive process of creating new ramp sites.

Several avenues exist for overcoming the expense of purchasing launch ramp sites. Cooperative efforts with municipalities could result in the identification of city owned properties with ramp development potential. For example, East Providence has already expressed its desire to develop land it owns on Bold Point as a launching area. Providence owns a considerable amount of park land along the western shore of the Seekonk which may have potential. In Pawtuxet Cove, both the state and the City of Cranston own land which was slated, but never developed, for boat ramps. Another option for ramp development is the rail right of way owned by the Department of Transportation along the east side of the Upper Bay. A major portion of the East Providence shoreline is occupied by the rail bed, which crosses several coves and passes near several parcels of publicly owned land. The State is currently examining the potential of this right of way for use as a bikeway.

An additional mode of access that is sorely lacking is that of readily accessible, shoreline structures that can be used by fishermen. There is a good deal of fishing that occurs now from bridges and piers around the Bay but these facilities are noticeably lacking in the Upper Bay and its coves and tributaries. Other urban centers such as Detroit which have had success in revitalizing their urban waterfront, are encouraging recreational use of existing piers or building new ones to serve the urban recreational fisherman. There are numerous opportunities to do this in the Upper Bay. If sufficient fish are available there is potential to fish from Port of Providence piers, from the tank farm flood protection banks in East Providence, from the Fox Point barrier, from the old railroad bridge across the river at India Point or at Watchemoket Cove if access could be made available and reinforcing construction carried out where needed. There is potential to expand and encourage shorefront fishing at such places as Rocky Point Park, Bullocks Cove, the bridges over the Barrington and Warren Rivers, the riverfront land at the Bucklin Point Sewage treatment plant on the Seekonk. Any way to encourage fishing is as a multiple use of existing structures is a relatively inexpensive means of enhancing the use and appreciation of the Upper Bay.

Removal of Debris

Piers, bulkheads, wharves and barges which have lost their economic function through abandonment, storm damage, sinking and lack of maintenance, are a serious problem on the water. Unusable shorefront structures, derelict vessels, loose wood from collapsing piers and shorefront dumps have accumulated in the Upper Bay and Providence Harbor over several decades and exceed 26,000 cubic yards according to a 1978 survey by the Army Corps of Engineers. About 90 percent of this material is along the Providence and East Providence shorelines (Table 4-8).

Table 4-8. Sources of Debris

| Community | Shorefront Structures No. | Shorefront Structures Cu. Ft. of Debris | Derelict Vessels No. | Derelict Vessels Cu. Ft. of Debris | Loose Onshore Debris Locations No. | Loose Onshore Debris Locations Cu. Ft. of Debris | Total |
|---|---|---|---|---|---|---|---|
| Barrington | 13 | 2,661 | 0 | 0 | 4 | 1,900 | 4,561 |
| Cranston | 17 | 6,610 | 3 | 20,150 | 7 | 2,500 | 29,260 |
| East Providence | 63 | 143,344 | 22 | 68,835 | 51 | 44,250 | 256,429 |
| Pawtucket | 8 | 12,676 | 1 | 200 | 1 | 6,500 | 19,376 |
| Providence | 32 | 220,618 | 22 | 144,500 | 7 | 11,700 | 376,818 |
| Warwick | 28 | 3,344 | 5 | 3,735 | 20 | 6,800 | 13,879 |
| | 161 | 389,253 | 53 | 237,420 | 90 | 73,650 | 700,323 |
| | | | | | | Study Area Drift* | 800 |
| | | | | | | Total Study Area Debris | 701,123 |

*Drift is that floating material always present on the water surface.

Source: Army Corps of Engineers, 1978.

The Corps of Engineers has been working with municipalities since 1967 in identifying needs and plans for debris removal. In 1970 federal funds became available on a 2/3 federal 1/3 state cost sharing basis for debris removal. At that time, the estimated cost of the Rhode Island project was $1.2 million, of which $400,000 would have to be provided by the state. Rhode Island chose to obtain its share by going directly to affected Upper Bay communities, and seeking contributions proportioned to the amount of debris in areas under their jurisdiction. Providence was asked to contribute $250,000, while Barrington asked to contribute $5,000. Providence felt that costs should be more equitably distributed. The conflict was not resolved, and federal funds were withdrawn for the entire program by the Nixon administration in 1973.

Funds were reauthorized by Congress in 1976. The most recent plan, released in 1978, is based on a one-time cleanup of the entire Upper Bay for an estimated cost of $4 million (Table 4-9). The Study notes that:

> The economic forces that would normally lead to full utilization of the prime waterfront properties, especially within the Harbor area, have been diminished by the influence of the cost to remove and dispose of these sources of debris. There is also a need to reduce the losses that have been caused by collisions between pleasure boats and floating debris.

The Corps plan could be completed within two years. Active state participation is necessary both for providing matching funds and for identifying a disposal site for the debris. No progress has been made in either area. In addition, a new difficulty is clouding the prospects of a debris project in the near future. New language in the reauthorization act, (P.L. 94-587, § 202) states that:

> Non-federal interests in future project development...shall be required to recover the full cost of drift or debris removal from any identified owner of piers or other potential sources of drift or debris, or to repair such sources so that they no longer create a potential of drift or debris (33 USCA 426 m (c)).

The Corps interprets this section to mean that if owners of the debris can be identified, the owners are liable for the cost of removal. The Boston Harbor debris removal project is currently being delayed in part because of the Corps interpretation. A resolution of this conflict is not expected until 1981 and will establish a precedent for other cleanup projects. If debris ownership must be determined, a different state strategy for dealing with the debris question must be formulated. In the meantime, Massachusetts is seeking support to obtain changes in the law.

In Rhode Island authority for debris removal rests with the Coastal Resources Management Council which prohibits the abandonment of structures in navigable waters:

> 520.1-2 c. Abandonment of vessels, piers, wharves, or other such structures in the navigable waters of the state of Rhode Island is specifically prohibited. Upon verification of legal tital to such abandoned structures the Council shall order their removal at owner expense within a time period specified in said order.
>
> Failure to comply with the terms of such an order shall be a violation of a duly adopted Council regulation and subject to all fines and penalties established by law. Each day of noncompliance, defined as beginning the day after expiration of the specified notice period, shall be deemed a separate and distinct violation in accordance with 46-23-1, GLRI.

Progress in debris removal can occur only after the state, in close cooperation with affected municipalities, develops a plan which answers the legal, technical, and financial questions that must be resolved before Corps of Engineers participation is possible.

Table 4-9. The Providence River and Harbor and the Seekonk River, R.I.
Debris Study Inventory Summary of Removal Costs of Debris Sources in the Study Area

| Item | Number Of Sites | Quantity of Materials Floatable (C.F.) | Quantity of Materials Non-Floatable (tons) | Total Removal Cost ($) | Total Disposal Cost ($) | Total Repair Cost ($) | Total Cost ($) |
|---|---|---|---|---|---|---|---|
| A. Waterfront Structures | | | | | | | |
| 1. Dilapidated-not in use | 131 | 307,396 | | 1,052,690 | 153,714 | 0 | 1,206,404 |
| 2. Dilapidated-in use | 4 | 19,432 | | 71,223 | 9,716 | 23,903 | 80,939 |
| 3. Portions dilapidated to be repaired | 9 | 16,607 | | 74,835 | 8,305 | 175,720 | 83,140 |
| 4. Portions dilapidated not to be repaired | 17 | 45,818 | | 181,634 | 22,910 | 0 | 204,544 |
| B. Derelict (wrecked) vessels | 53 | 237,420 | | 843,128 | 118,711 | | 961,839 |
| C. Loose onshore debris (flotables) | 90 | 73,650 | | 216,531 | 36,825 | | 253,356 |
| D. Drift collection | | 800 | | 19,704 | 401 | | 20,105 |
| E. Shorefront dumps | 24 | | | | | | |
| TOTALS | 328 | 701,123 | | 2,459,745 | 350,582 | 199,623 | 2,810,327 |

Source: Department of the Army, New England Division Corps of Engineers. 1978. Providence River and Harbor and Seekonk River Debris Study.

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# APPENDIX A: The Urbanized Estuary

## INTRODUCTION

The upper portion of Narragansett Bay, extending from the northernmost point on Prudence Island to the falls of the Blackstone River in Pawtucket, is a heavily urbanized estuarine ecosystem (Figure A-1). Upper Narragansett Bay is surrounded by the Providence metropolitan area, which began and flourished as a port city following the Revolutionary War, experienced tremendous growth during the Industrial Revolution of the 19th century and was transformed during the massive suburbanization of the 20th century. This growth in activity and population modified the landscape and shoreline of the Upper Bay, altered the flow and quality of water, and changed the quality of the Upper Bay as a place to live and as an estuarine ecosystem.

At the turn of the century, Providence reached its peak of influence, possessing 40 percent of the state's population. Providence attained its highest population level in 1940, followed by a steady decline, as surrounding municipalities experienced rapid growth. Post-war propserity and deteriorating city conditions led to the present patchwork of residential developments of different housing values, unit ages, and social characteristics.

Recent population projections and preliminary census data indicate that the Providence metropolitan area has stopped growing, and that Upper Bay coastal communities will stabilize or lose populations in the next decade (Figure A-2). While population growth is not an essential ingredient for viable communities, the continuous maintenance and improvement of neighborhoods, businesses, and public facilities is critical for protecting the attractiveness and habitability of an urban area. Consequently, an interested population base willing to supply capital from both private and public investments is essential to ensure improvements in the Upper Bay coastal communities. Unfortunately, much of this vital capital is currently channeled to support suburban growth.

Environmental laws and management programs created in the 1960s and 1970s help supplement the role capital investment plays in protecting special areas and species necessary to sustain natural resources. The natural values and resources of many urban areas have unfortunately often been ignored. Yet environmental protection and enhancement is especially important in urban environments which house large population centers. Programs which provide financial investments in physical improvements including provisions for greater shoreline access and protection of natural features are needed to enhance the quality of life for Upper Bay residents.

Figure A-1. Upper Narragansett Bay.

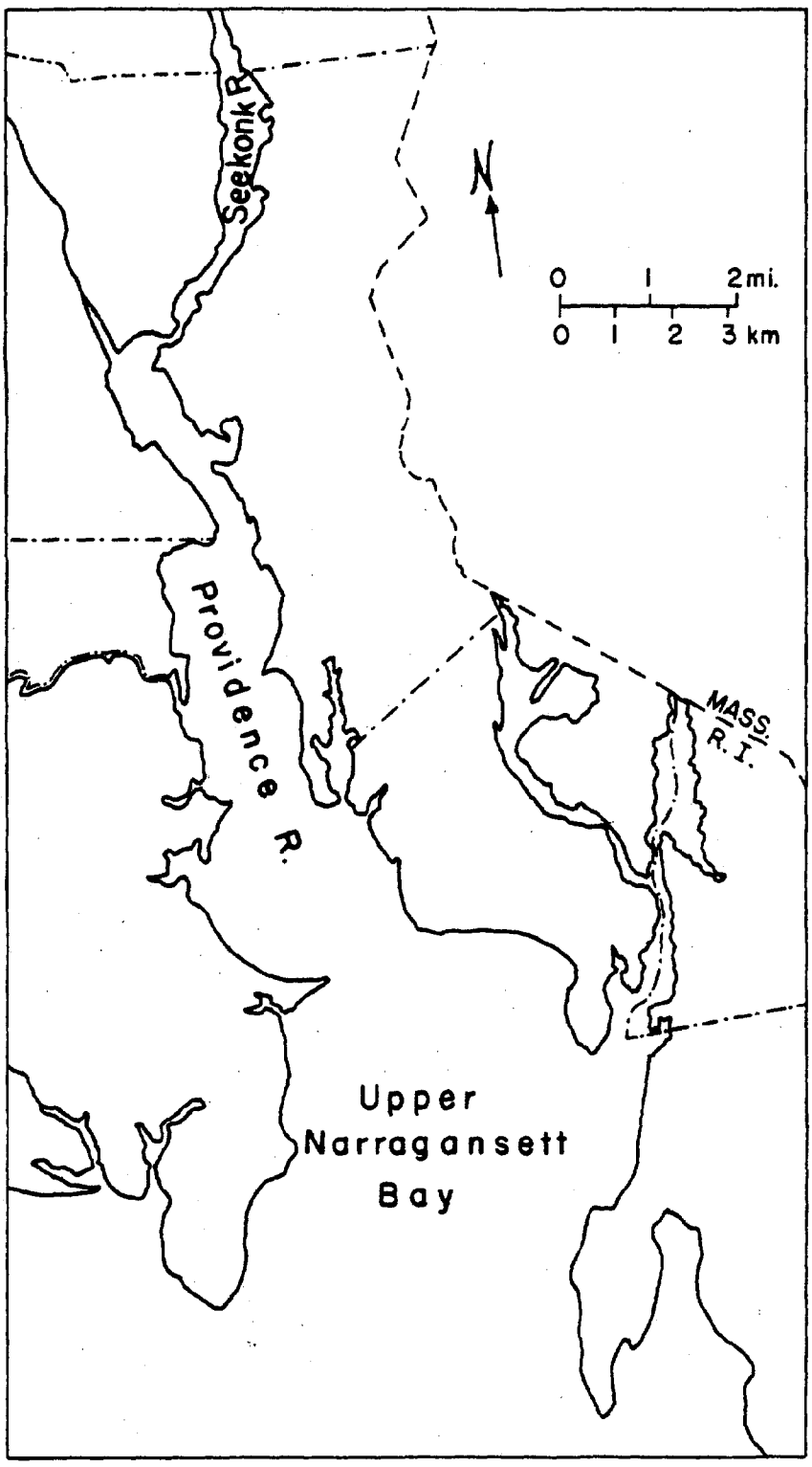
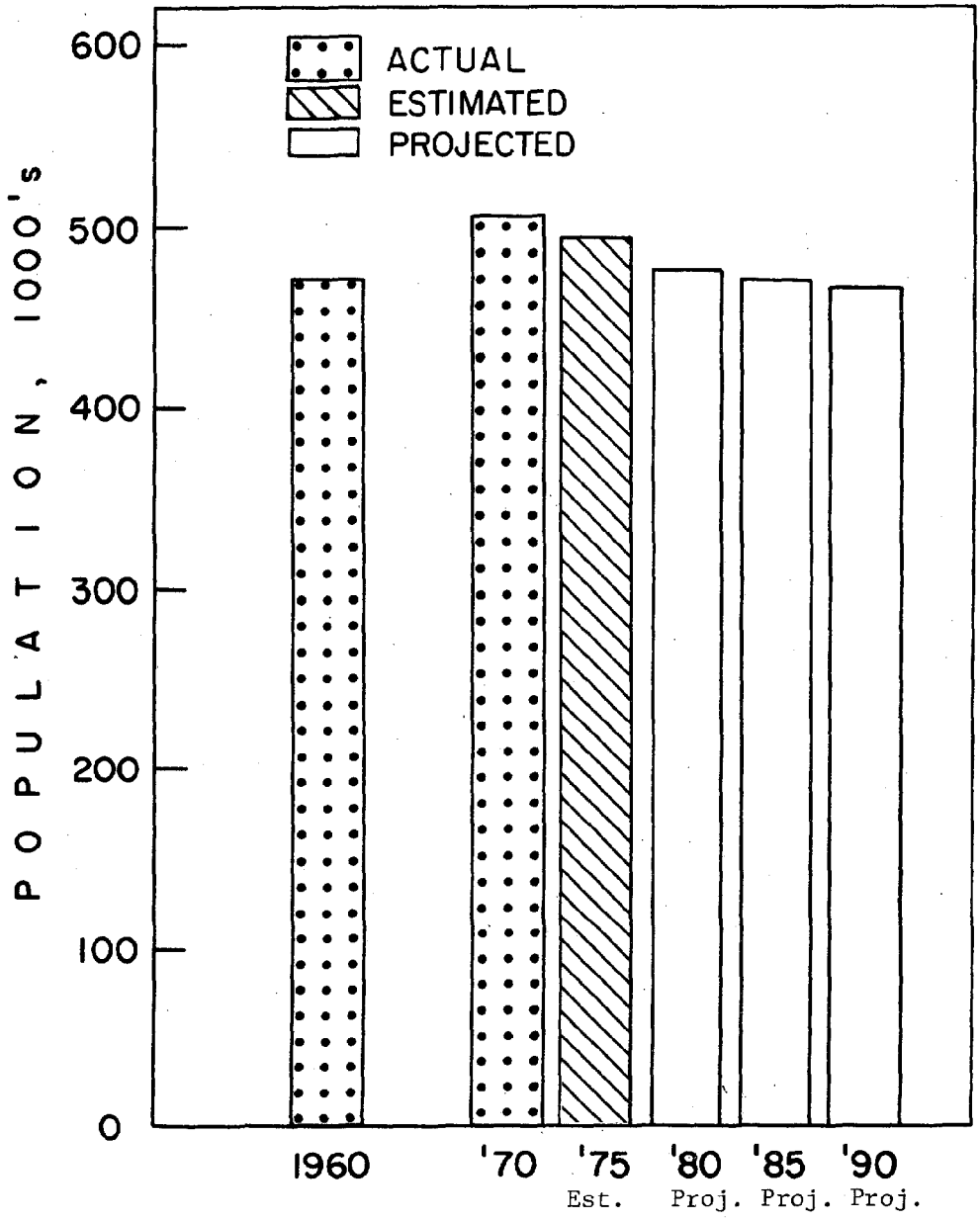


Figure A-2. Population of Upper Bay Communities; Actual, Estimated, and Projected




Source: Rhode Island Statewide Planning Program. April 1979.

This Appendix contains the descriptive material prepared in order to gain a better understanding of the social and environmental characteristics of the Upper Bay as an urban estuary. It is presented here for reference and as a demonstration of the richness and variety of the urban coast as a setting for human and biological life. The discussion is in two parts, first an overview of social characteristics, and secondly, a discussion of the marine and coastal environment which concludes with a summary of water quality issues.

## URBANIZATION OF UPPER BAY COMMUNITIES

### Settlement and Economic Growth

Dramatic economic and population growth in the eight communities surrounding the Upper Bay has produced a shorefront with a distinct mixture of old and new neighborhoods and obsolete as well as modern industry which severely altered the natural landscape. Providence began as a small settlement which served as a port for coastal trade, passenger travel, and fisheries. This function expanded during the 18th Century, although Newport was the primary port of international trade until the Revolutionary War. In 1800 Providence surpassed New York, serving as the home port of 110 sailing vessels. Providence was heavily engaged in foreign trade which became more risky and declined after 1820. The city's share of the state population increased steadily from 1800 to 1910, as waves of European immigrants participated in the economic growth stimulated by major advances in textile production and heavy local investments in manufacturing. By 1900, Providence had 40 percent of the state population compared to 11 percent of a century earlier, an increase of 23 times. Port activity changed from speculative ventures in foreign trade to the import of fuel and materials.

However, a number of factors contributed to a decline in population and economic structure of Providence after 1900. Interstate highways began to greatly increase the ease of transportation which, in turn, affected the economic structure of the city. Residential and industrial development spread from Providence to outlying areas. Textile manufacturers began relocating their operations to southern states. Massive expenditures were made on roads, sewage treatment, schools and services by suburban taxpayers, while cities faced mounting financial burdens and economic decline. The industrial port facilities along the Providence and Seekonk Rivers also suffered as interstate highways, power plants and tank farms began to take the place of railroad lines, wharves and coal piers.

### Suburbanization and Coastal Development

By 1970, Providence had 29 percent fewer residents than in 1940. The greatest decade of change occurred during the 1950 when the city lost 41,100 in population. This was caused in part by the net migration of 8,655 families of which more than 70 percent moved to other Upper Bay communities (Table A-1).

Table A-1. Destination of Families Migrating From Providence 1950-1959

| Destination | Percent of total net migration from Providence |
|---|---|
| Barrington | 2.4 |
| Bristol | .2 |
| Cranston | 28.6 |
| East Providence | 9.0 |
| Pawtucket | 3.7 |
| Warwick | 28.4 |
| Warren | -- |
| | 72.3 |

Source: Goldstein, Meyer, 1961.

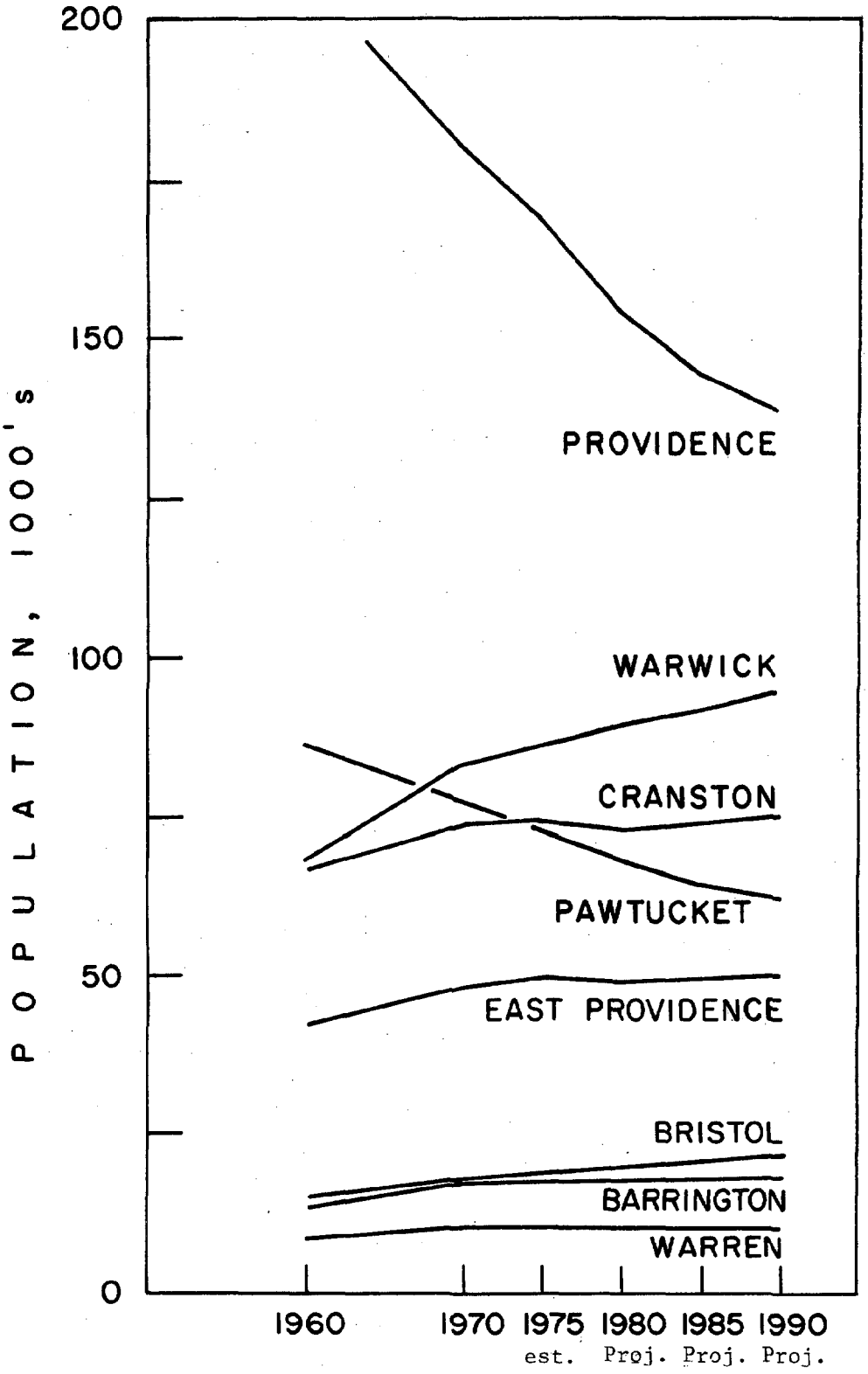
A less dramatic change has affected Pawtucket, which lost five percent of its population between 1950 and 1970.

The physical development of the Upper Bay is the result of a social process which is historical in nature. The desire of people to improve the quality of their residential environment includes a search for lower density, more open space and natural landscape, newer and better quality homes and compatible neighbors. Increasing affluence, detriorating city conditions and dislocation of neighborhoods due to urban renewal and highway construction provided reasons for seeking new places to live outside Providence. Projections by the Statewide Planning Program indicate that both Providence and Pawtucket will continue to lose population until the end of this century. Other Upper Bay municipalities are expected to stabilize at current levels, with the exception of Warwick, which is expected to grow, but at a slower rate than during the 1950s and 1960s (Figure A-3).

Residential Character of the Upper Bay Coastal Towns

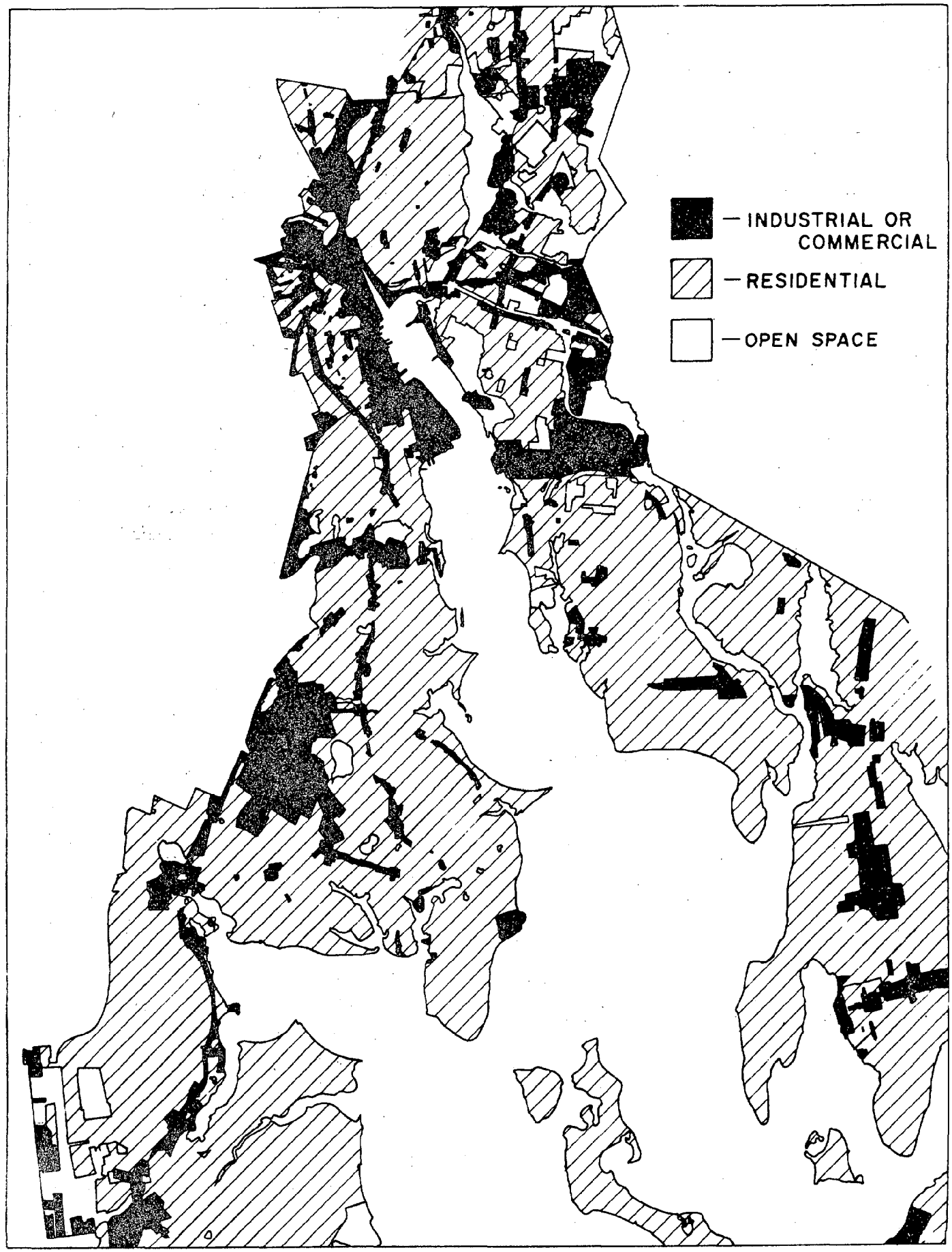
The Upper Bay shore is dominated by residential land use of various densities. The two exceptions are the eastern shore of the Seekonk River which is an industrial district known as Phillipsdale, and both sides of Providence Harbor which are utilized by the port industry. Figure A-4 is a generalized map of the zoning classification of the Upper Bay shore which serves as a reasonable general land use map, since to a large extent the zoning ordinances reflect existing urban land cover. However, the amount of undeveloped land in each remaining community differs. Providence and Pawtucket possess less than 10 percent vacant land compared to nearly 20 percent in East Providence, and even greater quantities in Warwick and Bristol.

Figure A-3. Population of Upper Bay Communities
Actual, Estimated, and Projected




Source: Rhode Island Statewide Planning Program. April 1979.

# LAND USE BASED ON MUNICIPAL ZONING



Residential districts which dominate the Upper Bay shore and differ considerably from one another in some important social and housing stock characteristics. Census information from 1970 can be used to illustrate significant variations among the 39 shorefront census tracts (Figure A-5).

Family income is closely related to the value of housing units and the tendancy to rent rather than own a home. Median family income for the entire Providence metropolitan area in 1969 was $9,929, with a range of $4,800 to $22,000 in Upper Bay communities (Table A-2) (Figure A-6). The number of families below the federal poverty level varied between 1.8 and 27.6 percent. However, in one half of all the shorefront census tracts at least ten percent of all families were considered low income, defined as an income less than 125 percent of the poverty level (Table A-3).

Table A-2. Median Income of Families in Shorefront Census Tracts (shown in Figure A-5)

| Median Income $ 1969 | number of census tracts |
|---|---|
| 15,000 + | 2 |
| 13 & 14 | 3 |
| 11 & 12 | 10 |
| 9 & 10 | 13 |
| 7 & 8 | 9 |
| 4, 5 & 6 | 2 |
| | 39 |

Table A-3. Percentage of Low Income Families in Shorefront Census Tracts (shown in Figure A-5)

| % low income families | number of census tracts |
|---|---|
| 25 + | 3 |
| 20-24 | 0 |
| 15-19 | 5 |
| 10-14 | 10 |
| 5- 9 | 15 |
| 0- 4 | 6 |
| | 39 |

Source: Bureau of the Census. 1970 Census of Population and Housing.

Considerable variation also exists in the proportion of owner occupied houses in the Upper Bay. Apartments and rented houses comprise 38 percent of all units, but a range of 6 to 90 percent exists among census tracts (Table 2-4). A similar broad range can be seen in the value of owner occupied houses in the Upper Bay. The mean value of a house in the Providence metropolitan area was $19,214. The range of the Upper Bay was $8,200 to $44,700 in 1970, with one third of all tract possessing average house values of $15 to $20,000 (Table A-5) (Figure A-7).

Table A-4. Percentage of Rental Units in Shorefront Census Tracts (shown in Figure A-5)

| % rental units 1969 | # tracts |
|---|---|
| 80-99 | 1 |
| 60-79 | 6 |
| 40-59 | 8 |
| 20-39 | 12 |
| 0-19 | 12 |

Table A-5. Average Home Value in Shorefront Census Tracts (shown in Figure A-5)

| average home value 1970 | # tracts |
|---|---|
| 35,000 + | 3 |
| 30-34,900 | 3 |
| 25-29,900 | 3 |
| 20-24,900 | 8 |
| 15-19,900 | 12 |
| 10-14,900 | 7 |
| 5- 9,000 | 3 |
| | 39 |

Source: 1970 Census of Population and Housing.

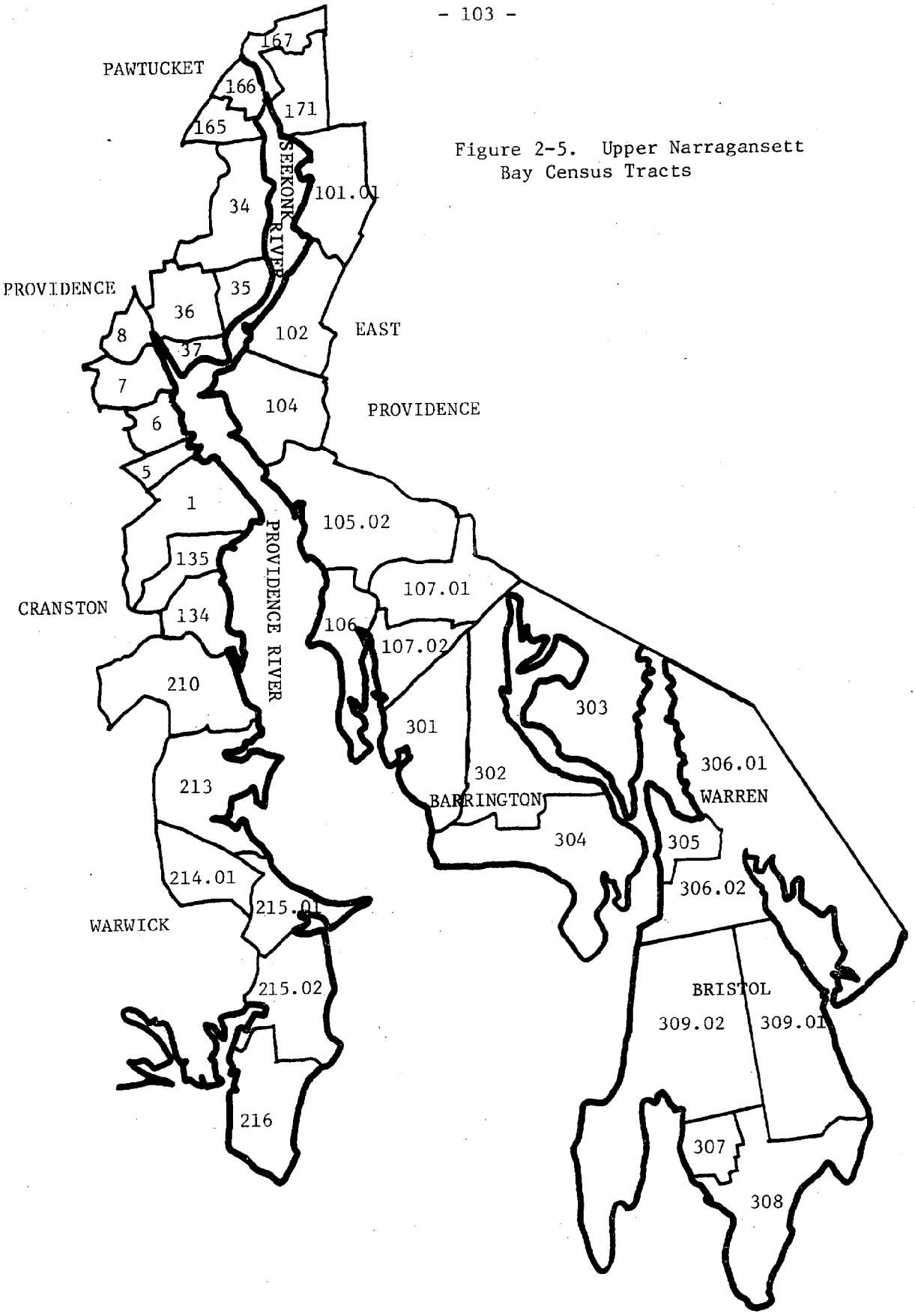



Figure 2-5. Upper Narragansett Bay Census Tracts

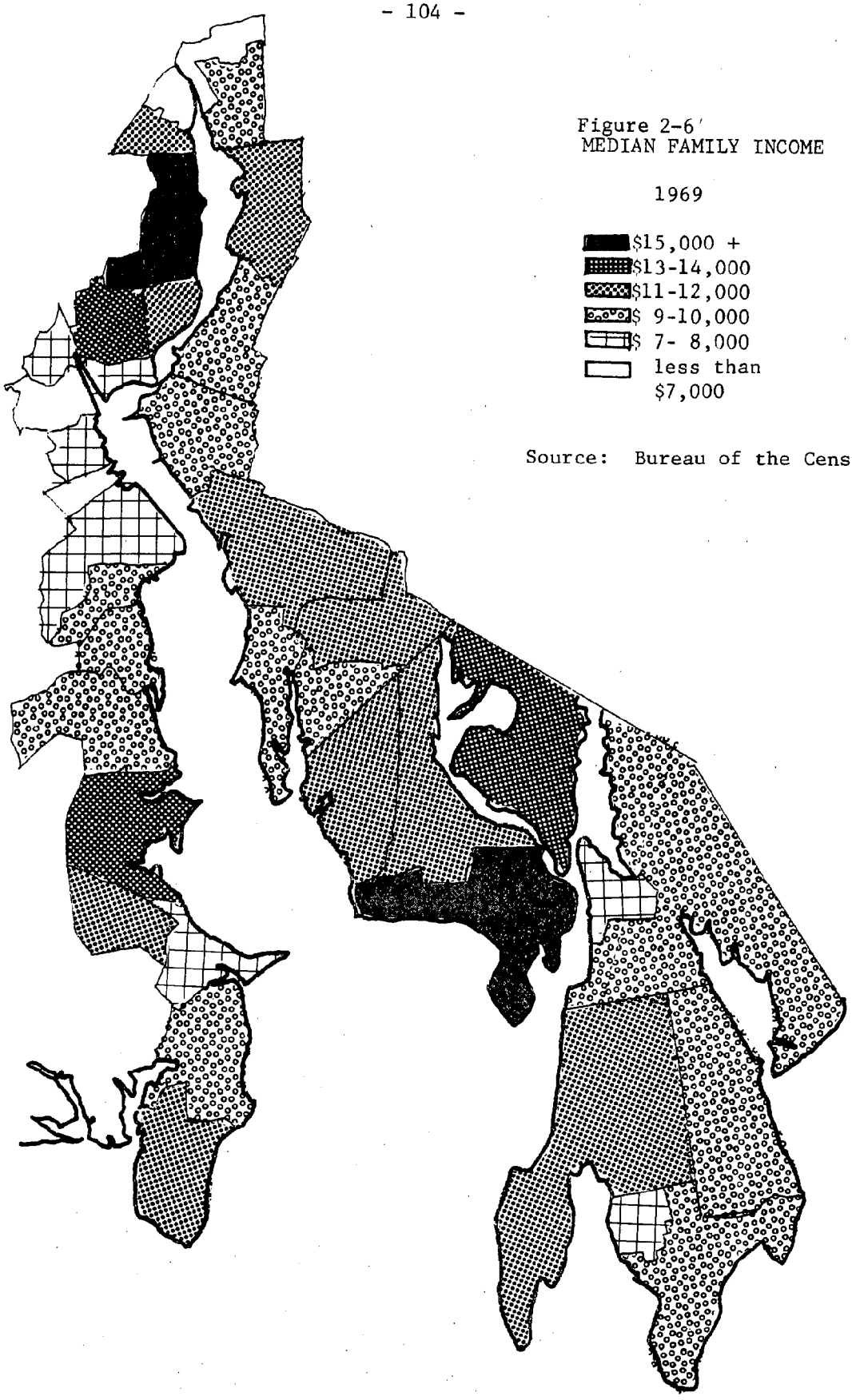



Figure 2-6
MEDIAN FAMILY INCOME

1969

Source: Bureau of the Census, 1971

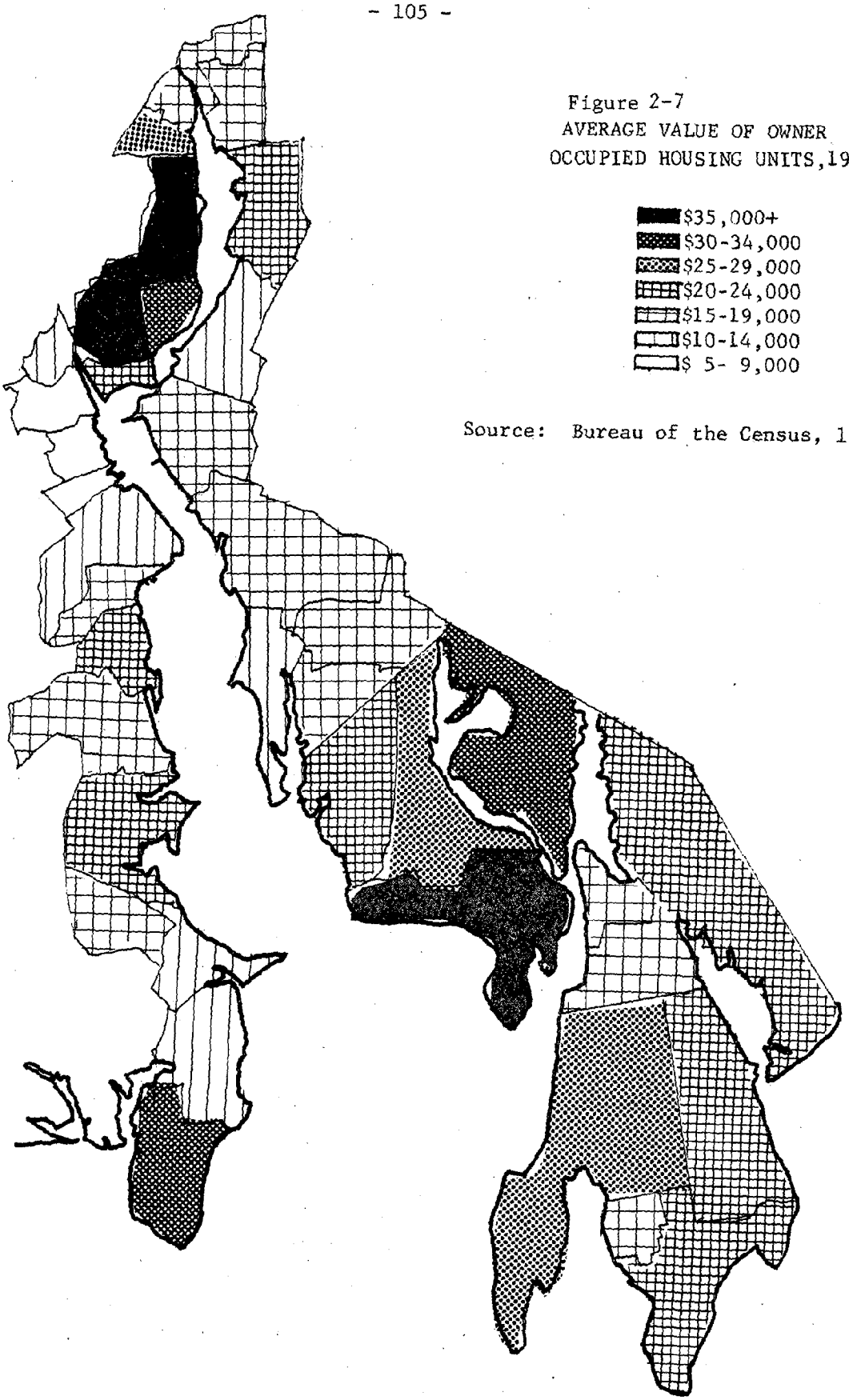



Figure 2-7
AVERAGE VALUE OF OWNER
OCCUPIED HOUSING UNITS, 1970

Source: Bureau of the Census, 1971

The physical development of the Upper Bay has been dramatic in recent decades. Although two thirds of all housing in the area was constructed before 1940, the proportion of these units varies from 11 to 95 percent among shorefront census tracts. Relatively little new housing was constructed during the 1930s. Rapid suburbanization followed World War II, lasting well into the 1970s. Pawtucket and Providence began to lose population, and along with Cranston saw little new housing construction. More than half of the housing units along the western shore in Warwick were built after 1940. On the eastern shore of the Bay, about 45 percent of all housing was build after 1940, with 12 out of 20 census tracts containing predominately post-1940 dwellings.

The segregation of families by income is clearly manifested in the geographic distribution of housing by age, value, and occupancy characteristics. With the notable exception of the Providence East Side, census tracts with very high amounts of pre-1940 housing are occupied by families with lower incomes, who rent rather than own their dwelling unit. Owner-occupied housing in these areas tends to be much lower in value as well. Population losses between 1960 and 1970 occurred in most of the poorest census tracts. House values and the tendency to own rather than rent steadily increase with family income. Tracts with concentrations of families of a certain income are quite likely to have housing at a particular value (Figure A-8).

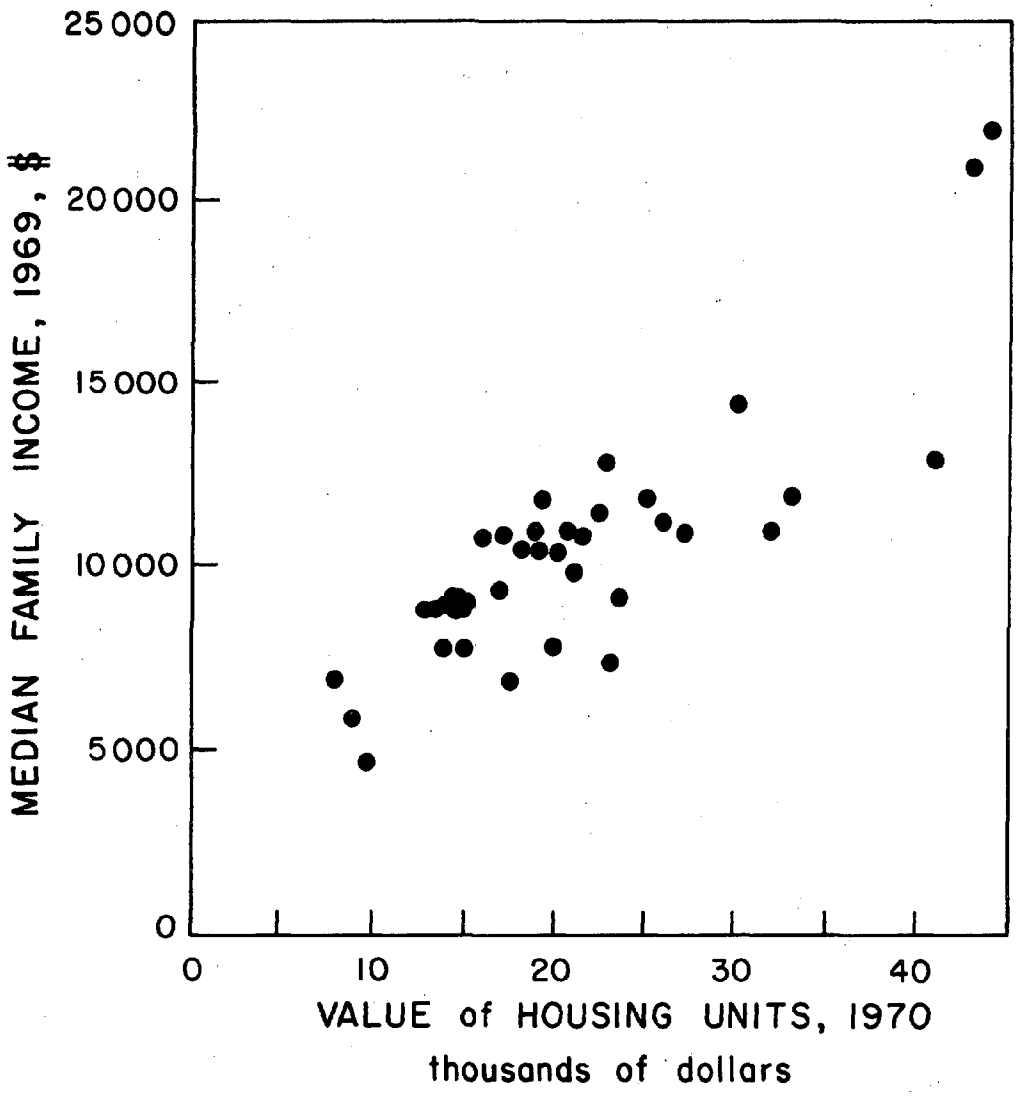
Even though the census tract is a somewhat arbitrary geographic unit, the sharp differences in the family income and home values of adjacent tracts serves as a strong indication of the powerful role of family preferences and choices in selecting a place to live when the financial means are available. Segregation by family income may be prevalent, but it is important to note that high, moderate and low income neighborhoods are scattered throughout the Upper Bay, rather than clustered together. Such diversity may well be a strength as the Providence urban area enters a new and difficult stage in its development.

Implications of the No-growth Metropolitan Area

The Upper Bay is part of a much larger urban system labeled as the Providence-Warwick Standard Metropolitan Statistical Area (SMSA) by the Bureau of the Census. It consists of 25 towns in Rhode Island and 8 in Massachusetts, and had a population of 910,781 in 1970. The cities and towns surrounding the Upper Bay, Warwick, Cranston, Providence, Pawtucket, East Providence, Barrington, Warren, and Bristol had a population of 507,016 in 1970, or 55.6 percent of the SMSA and 53.3 percent of the state. Nationwide, there were 272 SMSAs in 1975, an 11 percent increase over 1970. These urban areas are where 72 percent of the nation's population resides and works.

Between 1960 and 1970, 8 large (over 200,000) SMSAs in the U.S. suffered a net population loss, or grew less than one percent during the decade. No-growth metropolitan areas differ from rapidly developing places in some

Figure A-8. Relationship of family income and housing values 39 coastal census tracts




Source: Data taken from Bureau of the Census, 1971

important aspects, including employment opportunities, income distribution, public services, and real estate values. Population growth is a sensitive indicator of the economic well-being of a metropolis. Places with expanding job opportunities not only retain their population but attract young, skilled, economically and physically mobile people and families, as well as laborers with few skills and little education who can fill lower paying jobs. Many cities in the South and West are experiencing such growth, and a great deal is known about how such areas develop. Less national concern has been given to those SMSAs which are experiencing stagnation or decline in both the central city and outlying communities, and which have economies that fail to attract new residents and tend to foster the out migration of mobile segments of the existing population. In exploring the effects of no growth on the Upper Bay, Rhode Island data is used because detailed historical data on the Providence SMSA is limited.

Rhode Island has slowly lost ground to the rest of the nation in per capita income since World War II (Figure A-9). Although the state has remained close to the middle of national rankings, the trend in the 1970s has been toward continued decline. Average weekly wages in manufacturing during 1977 were 78 percent of the national average, a decline from 83 percent in 1970. Changing economic conditions are reflected in the loss of population in the 20-34 age group during the 1960s and projected losses in the 25-49 group during the 1970s. Although total civilian employment has increased steadily since 1975, the labor force declined in 1978 (Table A-6).

Table A-6. Employment, Labor Supply, and Unemployment Rate in Rhode Island

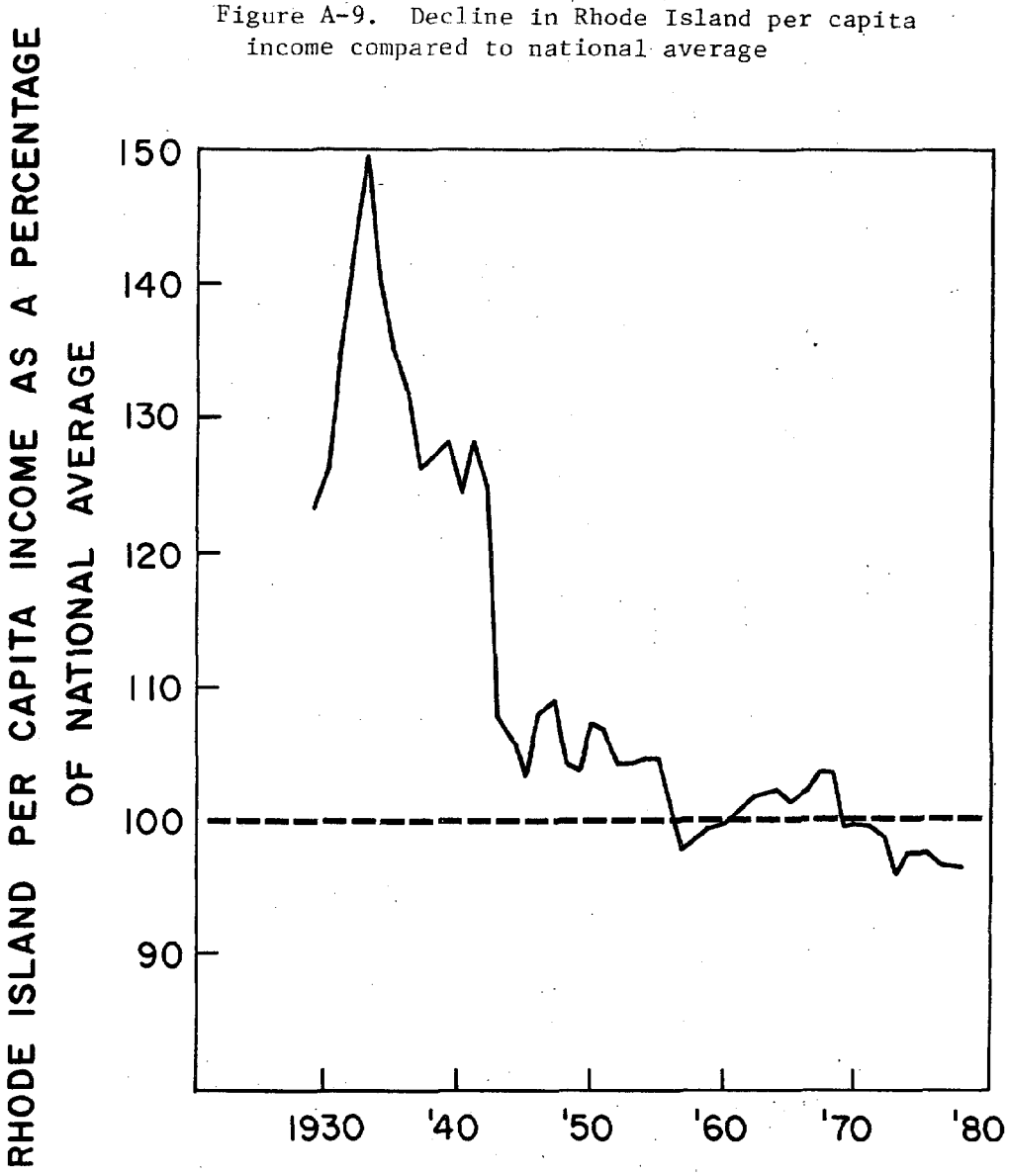
| | Total Employment | Labor Force | Unemployment Rate (percent) |
|---|---|---|---|
| 1970 | 344,100 | 394,700 | 5.6 |
| 1975 | 349,200 | 429,800 | 11.1 |
| 1976 | 366,700 | 434,000 | 8.1 |
| 1977 | 381,700 | 441,000 | 8.6 |
| 1978 | 397,800 | 433,000 | 6.7 |

Source: Rhode Island Department of Economic Development, 1979.

This change has occurred despite the entrance of the largest number of young people into the 15-24 age group in the state's history.

The failure of a metropolitan area to grow can have some significant effects upon both the population and the landscape. The decline in population serves as an indicator of economic decline. Those who are capable of leaving an area represent only a small segment of the entire population. Rust observes (1975):

Figure A-9. Decline in Rhode Island per capita income compared to national average




Source: R.I. Department of Economic Development, 1979.

> Economic distress could conceivably be a "push" when it affects people who are childless, own no real estate, are about to enter the labor force for the first time, or are forming a new family, all of which are more frequent among the young. At the same time, distress could be a barrier to mobility for other persons whom it deprives of resources needed for the move, or on whom it imposes a greater dependence on friends and relatives, property and community institutions. A home-owner or small businessman in a distressed community, for example, would be hard put to recover enough equity in the sale of his property to afford to buy elsewhere.

The result in many no growth metropolitan areas is a lack of outmigration which in some cases could help relieve pressure on the labor market. The economy of such areas is further weakened by an inability to develop or attract new industries and utilize available capital locally. Average family income declines relative to the nation as families share in a shrinking or stagnant economic base. Municipal governments experience increasing difficulty in supplying public services when property values decline and the tax base is eroded.

The Providence metropolitan area has already experienced some of the changes characteristic of no-growth SMSAs. In addition to slow economic expansion, suburban residential development has been occurring at the expense of developed neighborhoods, since total population has declined while that of suburban communities continues to increase. The trend should not be interpreted as a final verdict on the fate of Upper Bay communities, but as a signal of the seriousness which urban problems and needs should be taken.

## THE URBAN ESTUARY

### Introduction

Upper Narragansett Bay is a typical temperate estuary, a coastal embayment in which sea water mixes with an is measurably diluted by freshwater from land drainage. Of the various types of estuaries, the Upper Bay is best described as a stratified system in which freshwater derived from rivers, rain and runoff flows out over the top of heavier salt water that comes up the Bay from the Sound along the bottom (Figure A-10). Superimposed on this basic pattern of two-layered flow, are currents driven principally by wind and tides. Tidal flushing is an important force in the Bay. It has been estimated that the tides flush almost 250 times the volume of water in and out of the Bay as does the average total river input. Tidal flushing, combined with the intrusion of well-oxygenated, relatively clean bay water well upstream into the Providence River helps deter potentially more serious water quality problems than presently exist. This inflow of Bay water along the bottom is probably a major reason why anoxic conditions are not more frequent and wide-spread in the Providence and Seekonk Rivers.

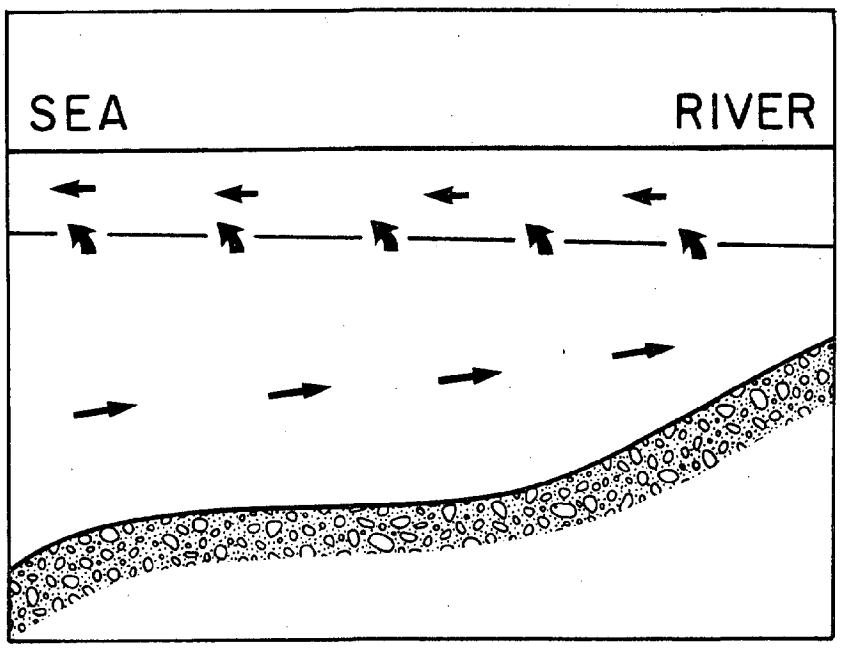



Figure A-10. Two-layered estuarine circulation in which a bottom layer of high salinity water flows in from the sea to compensate for a seaward flow of low salinity surface water derived from rivers, rain and runoff. In the Upper Bay the high salinity water extends along the bottom well up into the Providence and Seekonk Rivers.

A striking characteristic of the Upper Bay as an estuary is its great variability. This variability makes it difficult for us to assess impacts of any given change in the Bay on the rest of the system. There is variation over both space and time for many parameters, including sunlight, temperature, river discharge and salinity. In the Upper Bay, average salinity varies seasonally from about 18 to 27 parts per thousand and the annual water temperature range is normally from 0-24°C. Although rainfall is fairly constant year round, there is a distinct seasonal pattern to river discharge (Figure A-11), in which there is low flow in the summer and high flow the rest of the year. In the summer, vegetation in the watershed transpires to the atmosphere water that would have otherwise been discharged to the Bay. There are seasonal variations in the aquatic life in the Upper Bay which accompany the changes in physical parameters. There is a seasonal succession of spawning by organisms that inhabit the area as well as a seasonal pattern of migration in and out of the Bay. Great schools of menhaden come into the Bay from offshore waters in early spring and leave in the fall. They are pursued by large numbers of bluefish and striped bass.

There are also wide-spatial variations in the Upper Bay. For instance salinity, temperature, light penetration, turbulence vary with depth in the water column. The water of the Upper Bay is much more turbid than the lower Bay (about 10 times more turbid), which is a reflection of higher phytoplankton abundances in the Upper Bay (nourished by the increased nutrient loadings from urban areas) and high particulate loadings from runoff and sewage disposal. Marked spatial gradients in the bottom habitat extend down-Bay. Silt clay sediments are the characteristic bottom type in the Upper Bay while sands are abundant in the lower Bay. Fine sediments are typical of the upper reaches of estuaries where particles suspended in the freshwater flowing into the Bay precipitate out in the zone where fresh and salt water mix. There is a high proportion of organic matter in the Upper Bay sediments due to organic particles flushed from the sewage treatment plants, urban runoff, and phytoplankton cells sinking to the bottom. Consequently there is a gradient down-Bay in which nutrients and carbon content are much higher in the Providence River and Upper Bay sediments than down-Bay. The communities of organisms that inhabit the bottom of the Upper Bay are patchy in their distribution in response to gradations of dissolved oxygen, organic content and sediment size.

Susceptibility to Erosion and Flooding

The various kinds of development along the shorefront in the Upper Bay are all subject to potential damage from storm flooding and erosion. Some areas are particularly vulnerable due to specific factors such as their low elevation, soft easily erodable land type, or the orientation of a particular site that exposed it to wind and waves sweeping up the Bay.

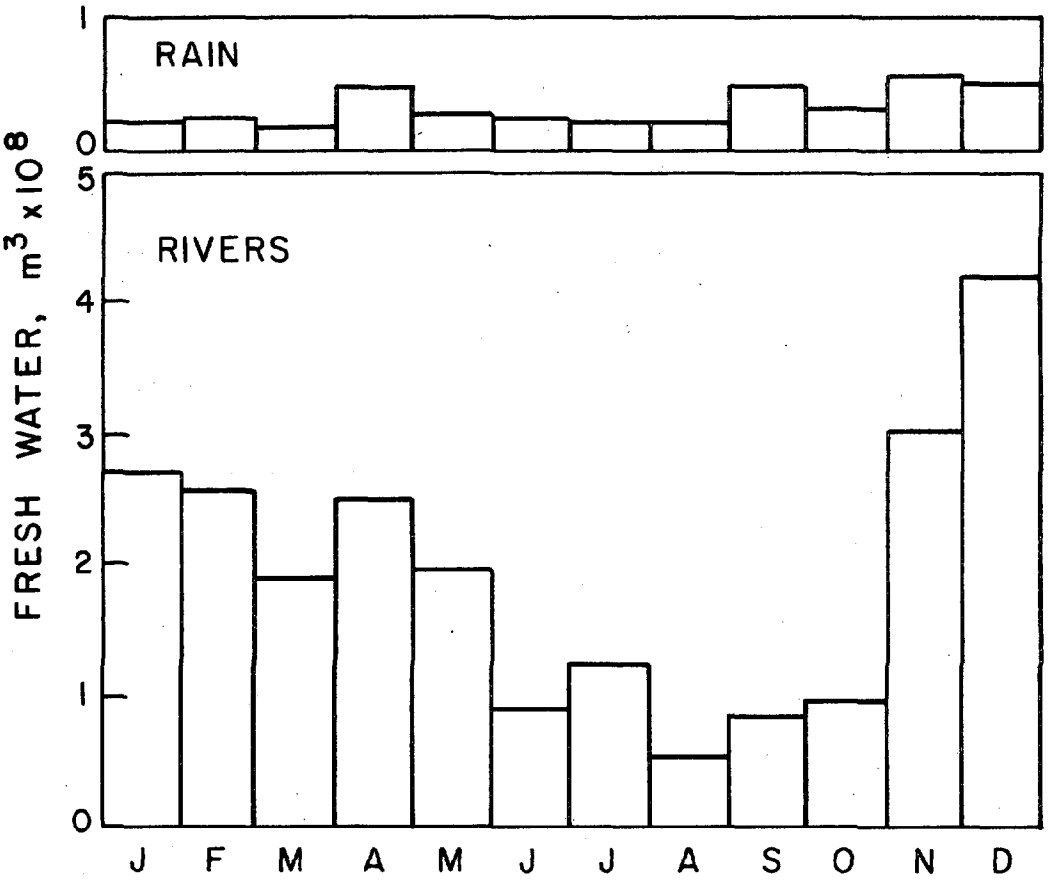



Figure A-11. The seasonality of freshwater input to Narragansett Bay. Even though the rainfall is fairly constant over the year, there is a distinct seasonal pattern to river discharge of low flow in summer and high flow the rest of the year.

A simple geological classification of the shoreline and an assessment of suscepibility to storm wave erosion and flooding has been done by Dr. Jon Boothroyd and Abdullah Al-Saud of the Geology Department at URI. The dominant types of shoreline are organized in order of increasing resistance to erosion. They are arranged as follows:

1. Beach and barrier spit
2. Glacial outwash gravel and sand
3. Glacial till
4. Soft bedrock (less resistant)
5. Hard bedrock (highly resistant)

Man-made bulkheads or other engineered structures also form a significant portion of the Upper Bay coastline. Depending on the design of the structure, they can be more of less resistant to erosion. They range from a resistance equivalent of glacial outwash (2) up to that of hard bedrock (5) depending on the type of structure (Table A-7).

Beaches and barrier spits are the most susceptible to flooding and erosion because they consist of the finest and smallest sediment sizes and are found at low elevations. Wave action of severe storms pounding against the beach first remove the sand from the forebeach and then attack the material behind the beach. During periods of fair weather the beachfront or berm is rebuilt from sand just offshore or from fine grained material eroded just up-current along the shoreline. Thus the beaches along the shoreline as well as the larger barrier spit beaches like Barrington Beach all undergo continual cycles of erosion and deposition in response to storm waves. Much of the shoreline in the Upper Bay is soft highly erodable beach sediment. In addition to the small stretches of beach interspersed along the shorefront there are large barrier spits such as Barrington Beach and cuspate beaches such as Sabin Point. Since these beach areas are naturally shifting systems, structures should not be built on them.

Most severe storm winds blow from the east, either as winter northeasterlies or summer hurricanes blowing from the southeast. Shorefronts with an eastern exposure to open stretches of Bay over which storm waves gain magnitude before striking the shore are particularly susceptable to erosion. When an eastern exposure is combined with a soft substrate the most vulnerable situation occurs. Examples of the most erodable sections of Upper Bay include such areas as the south shore of Conimicut Point, Warwick; Barrington Beach, Barrington. Next in erosion susceptibility are areas of glacial outwash such as Occupessatuxet Neck and Oakland Beach in Warwick and Coggeshall in Warren. Erosion of glacial till and soft bedrock proceed more slowly. Recession of this type of shoreline that is present in the towns around the Upper Bay. It is evident that the natural shoreline in Warwick and Barrington is particularly susceptable to erosion, about 75 percent of it being in the three most erosion prone categories. Warren and East Providence follow closely with 63 percent and 56 percent respectively of their shoreline in the first two highly vulnerable categories. About 61 percent of Bristol's shoreline is susceptable to erosion. These last three towns have shoreline that does not have

Table A-7. Upper Narragansett Bay Shoreline Character Type[1]

| | Beach and Barrier Spit | Glacial Outwash | Glacial Till | Discontinuous Bedrock | Soft Bedrock | Engineered Structure | Total |
|---|---|---|---|---|---|---|---|
| Warwick | 3.8 mi. | 3.74 mi. | 1.89 mi. | 0.05 mi. | 0.47 mi. | 2.69 mi. | 12.64 mi. |
| % | 27 | 31 | 15 | 1 | 4 | 22 | |
| Cranston | 0 | 0.57 mi. | 0 | 0 | 0 | 1.89 mi. | 2.458 mi. |
| % | 0 | 23 | 0 | 0 | 0 | 17 | |
| Providence | 0 | 0.10 mi. | 0 | 0 | 0 | 4.4 mi. | 4.495 mi. |
| % | 0 | 2 | 0 | 0 | 0 | 98 | |
| East Providence | 1.27 mi. | 2.36 mi. | 0 | 0 | 0.14 mi. | 2.72 mi. | 6.49 mi. |
| % | 20 | 36 | 0 | 0 | 2 | 42 | |
| Barrington | 4.68 mi. | 0.38 mi. | 0.62 mi. | 0.02 mi. | 0 | 2.03 mi. | 7.73 mi. |
| % | 60 | 5 | 8 | 1 | 0 | 26 | |
| Warren | 0.81 mi. | 0.33 mi. | 0 | 0 | 0 | 0.66 mi. | 1.80 mi. |
| % | 45 | 18 | 0 | 0 | 0 | 37 | |
| Bristol | 0.31 mi. | 0.54 mi. | 1.94 mi. | 0 | 0 | 1.75 mi. | 4.54 mi. |
| % | 7 | 12 | 43 | 0 | 0 | 39 | |
| TOTAL | 10.44 mi. | 8.02 mi. | 4.45 mi. | 0.07 mi. | 0.62 mi. | 16.14 mi. | 39.74 mi. |
| % | 26 | 20 | 11 | 1 | 2 | 40 | |

[1] Boothroyd and Al-Saud, 1979.

a southern or eastern exposure and therefore are not plagued with the same degree of erosion problem as are the towns on the west side of the Bay.

Severe storms cause enormous amounts of erosion. Whole chunks of cliffs or bluffs may be lost in one storm. Table A-8 is a compilation of erosion that occurred due to a single storm in various areas of the country.

Table A-8. Erosion by Waves in a Single Storm

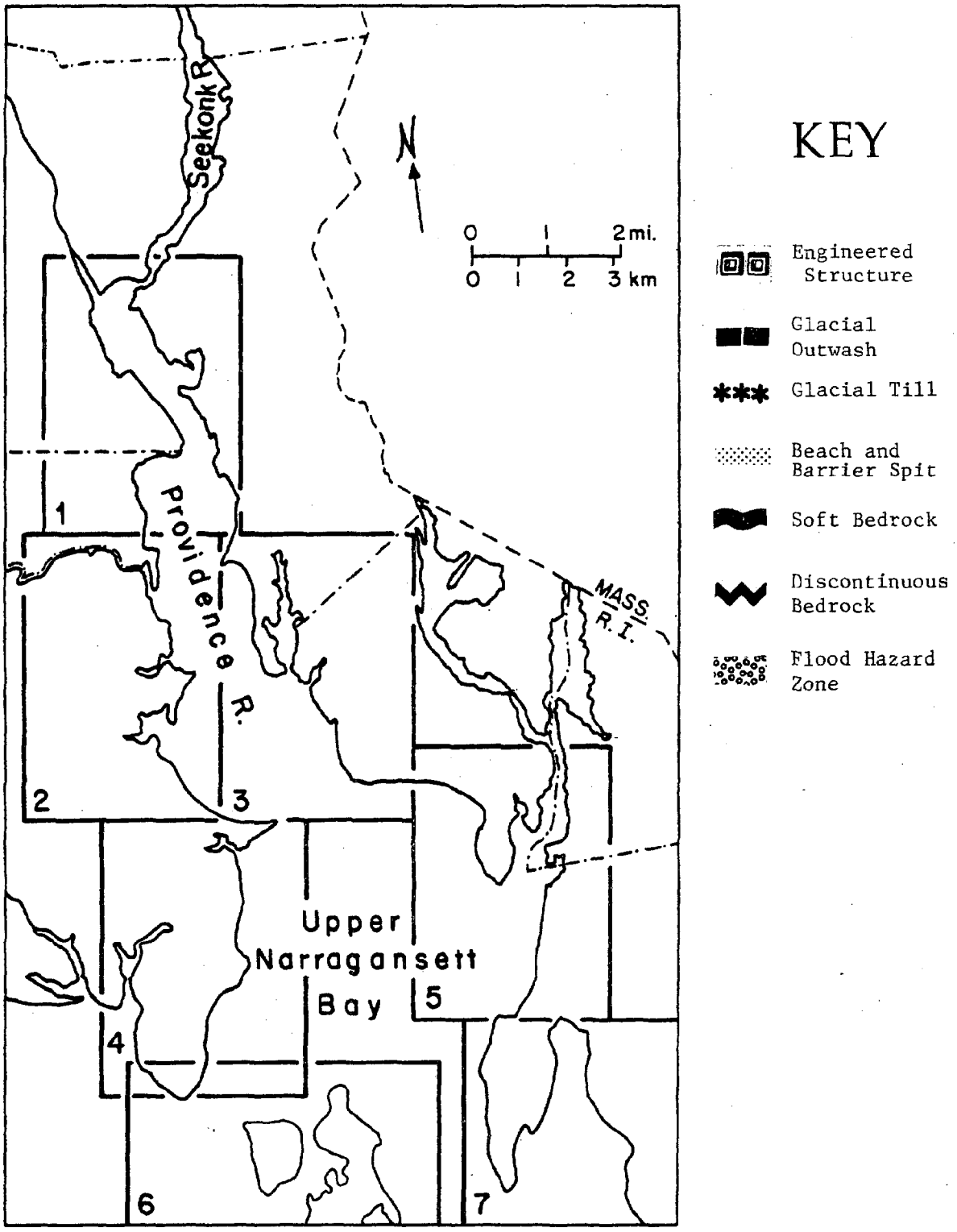
| Location | Year | Average Cutback |
|---|---|---|
| Long Island | 1938 | 40 ft. |
| Cape Cod | 1944 | 25 ft. |
| New Jersey | 1953 | 65 ft. |
| Virginia Beach | 1948 | 100 ft. |
| Florida | 1950 | 35 ft. |
| Louisiana coast | 1957 | 125 ft. |

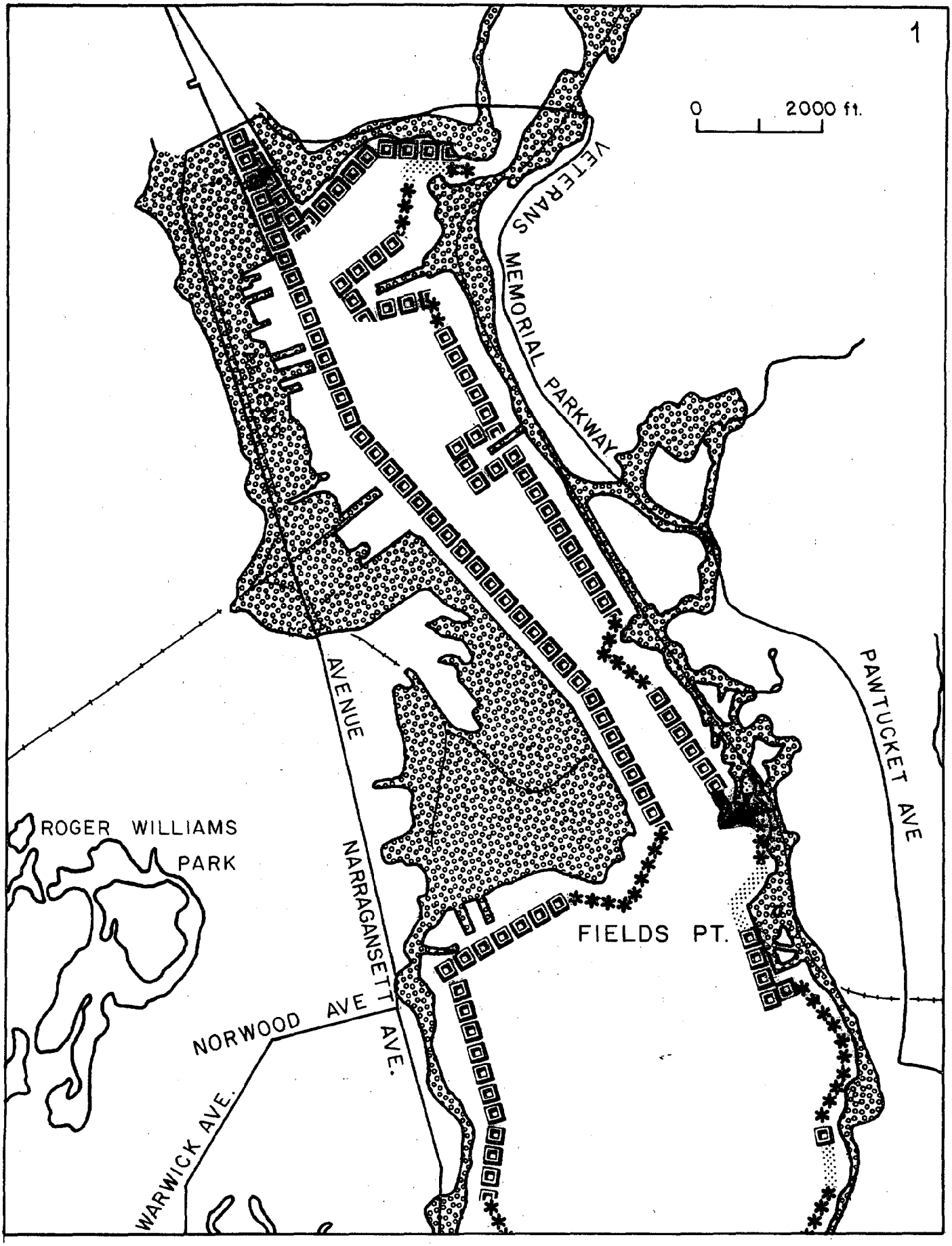
Providence and Cranston have had most of their shorefront altered with engineering structures. Attempts to solidify and protect the shoreline have been extensive in the other towns around the Upper Bay as well. In some cases, particularly in shorefront of private residences, riprap has been used as erosion protection. Unless the rocks are very large and substantial, this effort is often ineffectual. The small rocks used in most of the less expansive attempts at shoreline stabilization can be removed by the force of most storm waves. Much of the rubble on East Oakland Beach in Warwick is from storm destroyed structures. Even extensive bulkheading can be eroded.

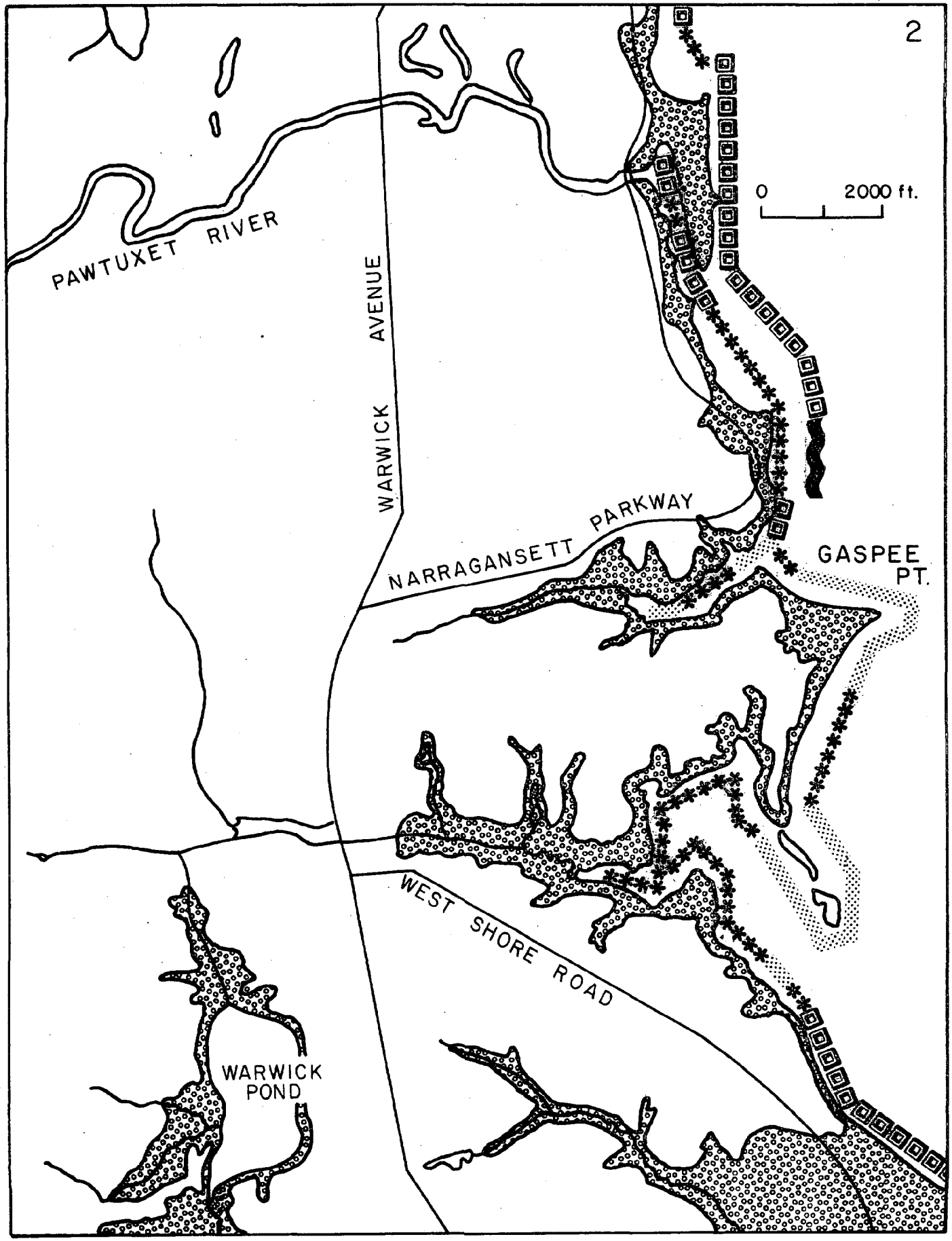
Not only is much of the Upper Bay subject to wave erosion, it is also susceptible to storm surge flooding. Bay water is piled up against the shore by wind and waves driven by severe storms at sea. It floods low lying coastal areas and occurs in addition to the type of flooding we more commonly associate with heavy rains and swollen rivers tributary to the Bay.

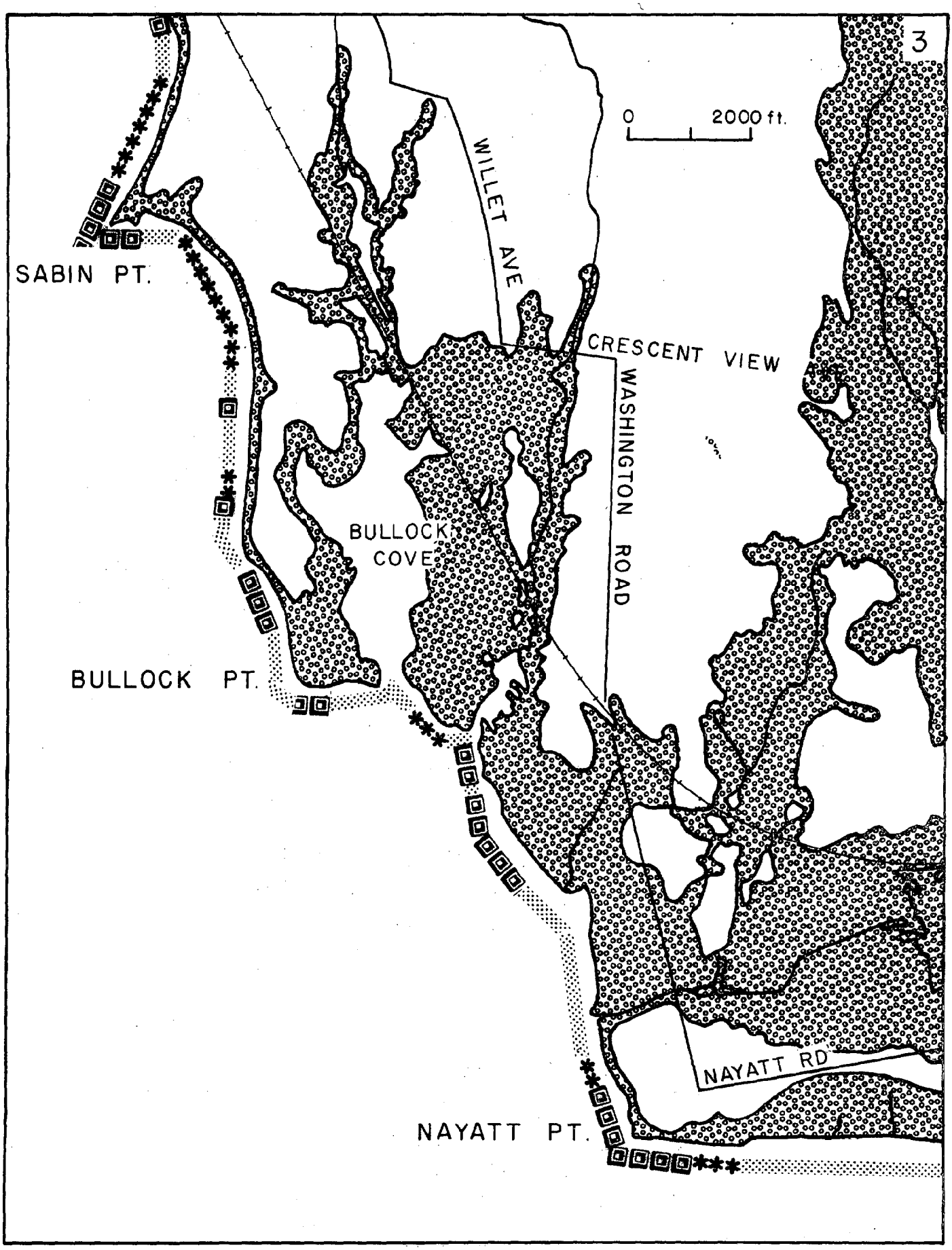
Figure A-12 depicts the potential severe storm surge line all along the coast of the Upper Bay. Everything below the twenty foot elevation above mean sea level is potentially vulnerable to storm surge flood damage. For instance, in the hurricane of 1938, the storm surge still water elevation was about 4 meters (12 feet) above mean highwater. Since land elevations on standard topographic maps (from which our figure was drawn) are given in feet above mean sea level, another 2.5 feet must be added for average high tide. With a wave height of 3 meters (9 feet) the total elevation of the wave damage of 1938 hurricane probably reached was 24 feet above sea level. Consequently everything built below the 20 foot contour is subject to storm damage in a storm the magnitude of the 1938 hurricane. Much development has occurred along the shorefront in the 40 years since that catastrophic storm. Some redeveloped areas are particularly vulnerable. Conimicut Point, for example, was devastated by

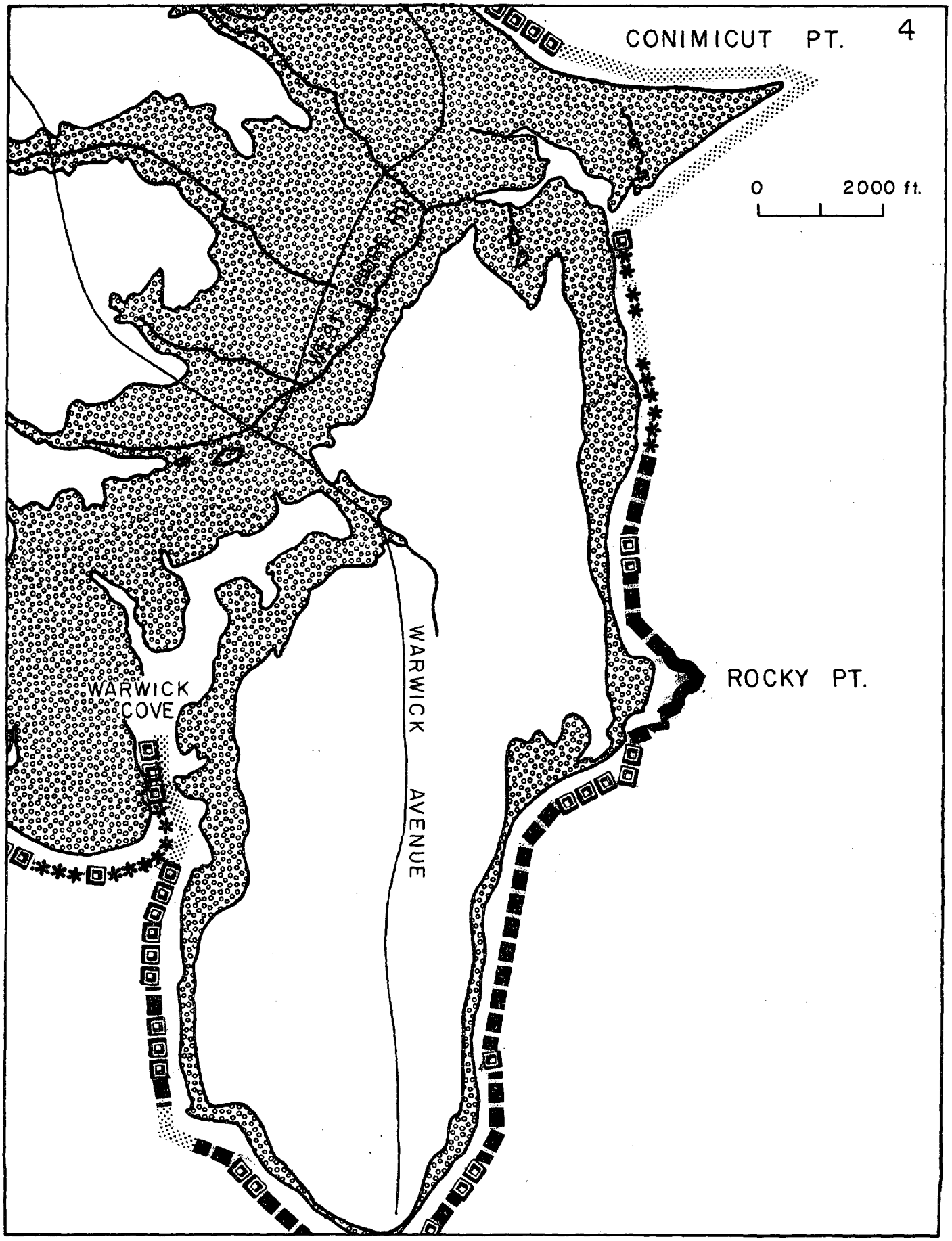
Figure A-12. Shoreline Types

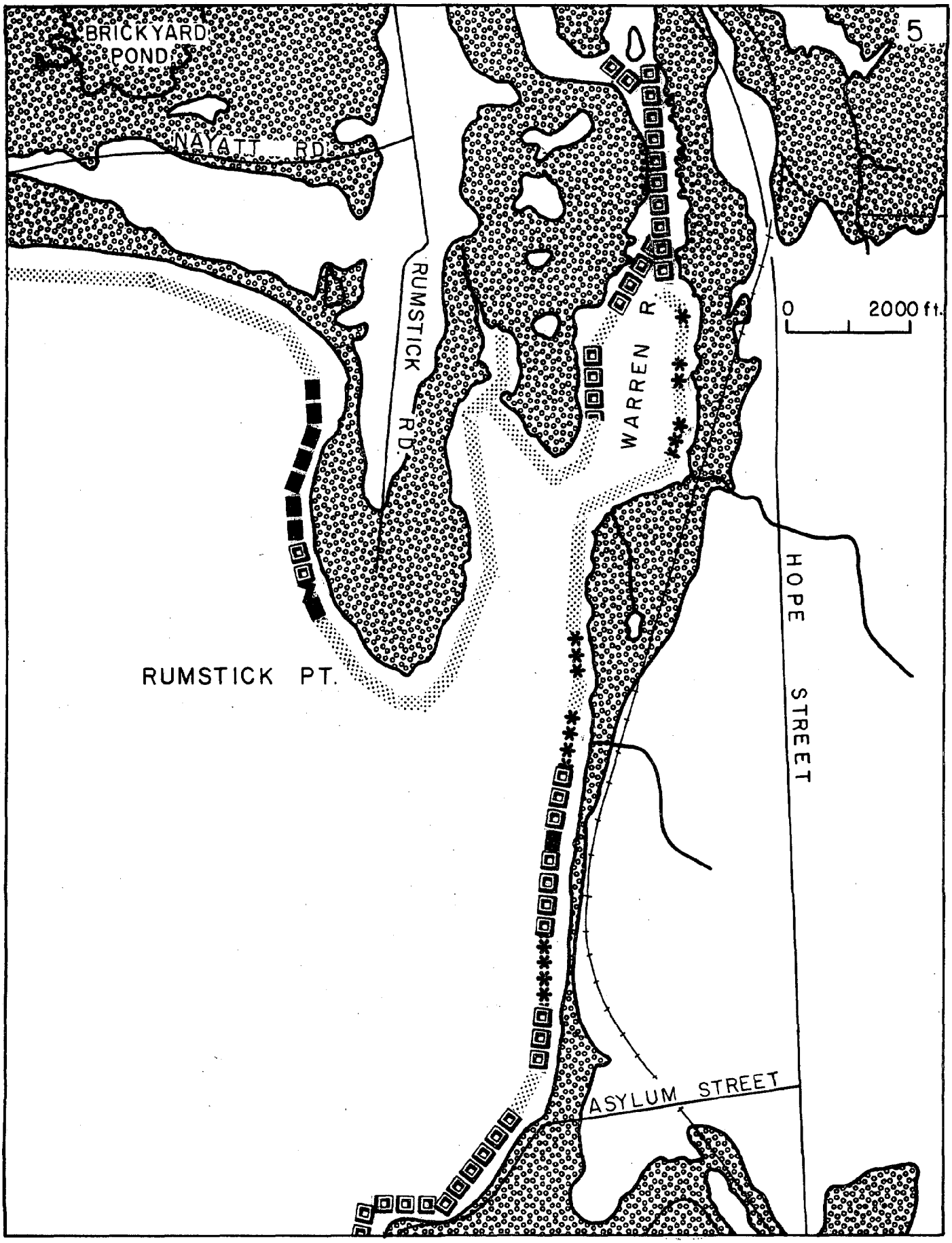


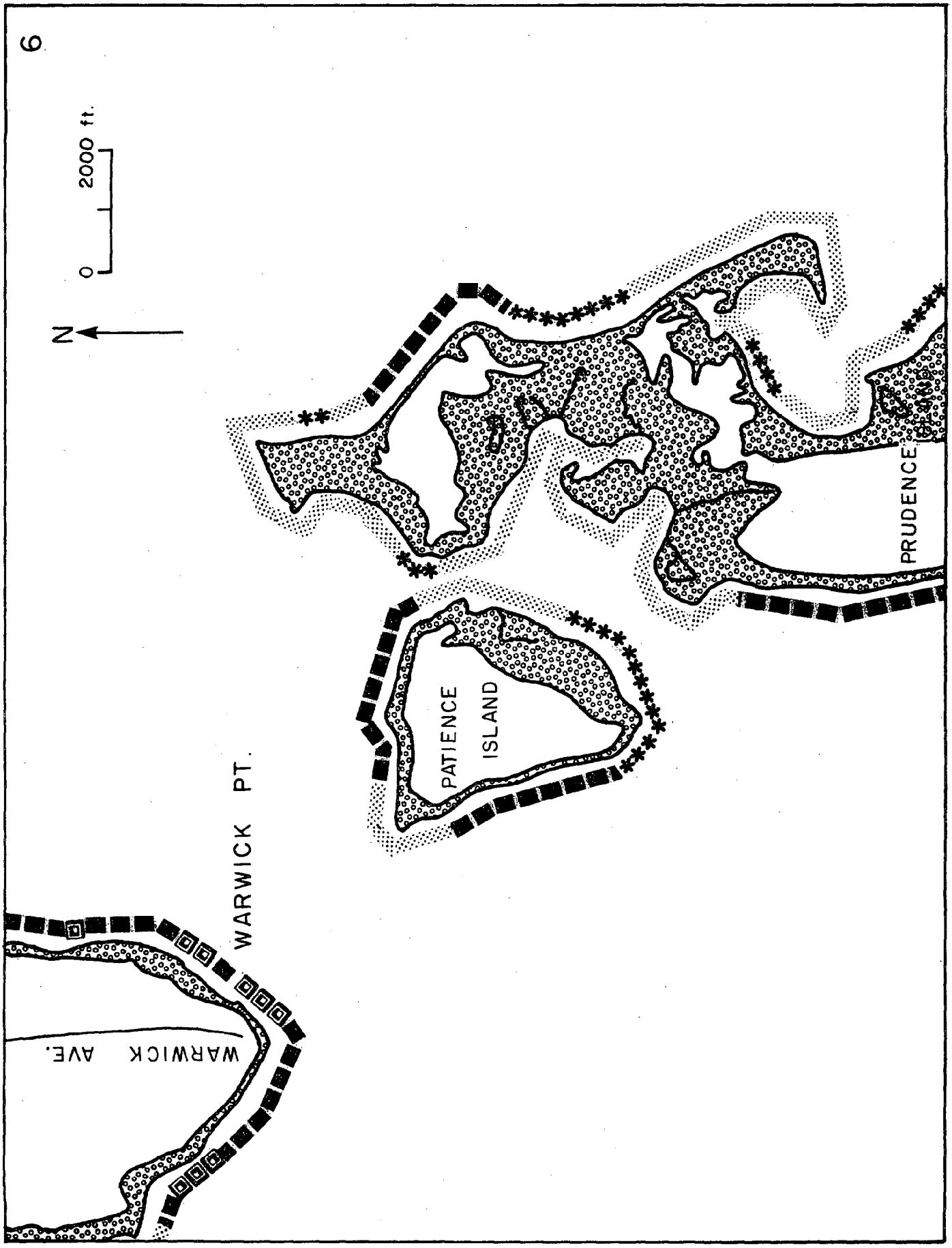

1
0
2000 ft.
VETERANS
MEMORIAL PARKWAY
AVENUE
NARRAGANSETT AVE.
PAWTUCKET AVE
ROGER WILLIAMS
PARK
FIELDS PT.
NORWOOD AVE
WARWICK AVE.

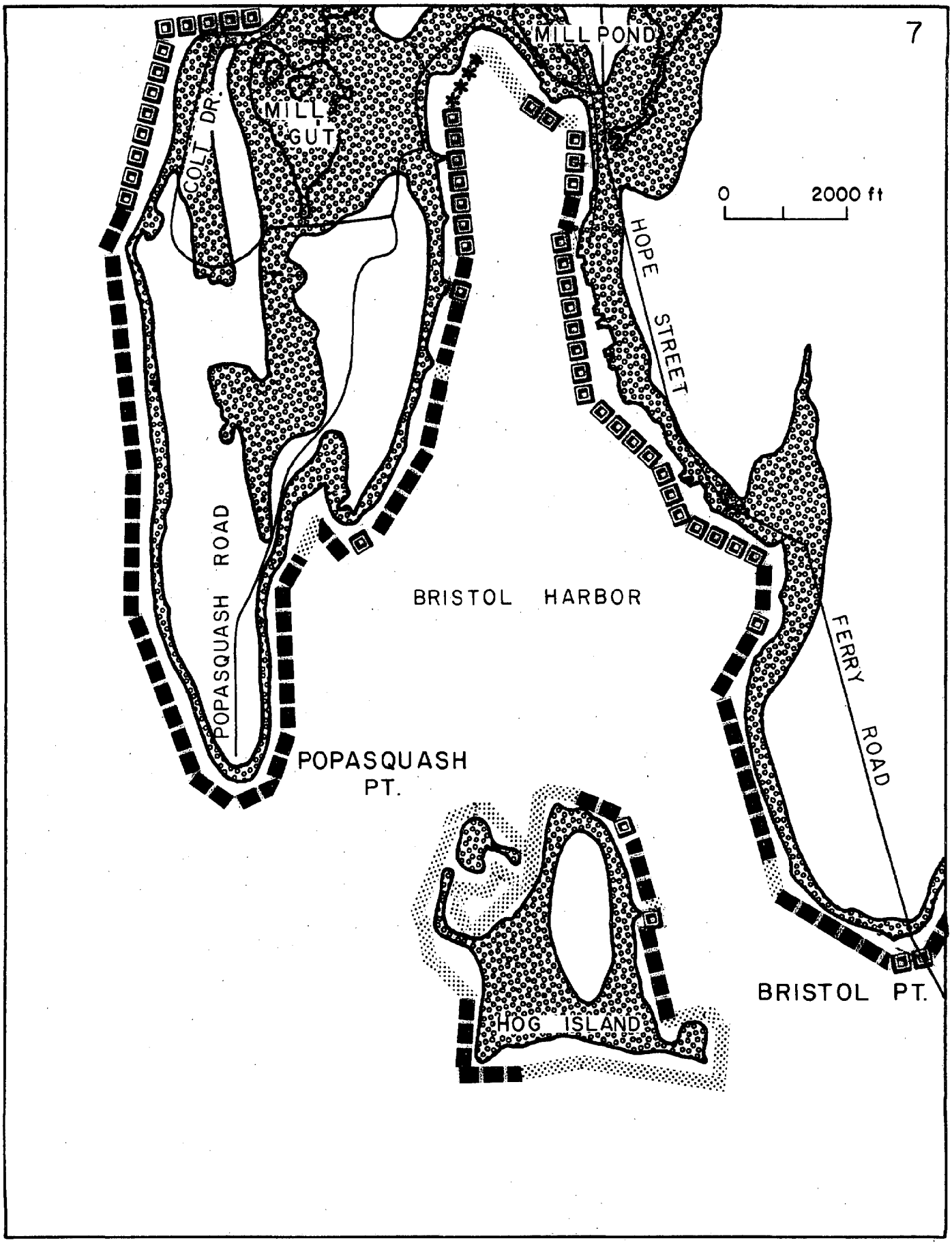

2
0
2000 ft.
PAWTUXET RIVER
WARWICK AVENUE
NARRAGANSETT PARKWAY
GASPEE PT.
WEST SHORE ROAD
WARWICK POND


3
0
2000 ft.
WILLET AVE
CRESCENT VIEW
WASHINGTON ROAD
SABIN PT.
BULLOCK COVE
BULLOCK PT.
NAYATT RD
NAYATT PT.


CONIMICUT PT.
4
0
2000 ft.
WARWICK COVE
WARWICK AVENUE
ROCKY PT.


BRICKYARD POND
NAYATT RD.
RUMSTICK RD.
WARREN R.
5
0
2000 ft.
HOPE STREET
RUMSTICK PT.
ASYLUM STREET


6
0
2000 ft.
N
PRUDENCE
PATIENCE
ISLAND
WARWICK PT.
WARWICK AVE.


7
MILL POND
MILL GUT
COLT DR.
0 2000 ft
HOPE STREET
POPASQUASH ROAD
BRISTOL HARBOR
FERRY ROAD
POPASQUASH PT.
HOG ISLAND
BRISTOL PT.

by severe storms in the past and will see massive inundation in the future. Lowlying glacial outwash and till areas such as Oakland Beach, Annawomscutt, Barrington and the west side of Rumstick Neck, Barrington, are also susceptible to storm surges. Much of the area between Bullock Point and Nayatt Point, Bullocks Cove, Drown Cove, and behind Nayatt Point will all be flooded during a major storm or hurricane.

Tributary Streams

A century ago, most of the Upper Bay shore was rural in character. However, population increases along with a strong desire to live near the shore has caused much of the open space to be consumed by residential development. Much of the development was focused along freshwater streams which feed into Upper Bay coves. The principal tributary streams and rivers are shown in Figure A-13. The list includes both the major rivers draining the Blackstone and Pawtuxet River Basins, as well as the several streams which drain storm water from coastal neighborhoods into coves along Upper Narragansett Bay.

The watershed boundaries of the tributary streams are an important coastal geographic feature. The steep slopes and flowing water provides a natural constraint to land development adding character and diversity to otherwise conventional suburban developments. Many tributary streams enter coves which have high recreational values.

Maintenance of the health of the tributaries and the subsequent recreational and aesthetic values associated with them depends upon good management practices which protect these values and resolve development conflicts. Management attention must also be focused on the role tributaries play as pathways for pollutants and sediments.

The Bullock Cove drainage way bordered by East Providence and Barrington provides several examples of the coastal management issues which require attention as part of an effort to improve urban environmental quality. The cove is an important recreational and residential area with about 1600 acres of land within the basin (Figure A-14). One third of the land cover is dense residential, while nearly half is open space. Much of the undeveloped land is zoned for industrial use and controlled by the Mobil Oil Corporation. An unnamed stream flows for two miles through Willett Pond, and into Bullocks Cove. The tidal flow into the upper cove is restricted by the drainage culvert under Crescent View Avenue, and the state owned railway and bridge constructed in the mid 19th century. A dredged channel with a control depth of 6 feet serves the marinas in the lower portion of the cove. Bullocks Cove is a major center for recreational boating and is bordered by Haines State Park and Crescent Park, a defunct amusement park, and surrounded by the established communities of Riverside and Bay Spring. A number of changes are about to take place which raise many coastal management concerns.

Figure A-13

Major Tributaries and Basins of the Upper Narragansett Bay

1) Buckeye Brook/Mill Cove
2) Spring Green Pond/Occupessatuxet Cove
3) Unnamed Brook/Passeonquis Cove
4) Pawtuxet River/Pawtuxet Cove
5) Woonasquatucket, West, & Moshassuck Rivers/Providence River
6) Ten Mile River/Omega Pond
7) Unnamed Brook/Watchemoket Cove
8) Willett Pond/Bullock Cove
9) Annowomscutt Brook/Drown Cove
10) Brickyard Pond, Echo Lake/Mussachuck Creek
11) Runnins River/Barrington River
12) Unnamed Brook/Smith Cove
13) Barrington and Palmer Rivers/Warren River
14) Unnamed Brook/Mill Gut

Figure A-13. Major Tributaries and Basins of Upper Narragansett Bay

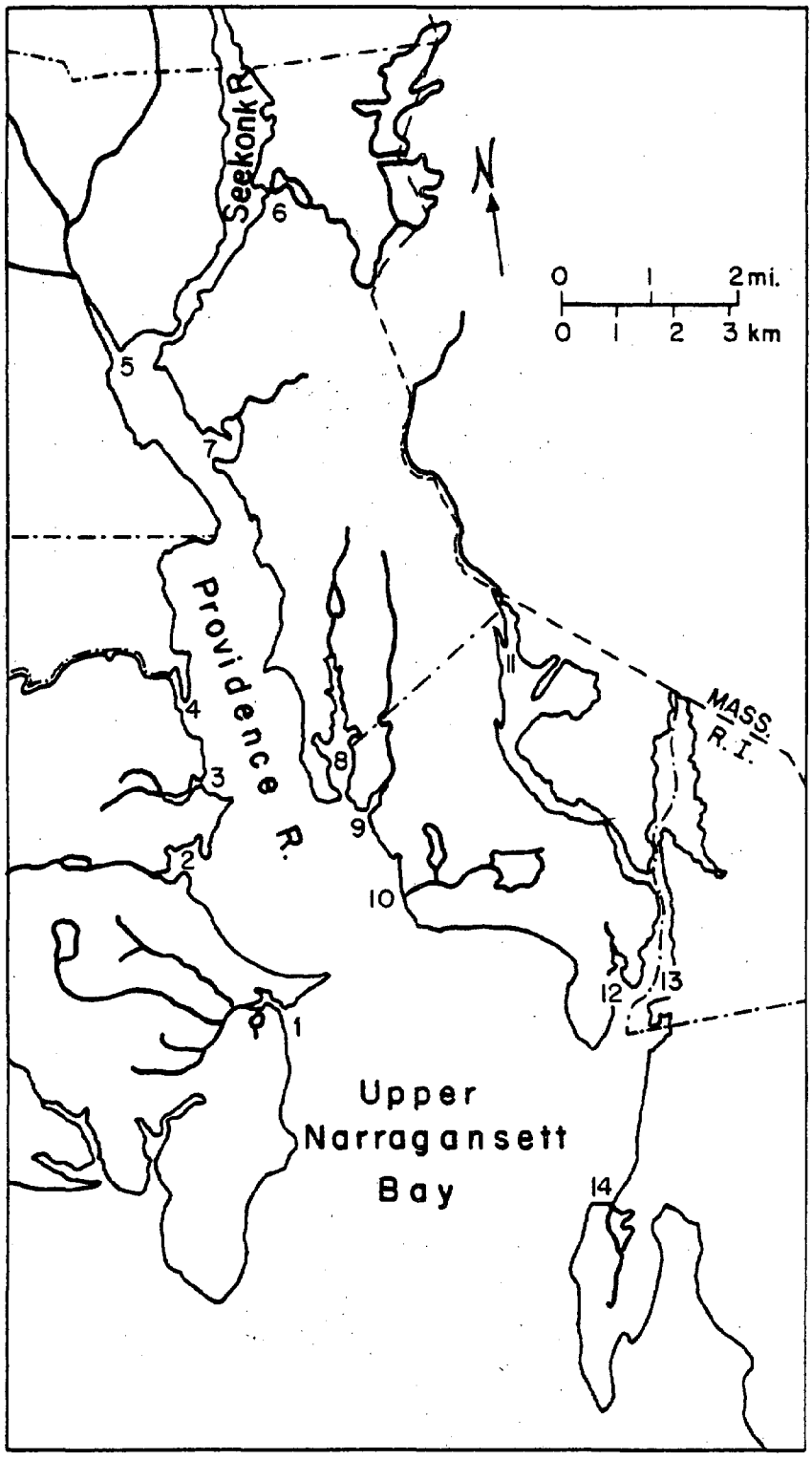
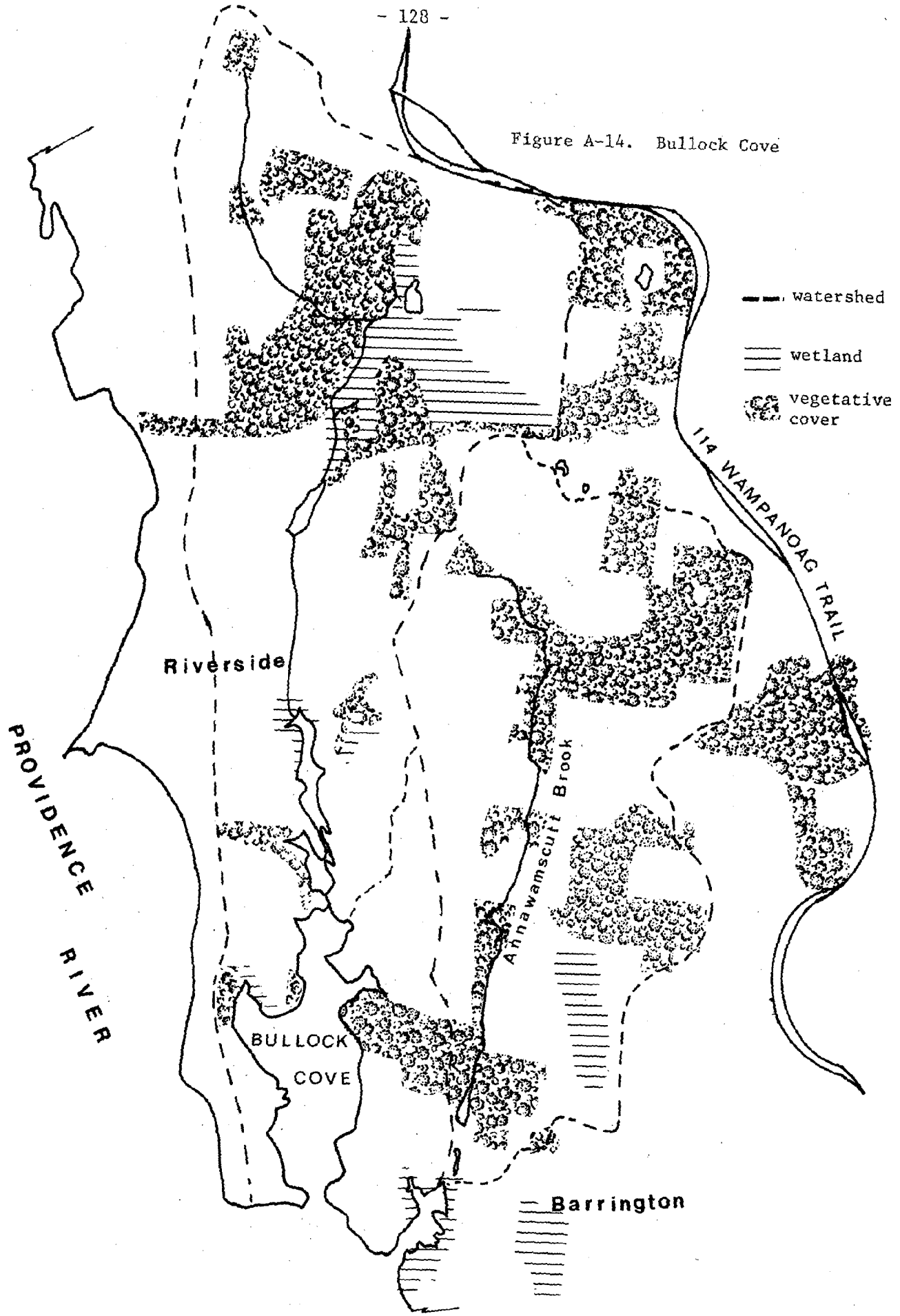


Figure A-14. Bullock Cove



The bulk of the 55-acre Crescent Park, owned by East Providence, will be sold to a real estate firm for housing development. Remaining city held cove property is slated for marina development, increasing the need for maintenance dredging of berths and the channel. A shorefront debris problem also exists. In addition, the Department of transportation plans to study the potential of the rail right of way for use as a bikeway.

The Crescent Park sale has caused considerable controversy in the surrounding neighborhood, in part over the issue of protecting public access. The opportunity exists in Bullock Cove to link the various private and public efforts into a coherent effort directed at improving the area as a whole, resolving existing conflicts and avoiding future problems.

Water Quality

Pollution problems are not new in Narragansett Bay. There is a long history of urban and industrial discharges to the head of the Bay since the 1800s when the Providence area led the country in rapid industrial growth. In 1854 there was a cholera epidemic attributed partly to polluted river water. By 1877 the Moshassuck River was so foul that the superintendent of health reported that "it frequently looks black and thick and gives off an offensive odor of sulphenated hydrogen gas." The sources of pollution were wastes from slaughter houses, fertilizer factories and woolen mills along the river. In 1885 the major industries, listed according to the amount of capital invested were as follows: cotton and woolen manufacturers, print works, metals and metallic goods, gas works, machinery, paper and paper goods, jewelry, building, silverware, rubber and elastic goods (McLoughlin, 1978). Complaints of severe pollution problems in the Providence River and its tributaries were common. In 1883 the Providence Board of Trade passed a resolution stating "....in view of the present state of the waters of the Providence River and Cove Basin, we deem it essential for the preservation of the health of our city, that immediate steps should be taken to provide a better system of sewage." The Mayor and City Council received a petition stating that "sewage that is permitted to flow into the waters of the Providence River above Fox Point has become very offensive to the comfort and dangerous to the health of our people. The problem will increase in magnitude with increasing population." There can be no doubt that the whole of both Rivers--the West and Moshassuck-- above Allen's Print Work and still worse, the Moshassuck below the Print Works, are causes to some extent of sickness, disease, and death to the public." The statement continued, ".... the (Providence) River at the Weybosset Bridge has become extremely filthy and at times very offensive to sight and smell...."

A pollution control law for manufacturing was suggested to try to lessen the amount of waste dumped into the river and stated that the major sources of pollution are private privies and manufacturers wastes. By 1895, a report to the General Assembly reported that 6 million gallons of manufacturer's refuse and 50,000 lbs. of grease from the woolen mills were daily

turned into the Providence River. The condition of the River became so foul and dangerous to the health of the city that the city adopted an elaborate sewage treatment plan in 1887 and began construction on the Field's Point Treatment Plant in 1890.

At present, pollution of the Providence River and Upper Bay is still a major concern. Sewage enters the Bay from a number of sources, from discharges to rivers and streams outside of the state boundaries, from nonpoint runoff, from combined storm sewer overflows, from industrial outfalls and from sewage treatment plants. Not only are the sources of pollution complicated but the sewage itself is a rich mix. Sewage pollution not only brings just bacterial contamination and dissolved oxygen depletion, that are the only parameters for which there are legal standards nationwide. It also contains toxic metals, carcinogenic pesticides, organic solvents and petroleum hydrocarbons. There are problems of eutrophication from excess nutrient and organic loadings as well.

Sewage outfalls are the major source of pollution to the Bay. They treat a variety of industrial discharges as well as municipal and domestic sewage. In 1977 the daily flow of sewage effluent to the Bay averaged 126 million gallons per day and the Fields Point plant contributed about half of the total. Annual municipal discharges have been summarized in Table A-9 and Figure A-15. The volume of effluent discharged from industries directly to the Bay or its tributaries averaged 3 million gallons per day in 1977 which was only 2 percent of the sewage treatment plant.

The volume of effluent discharged from sewage treatment plants and combined sewer overflows to Narragansett Bay has steadily increased since 1960 (Figure A-16). Since there is little freshwater input to Narragansett Bay, the contribution from sewage is relatively large and varies from about 2 percent of the freshwater budget in December to 12 percent in August. Over 75 percentof sewage discharged into the Bay enters the Providence River from combined sewage systems in the cities of Providence, East Providence, Pawtucket, and central Falls. Over 50 percent of the total volume comes from one treatment plant at Fields Point. Since Fields Point discharge is the largest single waste water to the Bay, there are strong gradients of contamination extending down Bay from Fields Point. Levels of metals and petroleum hydrocarbons are 10 times as high in the river sediments off Fields Point as they are down Bay.

Fields Point is not the only major source of pollution to the Upper Bay. In a study done by Dr. James Quinn at URI on the input of petroleum hydrocarbons from Fields Point, sampled over a year, it was estimated that the plant contributed only about 35 percent of the total petroleum loading in the River. Two-thirds of the contamination must come from other sources. Urban runoff and the combined sewer overflows emptying into the Providence and Seekonk Rivers from Providence, Central Falls, Pawtucket and the Blackstone Valley District Commission. However, it is extremely difficult to get a reliable estimate of the output of these discharges. They are not routinely monitored and the flows and pollution loads are highly variable depending on storm events.

Table A-9. Summary of Annual Municipal Sewage Treatment Plant Flows (MGD)[1] Discharged to Narragansett Bay

| Year | Prov. | Bucklin Point | Newport | Cranston | Woon. | East Prov. | West Warwick | Bristol | Warren | Warwick | East Greenwich | Narr. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 65.2 | 20.5 | 10.8 | 10.7 | 6.0 | 4.1 | 2.7 | 2.2 | 1.6 | 1.3 | 0.6 | 0.3 | 126 |
| 1976 | 62.2 | 20.2 | 7.1 | 10.9 | 6.7 | 6.1 | 2.6 | 2.0 | 1.3 | 1.0 | 0.5 | 0.3 | 119 |
| 1975 | 56.6 | 20.2 | 7.6 | 10.0 | 8.0 | 4.5 | 2.7 | 2.2 | 1.3 | 0.9 | 0.4 | 0.3 | 115 |
| 1974 | 58.4 | 19.5 | 7.0 | 8.2 | 7.5 | 3.8 | 2.0 | 1.9 | 0.8 | 0.8 | 0.3 | 0.2 | 110 |
| 1973 | 47.1 | 20.8 | 8.0 | 7.2 | 8.2 | 4.4 | 2.2 | 2.2 | 1.4 | 1.2 | 0.2 | 0.2 | 103 |
| 1972 | 53.1 | 22.5 | 9.0 | 8.2 | 8.0 | 5.0 | 2.2 | 2.6 | 2.1 | 1.5 | 0.2 | 0.2 | 115 |
| 1971 | 51.0 | 17.2 | 7.5 | 7.0 | 6.4 | 4.2 | 1.8 | 1.8 | 2.6 | 1.2 | 0.2 | 0.1 | 101 |
| 1970 | 52.0 | 18.3 | 8.4 | 6.8 | 6.4 | 4.4 | 1.6 | 2.2 | 1.8 | 0.9 | 0.2 | 0.1 | 103 |
| 1969 | 50.9 | 17.4 | 7.5 | 6.4 | 4.8 | 4.1 | 1.7 | 1.8 | 1.7 | 0.8 | 0.2 | 0.0 | 99 |
| 1968 | 45.7 | 16.8 | 6.6 | 5.5 | 5.3 | 3.6 | 1.7 | 1.8 | 1.6 | 0.7 | 0.2 | 0.1 | 90 |
| 1967 | 47.4 | 16.2 | 6.6 | 5.0 | 5.3 | 3.8 | 1.6 | 2.6 | 1.1 | 0.6 | 0.2 | --- | 90 |
| 1966 | 40.7 | 15.2 | 5.5 | 4.5 | 3.9 | 3.0 | 1.5 | 1.8 | 0.6 | 0.4 | 0.2 | --- | 77 |
| 1965 | 40.2 | 15.7 | 5.7 | 4.7 | 3.9 | 2.8 | 1.9 | 1.8 | 0.7 | 0.2 | 0.1 | --- | 78 |
| 1964 | 44.9 | 16.2 | 6.2 | 4.7 | --- | 3.0 | 1.9 | 2.2 | 0.9 | --- | 0.2 | --- | 80 |
| 1963 | 40.9 | 15.8 | 6.1 | 4.6 | --- | 2.8 | 1.7 | 2.0 | 1.0 | --- | 0.2 | --- | 75 |
| 1962 | 46.7 | 16.5 | 6.9 | 5.1 | --- | 3.5 | 1.6 | 2.3 | 1.2 | --- | 0.2 | --- | 84 |
| 1961 | 40.3 | 15.7 | 6.9 | 4.9 | --- | 3.5 | 1.9 | 2.0 | 1.6 | --- | 0.2 | --- | 77 |
| 1960 | 42.5 | 14.5 | 6.2 | 4.1 | --- | 2.9 | 1.8 | 2.0 | 0.9 | --- | 0.1 | --- | 75 |
| 1959 | 41.0 | 14.7 | 6.1 | 4.3 | --- | 2.8 | 1.6 | 1.8 | 1.0 | --- | 0.2 | --- | 74 |

[1] From R.I. DEM monthly monitoring files.

Figure A-15. Map Key of STP Discharges

| Key Number | Sewage Treatment Plant |
|---|---|
| 1 | BVDC |
| 2 | Providence |
| 3 | Narragansett Village |
| 4 | Warwick |
| 5 | Cranston |
| 6 | West Warwick |
| 7 | East Greenwich |
| 8 | South Kingstown |
| 9 | Jamestown |
| 10 | Jamestown |
| 11 | Newport |
| 12 | Bristol |
| 13 | Fall River |
| 14 | Warren |
| 15 | East Providence |

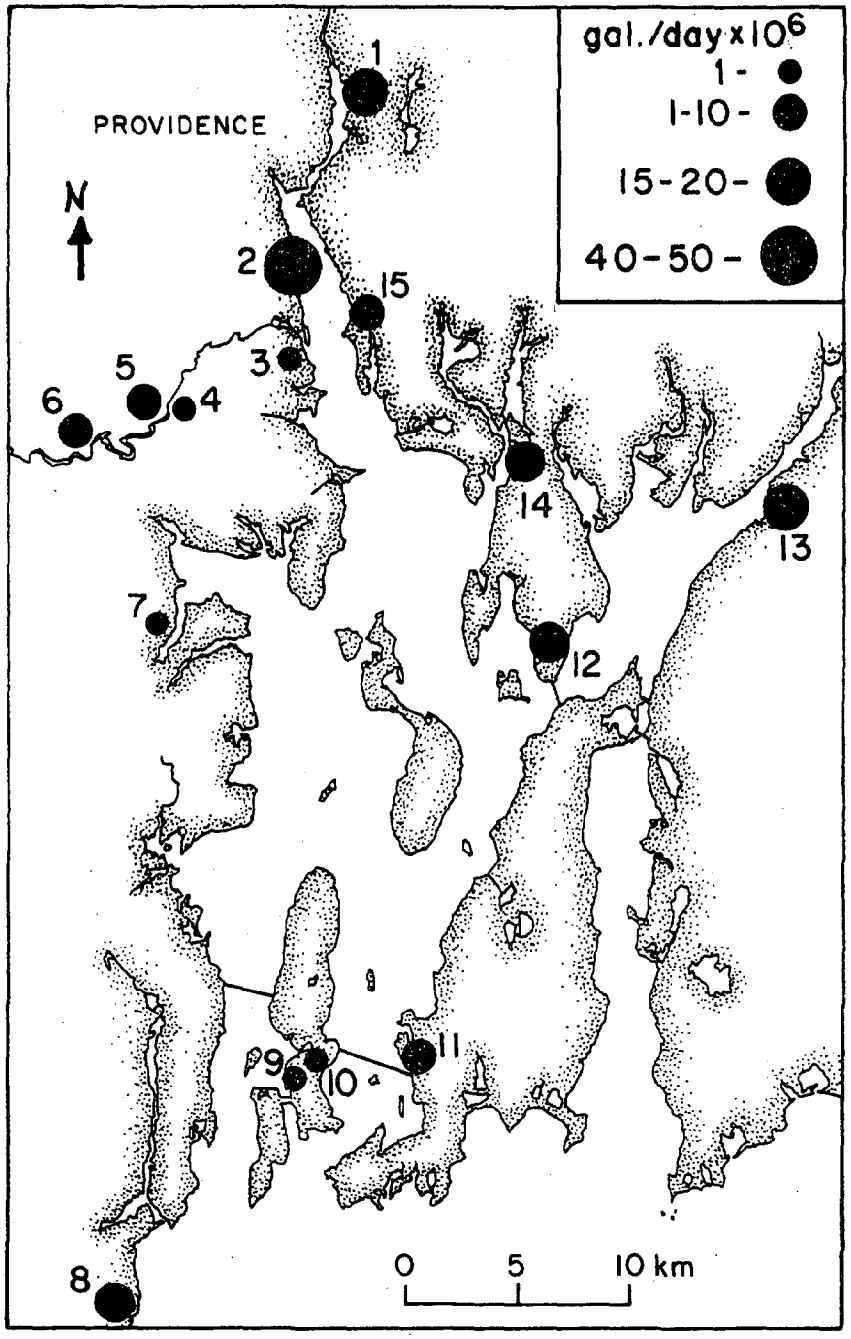
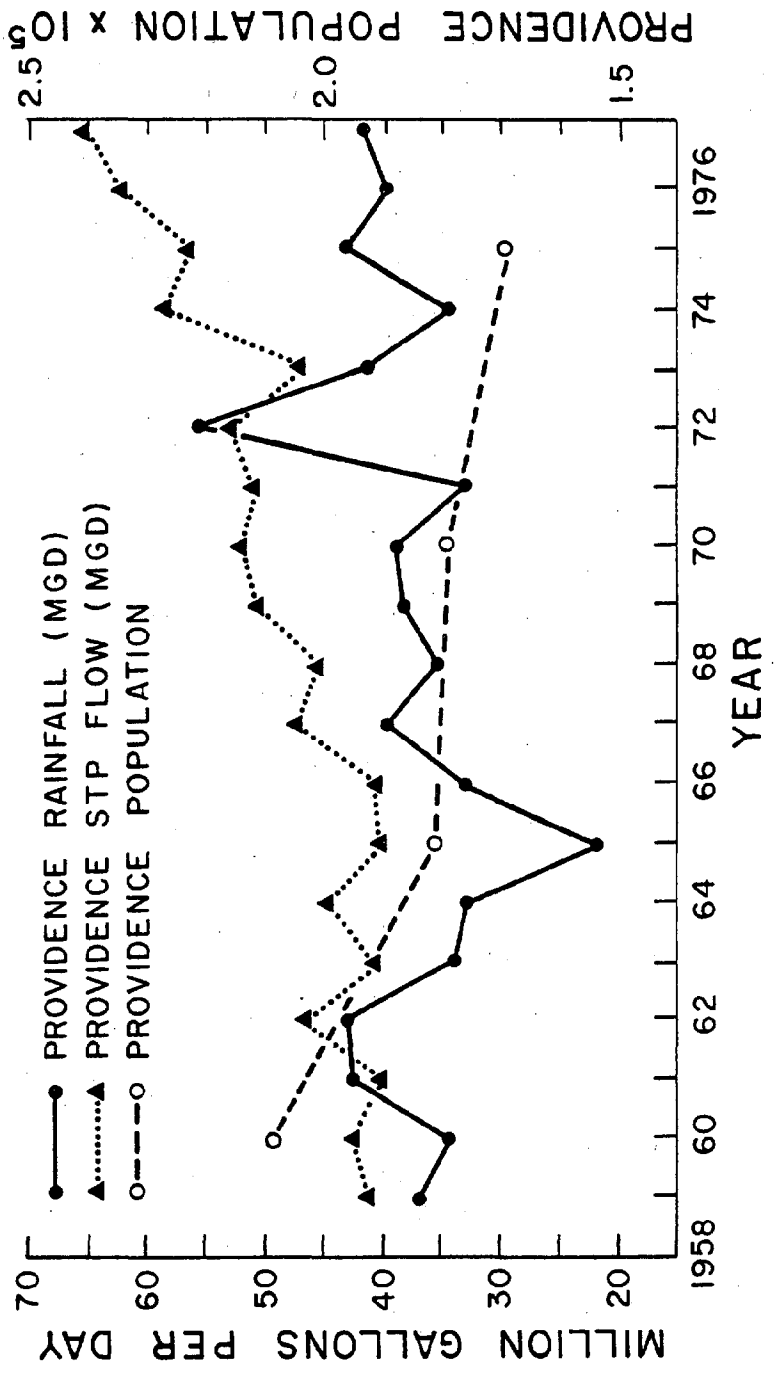



Figure A-15. Location of sewage treatment plants discharging into Narragansett Bay. Over 75 percent of the volume of discharges flow into the Providence River and Upper Bay. The plant at Fields Point is by far the largest discharge.

Figure A-16. Historical Trend in Discharge of Sewage Effluent



The impacts of this pollution are many and far reaching. The pollutants that flow into the Providence River can be traced in the sediments and water column in a decreasing gradient down the entire Bay. The most productive shellfish beds are either permanently closed or fall within a conditional area where harvesting is only occasionally permitted. Pollution from industrial and municipal discharges and urban runoff is also having severe repercussions on the Port of Providence where berths for cargo vessels and tankers are desperately in need of dredging. Because the sediments in the Upper Bay berths and channels are so heavily polluted, it is difficult ot impossible to find acceptable sites for the disposal of dredge spoils. The low quality and often unpleasant appearance and odor of the water in the Providence River and Upper Bay has also curtailed properties has been adversely affected in some Upper Bay areas by the unpleasant qualities of the water.

The Fields Point Sewage Treatment Plant

Built at the turn of the century as a showcase of modern technology, the Fields Point sewage treatment plant was designed to treat the domestic wastes of 200,000 people or about 50 million gallons of waste water a day. Many years of wear and tear on the equipment and poor maintenance of the facility have taken their toll. In the last twenty years failures in the treatment system have been occuring more and more frequently causing severe pollution problems in the Upper Bay. The plant still treats sewage from about 200,000 people in Providence, Johnston, North Providence and parts of Cranston and Lincoln. However, the volume of waste water entering the plant has been increasing beyond plant capacity in recent years. According to flow data monitored by DEM the average daily flow was up to 65 million gallons per day in 1977. The volume of water passing through the plant has increased because of additional industrial discharges into the city sewer system and because of groundwater infiltration into cracks and seams in the pipes. An additional load of water comes into the treatment system from the Providence River. Tide gates that were built to cover the end of the discharge pipes and block river water from flowing back into the system at high tide have rotted or are jammed open. It is estimated that as much as one third of the volume that the plant treats is Providence River water surging back into the system. This could be reduced by repairing the tidal gates.

The treatment plant was not designed to treat industrial wastes. However, nearly 1800 firms ranging from commercial laundries to jewelry companies may discharge into the Providence sewage system. Many of these industrial discharges contain toxic chemicals that the plant cannot remove from the water or sludge. Consequently, toxic metals, organic solvents and salts that are discharged to the municipal sewers, disrupt the treatment process of the domestic sewage, contaminate the sludge and thus create disposal problems and further degrading the water quality of the Providence River and the Upper Bay.

The Environmental Protection Agency (EPA) has required the city of Providence to repair the sewage treatment plant, to assure that the quality of the water discharged to the Bay meet secondary treatment standards by

November 1979. When the city failed to do so, suit was brought by DEM and Save the Bay and in May 1980 the U.S. District Court cited the city in contempt for failure to rehabilitate the plant. In April 1980, plant equipment was still not operable, blowers necessary for aerating the sludge were in pieces, valves were not working, and the activated sludge was not of the correct composition needed to decompose the sewage, an essential step in obtaining secondary treatment. Consequently, the city hired an engineering firm, Krasnoff Associates, to fix the plant. They have made great strides by replacing most of the piping and building new weirs in the setting tanks, subsequently improving the quality of the treated water discharged to the Upper Bay. However, there is still a great deal of antiquated equipment that needs to be replaced. Aeration beds need to be repaired and the beach flow of Providence River salt water into the plant halted before the discharge will be of uniform high quality in compliance with EPA standards. Equipment failures and maintenance problems occur almost weekly impeding progress on other plant problems.

In addition to the problems the Providence sewage treatment plant has treating the regular or "dry weather" load of sewage, the system over loads with every severe rain storm. Since storm water, industrial wastewater and municipal sewage all flow into the same network of sewer pipes, whenever it rains more than 1/2 inch in 24 hours the volume of water flowing through the sewer system to the plant rises above plant capacity and is shunted off directly to the river. In addition to the overflow at the plant there are numerous bypasses throughout the piping system that automatically shunt off storm water overflow to some 65 outfalls along the river. These are called combined sewer overflows (CSOs) since they are designed to drain flood waters out of the city by combining it with sewage systems. The state DEM in cooperation with the EPA is concerned about the effect of this urban runoff on water quality in the Upper Bay and have hired an engineering firm to design ways to treat the sewage that is discharged through the CSOs. DEM has estimated that they contribute 87 percent of the 440 million gallons per year of settleable solids that flow to the Bay. They are a source of coliform bacteria and petroleum hydrocarbons as well. Some of these overflows are a source of contamination in dry weather as well. According to an FDA survey conducted in 1977 over 117 automatic sewage bypasses in the pipes of the Providence system were clogged and stuck open so that sewage was being discharged directly to the Bay before it even got to the treatment plant. Maintenance crews were supposed to have fixed the clogs but there is still considerable dry weather sewage discharge according to a recent survey by Dr. Eva Hoffman at URI. According to DEM estimates, the money needed to expand and upgrade the Providence sewage treatment plant and construction of two holding tanks at the site to process some of the combined sewage overlow would amount to approximately $115 million. The federal government was expected to contribute 75 percent of the cost, the state 15 percent and the local town 10 percent. Unfortunately, the amount of money these groups now have available for this project falls far short of what is needed. As a result the legislature authorized a referendum for an $80 million bond issue in November to help make up the cost. If passed, a new authority would be created to collect user fees, manage construction funds and operate the plant.

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