Rhode Island's Salt Pond Region: A Special Area Management Plan

Coastal Resources Management Council

Adopted November 27, 1984

Rhode Island's Salt Pond Region: A Special Area Management Plan

(Ninigret to Point Judith Ponds)

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This document was prepared
for the Coastal Resources Management Council by

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Financial support for the salt pond study and the plan was provided by URI Sea Grant, the Rhode Island Coastal Resources Management Program, each of the three towns, and a planning grant from EPA through the Office of Statewide Planning.

DEDICATION

This plan is dedicated to Foster Browning, Douglas Jackson, William Durfee, and George Boutillier, all of whom practiced the stewardship for the salt ponds that we hope this plan will rekindle.

RELATIONSHIP BETWEEN THIS SPECIAL AREA MANAGEMENT PLAN AND THE STATE OF RHODE ISLAND COASTAL RESOURCES MANAGEMENT PROGRAM AS AMENDED JUNE 28, 1983

This Special Area Management Plan provides greater detail and a plan of action that complements and adds to the policies, regulations and standards of the State of Rhode Island Coastal Resources Management Program as amended on June 28, 1983 hereafter referred to as the CRMP. In conformance with Section 130 of the CRMP, a Special Exception shall be required for any action that does not conform to the policies of this Plan or is specifically prohibited. With the exceptions noted below, no changes have been made to the water use categories, barrier beach designations, etc., as mapped in the CRMP. The Plan supercedes the CRMP on the following issues:

Chapter One

The inland boundary of the salt pond region as defined in Figure 1-2 supercedes the line shown on the Quonochontaug, Kingston and Narragansett Pier Quadrangle maps in the CRMP that designates where a review of proposed subdivisions and other specified activities is required as described in Section 320.D.

Chapter Two

Within the salt pond region, the coordinated permit review procedures described in Section 210 of this Plan supercede the process set forth in Section 320.D 2 and 3 of the CRMP.

Chapter Four

The policies and plan for dredging in Ninigret and Green Hill Ponds are an exception to, and supercede the prohibition on, improvement dredging in Type 2 waters.

The water use designations in this Plan supercede the designation made for the Port of Galilee area on the Kingston Quadrangle map as shown in the CRMP.

All other policies, regulations and prohibitions in this Plan are in addition to the requirements of the CRMP.

Cover photo: Jane Brawley

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RESOLUTIONS OF THE SPECIAL AREA MANAGEMENT PLAN REVIEW COMMITTEE

The Special Area Management Plan Review Committee strongly supports the Special Area Management Plan for the Salt Pond Region and urges the Towns and the State to act upon the initiatives set forth in this document as soon as possible. The following resolutions were passed by this Committee on June 14, 1984, to stimulate and assist rapid implementation of several of the most crucial initiatives.

RESOLUTION I

Whereas: A coordinated permit procedure and a Management Initiatives Action Committee are primary objectives of the Special Area Management Plan for the Salt Pond Region.

And whereas: These objectives are impossible to achieve without the Permit Coordinator described in Chapter 2, Section 220.3B, of this Plan.

And whereas: The rapid development in the Salt Pond Region requires that these objectives be put into effect as quickly as possible.

Therefore be it resolved: That the Special Area Management Plan Review Committee considers the staffing and funding of the Office of the Permit Coordinator to be a top priority and strongly urges the Coastal Resources Management Council, the Department of Environmental Management and the Governor to provide adequate financial support to this activity into the foreseeable future.

RESOLUTION II

Whereas: The coordinated permit procedure described in Chapter 2 of the Special Area Management Plan for the Salt Pond Region is a significant improvement and essential procedure for reviewing major developments within this area.

And whereas: This procedure will greatly assist coordinated planning and timely review by Town and State agencies and enable private developers to more clearly understand the environmental concerns of these agencies before extensive planning is undertaken.

And whereas: The same ecological effects documented for the salt ponds specifically studied through the URI salt ponds project can be expected to occur in the other salt ponds in South County.

Therefore be it resolved: That the Special Area Management Plan Review Committee feels strongly that this coordinated permit procedure should apply to all salt ponds in South County and urges the Coastal Resources Management Council to adopt this procedure for all major developments in the drainage basins of Narrow River, Quonochontaug Pond and Winnapaug Pond.

RESOLUTION III

Whereas: Individual Sewage Disposal Systems (ISDS) have been documented to be a major cause of the degradation of the salt ponds and freshwater supplies.

And whereas: Similar ISDS in other areas of South County can be expected to contribute to similar degradation in the other salt ponds.

Therefore be it resolved: That the Special Area Management Plan Review Committee urges the State and Towns to apply the existing information and procedures relating to ISDS contained in this Plan to develop ISDS maintenance/upgrading and public education programs in the drainage basins of Narrow River, Quonochontaug Pond and Winnapaug Pond.

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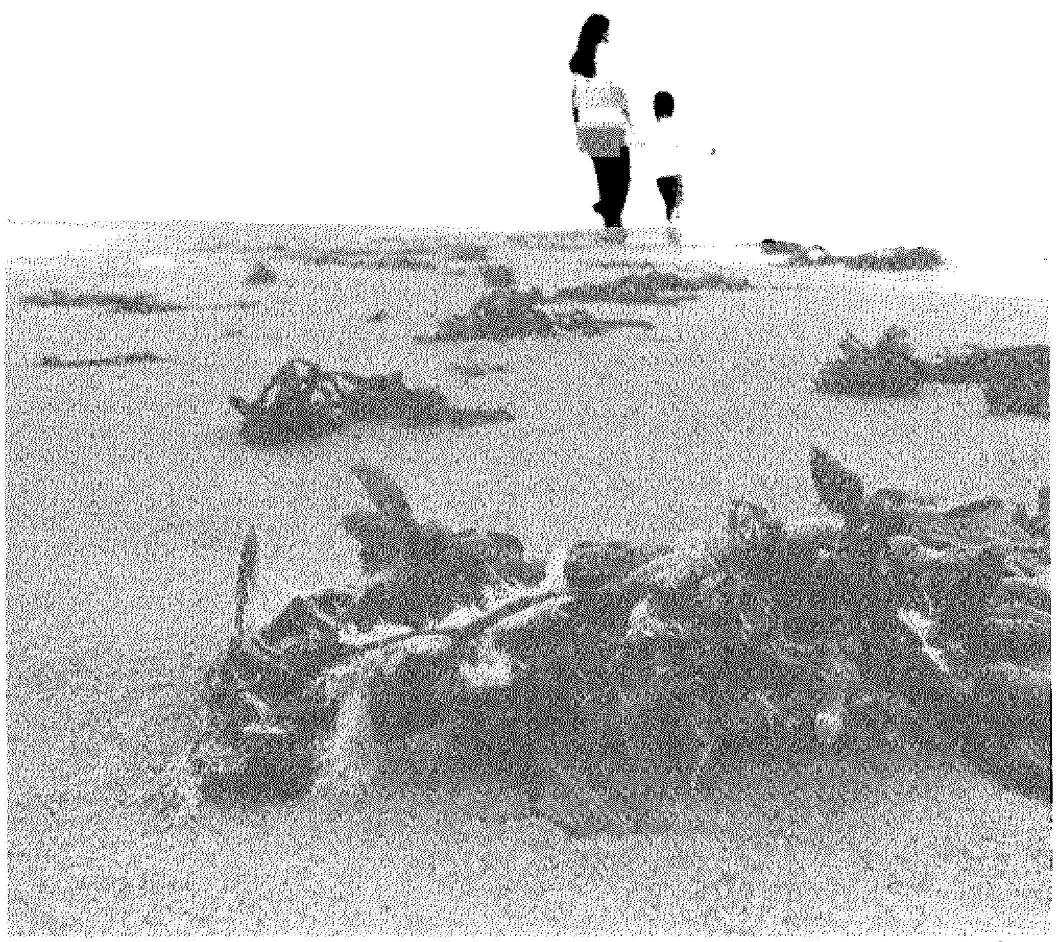
The Objectives of the Special Area Management Plan



Robert J. Izzo

110. THE CHALLENGE

All around the United States people are migrating to the coasts. By the year 1990, 75 percent of the population will live within 50 miles of tidal waters and the Great Lakes.[1] This national trend is dramatically illustrated along Rhode Island's south shore where the number of houses in the watersheds of the salt ponds that are the focus of this Plan increased threefold between 1950 and 1980, from 1,775 to 5,570 units (Figure 1-1). Under the zoning and wetlands protection regulations in force in 1984, there is the potential for three times more houses and seven times more people being crowded into this small area.[2] During summer months an additional 165,000 tourists pour into the south shore on a peak summer day.[3] This burgeoning population and increasing competition among often incompatible activities threatens to overwhelm the capacity of the salt ponds to absorb wastes, provide shelter for boats and vessels, produce seafood and maintain the scenic qualities that presently attract residents and tourists and underpin premium real estate values. Large areas of the salt ponds are poorly flushed, which makes them valuable as fish and shellfish nurseries but also particularly susceptible to eutrophication and bacterial contamination. Their ecology can be drastically changed by such alterations as stabilizing the inlets that connect them to the ocean, dredging channels, and altering the quality and quantity of freshwater inflow.

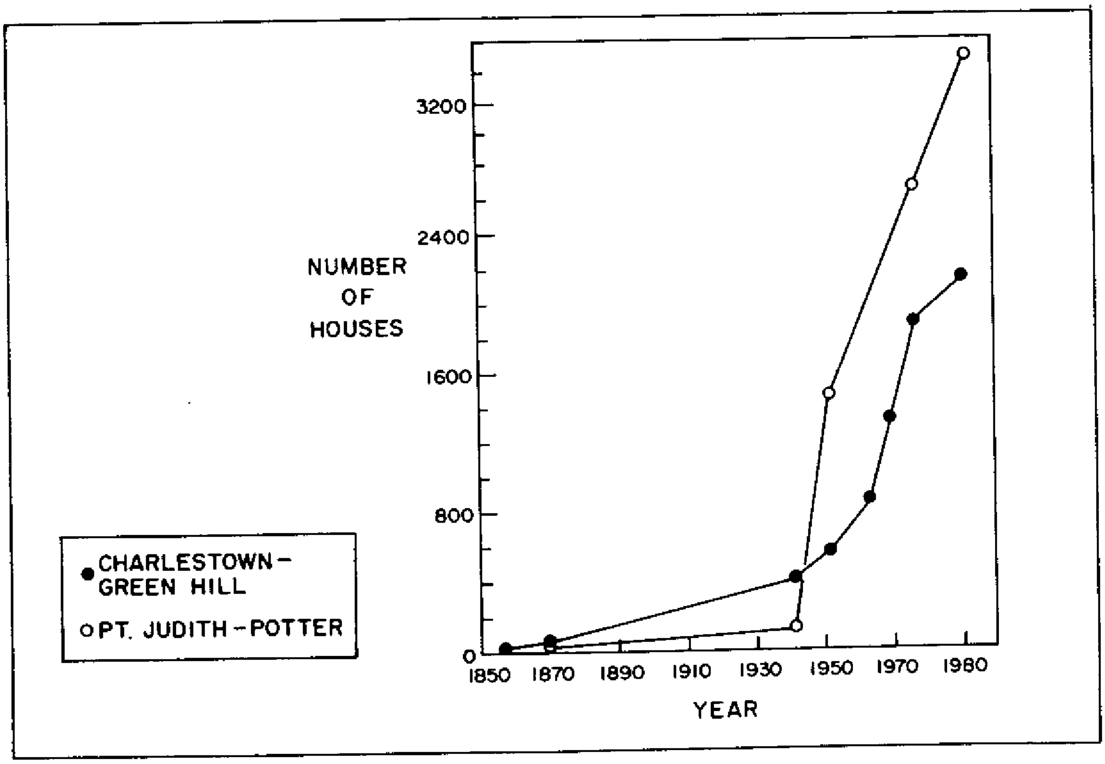


Figure 1-1. The increase of residential development within the salt pond watersheds south of Route 1.

120. THE ORIGINS OF THE PLAN

The residents of the region are keenly aware that the very qualities that attracted them to the area are in jeopardy. The Rhode Island Coastal Resources Management Council (CRMC) learned of these concerns in 1977 when it held a public workshop at the Quonochontaug Grange to discuss preliminary concepts for statewide policies and a regulatory program to control and protect coastal areas and their uses. Scores of residents and local officials voiced their concerns for the salt ponds and their ideas for steps that should be taken to avoid their further degradation. One year later a pilot project was funded to produce an ecological history of the salt ponds and to identify the interrelationships among the major management issues.[4] The principal issues raised at the Quonochontaug meeting and by the pilot project are as follows:

A. Some formerly abundant fish and shellfish stocks have virtually disappeared and others appear to be declining.

B. Permanent, stabilized inlets are causing rapid sedimentation within the ponds; many inlets no longer provide safe access to the ocean, and rapidly growing deltas are changing water circulation patterns and filling in large areas.

C. Water pollution threatens to become more widespread; bacterial contamination could close larger areas to shellfishing, and eutrophic conditions are degrading fish and shellfish habitats and the scenic qualities of the salt ponds.

D. Continuing residential development threatens to overwhelm the ecosystem's capacity to absorb wastes and produce potable drinking water and is consuming the farmland and woodland that give the area much of its character and beauty.

E. Residents and developers have forgotten that hurricanes periodically reshape this coast.

F. User conflicts must be arbitrated; competition among aquaculture, commercial and recreational fisheries, boaters, and commercial interests are all mounting as the number of people using the ponds increases.

This project led to a major four-year interdisciplinary research project funded primarily through the University's Sea Grant Program and the Rhode Island Coastal Management Program, with additional funding from the Statewide Planning Program and the Towns of South Kingstown and Narragansett. The research undertaken during 1978-1982 was designed to evaluate the issues raised in 1977, to document the present condition of the ponds and describe major trends. The results of this research are the foundations of this Special Area Management Plan.

130. AN ECOSYSTEM-BASED MANAGEMENT STRATEGY

A management strategy designed to address such a diversity of issues must be holistic and rooted in the CRMC's legislative mandate that states:

> ...the preservation and restoration of ecological systems shall be the primary guiding principle upon which environmental alteration of coastal resources will be measured, judged, and regulated.[5]

Central to a management strategy that is based on this principle is the recognition of the complex interrelationship among the many elements of the ecosystem and the often far-reaching and unexpected consequences resulting from a change to one element of the ecosystem. The salt pond region that is the focus of this plan extends from the barriers that separate the salt ponds from the ocean to the inland boundary of the watersheds of the individual ponds. For regulatory purposes, the region is defined as shown in Figure 1-2 and includes 32 square miles. This region incorporates approximately 20 percent of Narragansett, 30 percent of South Kingstown and 40 percent of Charlestown.[5]

The salt pond region contains many of the natural and historical assets that give the three towns their distinctive identity. The beautiful landscape, the salt ponds and ocean, the extensive beaches, the moderate climate, the small town atmosphere and the wide diversity of activities combine to give the area extraordinary appeal. A recent survey indicates that some 60 percent of the residents of the three towns use the ponds as a recreational resource and that 70 percent of these users visit the ponds more than ten times a year.[6] By far the most common activity (70 percent of the survey respondents) is simply enjoying the natural beauty of the area. Many steps have already been taken to help preserve diversity within the region and to check the overdevelopment that threatens to destroy the area's qualities and its capacity to absorb wastes and sustain unpolluted waters. All three towns are considering increasing the size of house lots in the remaining sparsely developed areas, several parcels in the region are high on DEM's priority list for land acquisition, and the CRMC has designated all of the ponds, except for portions of Point Judith Pond, for conservation and low intensity use. A major purpose of this plan is to combine initiatives such as these into a single, coherent strategy. Further development, however, should not and cannot be halted. There are many opportunities for making better and fuller use of the region's many amenities, but future change must not degrade the region's exceptional value as a high quality environment.

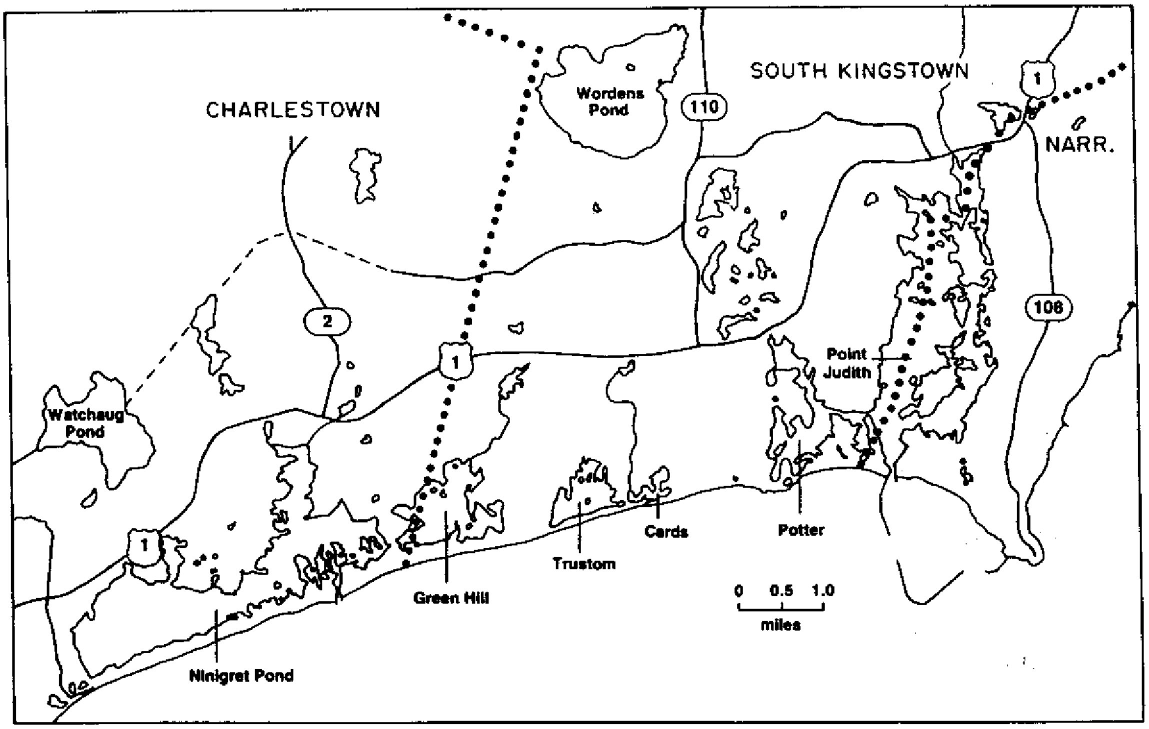


Figure 1-2. The salt pond region. For administrative purposes, the boundaries of the Salt Pond Region follow the roadways that most closely correspond to the watershed boundaries of the salt ponds. The region is bounded to the east by Route 108 in Narragansett, to the west by East Beach Road and Cookestown Road in Charlestown, and to the south by Block Island Sound. The northern boundary runs from Route 1 in Narragansett, along Tuckertown Road and Narragansett Trail in South Kingstown to the town hall in Charlestown; thence following a straight line across the northernmost shore of Schoolhouse Pond to Kings Factory Road; thence following the Burlingame State Park boundary to Watchaug Pond; thence Watchaug Pond, following Watchaug Pond, following Healy Brook to Cookestown Road in Charlestown. The dotted lines represent town boundaries.

140. THE GOALS OF THE PLAN

This Special Area Management Plan is based on eight goals.

1. <u>To maintain the exceptional scenic qualities of the salt pond region, and a diversity in the mix and intensity of the activities they support.</u>

In the 18th century Rhode Island was known as the "garden of New England," and the south shore, with its long vistas over pastures and cultivated fields, its tranquil salt ponds, and its sandy beaches, has long been famed for its exceptional beauty.[7] The south shore was already attracting large numbers of vacationers by the mid-1800s. After World War II a booming economy, automobiles, highways and commuter living began to transform the south shore from a chain of small rural communities and summer colonies to what had become by the 1970s the most rapidly developing residential area in the state and a major recreational resource for southern New England. Today many of the newer residents live in plat developments, but the sense of living "in the country" with unpolluted salt ponds, open beaches, fields and woodlands close at hand is known to all. The region has retained its individuality and is rich in contrasts, with fishing villages, mill communities and working farms clearly discernible among the more recent houses, highways and developments. If you know your way around, a spot for a quiet picnic can be found at any time of the year. The ponds are a boater's dream. The calm waters satisfy many close-to-home boaters, and for the more ambitious fishermen, the bass and bluefish in Block Island Sound are only minutes away. The pond shoreline provides not only a delightful view but excellent shelter for boats, fishing and shellfishing, and clean water that invites paddling and swimming on hot summer days.

2. <u>To prevent expansion near areas of the salt ponds that are contaminated by potentially harmful bacteria or eutrophic conditions.</u>

Only the upper reaches of Point Judith Pond are permanently closed to shellfishing by high levels of bacterial contamination. However, recent surveys of the six salt ponds have shown that bacterial contamination is becoming more widespread.[8] Surface runoff is believed to be the major pathway by which fecal bacteria from pets and failing septic systems enter the ponds. Bacterial contamination, if sufficiently severe, will preempt shellfishing and detract from the region's image as a high quality environment and an important recreational resource. The symptoms of eutrophication are prevalent during the summer months in poorly flushed waters surrounded by dense residential development.[9] In these areas large rafts of free-floating algae form on the surface and eelgrass beds become thick with slimy green growth. As the plant growth decays in the warm summer months, the amount of dissolved oxygen in the water occasionally falls to levels that can be lethal to fish and shellfish. The abundant plant life forms rotting windrows on down-wind beaches. It is estimated that 60 percent of the nitrogen that is primarily responsible for eutrophic conditions in the ponds may be attributed to the human activities in the watershed, primarily from fertilizers and treated domestic sewage.[9] Eutrophic conditions detract from the scenic quality of the ponds and greatly reduce the attractiveness of the ponds for swimming, boating and fishing. They also detract from the value of the ponds as fish and shellfish habitats. Both bacterial contamination and eutrophication are directly associated with dense residential development, and it is therefore a priority to control future residential development in the region.

3. <u>To ensure that groundwater will be unpolluted.</u>

The region's groundwater presently supplies 5,000 private wells and public water supply systems, and there is evidence that dense development threatens to contaminate aquifers in several areas. The high incidence of bacterial contamination in the private wells of the older, densely developed communities of South Kingstown made it necessary to build the South Shore Water Supply System in the 1970s. A high proportion of the private wells in areas of similarly dense development in Charlestown are known to be contaminated.[10] Extensive sampling for the concentration of nitrate in well water has shown that this pollutant is also a problem in areas of dense development. In some cases well water nitrate concentrations exceed the public health limit of 10 parts per million.[9] Public water systems are expensive to build and can alter the flow of fresh water into individual salt ponds. This can have profound impacts on their ecology. The challenge is to develop a management strategy to limit and direct further development in the salt pond watersheds and to reduce the pollution caused by existing development in the region.

4. <u>To preserve and enhance the diversity and abundance of fish and shellfish.</u>

According to recent surveys, the salt ponds of the region are enjoyed each year by recreational fishermen who annually harvest some 1,000 bushels of quahogs, 30,000 pounds of flounder, as many as 10,000 bushels of scallops, and several thousand pounds of other species of finfish.[11] A much smaller number of commercial fishermen harvest approximately equal quantities of quahogs and flounder. The fishery resources of the ponds are one of their most valuable assets, and their condition is a yardstick by which many assess the health of the salt ponds and the effectiveness of management. Much of the concern for environmental deterioration in the region is based on the perception that populations of the most important resident species, the quahog, oyster and winter flounder, are declining. Indeed, a combination of heavy fishing pressure, development around the ponds, and the building of permanent breachways has probably caused the virtual disappearance of once abundant fish and shellfish. The salt ponds provide winter flounder and several other commercially important species of finfish with spawning and nursery habitat that must be protected and maintained.[11] The management of the salt ponds must provide for attentive monitoring of fishery resources to prevent overexploitation and further changes to the ecology of the ponds that diminish their value as fishery habitats.

5. To restore barrier beaches, salt marshes, and fish and wildlife habitats damaged by past construction or present use.

Major alterations have been made to the ponds that have altered or destroyed the larger salt marshes, dammed the streams that flow into the ponds, and changed tidal circulation. Many of these alterations are irreversible but some are amenable to restoration. The dunes on the barrier beaches that are an important line of defense against major storms have not recovered since the most recent hurricane. Building on dunes has been prohibited by the CRMC since 1974, but trampling by people and vehicles remains a major problem. Habitat restoration both in the ponds and on the barriers must be judiciously implemented and will rely in good measure on educational programs.

6. To prepare a post-hurricane restoration plan.

The salt pond region is particularly susceptible to damage from hurricanes and major storms. On average, a hurricane strikes this coast every seven years, but there is no regularity to their occurrence.[12] Many of the coastal barriers have been redeveloped after having already suffered extensive damage twice in the past 50 years. Low-lying lands shoreward of the salt ponds that were fields 20 years ago are now thickly developed and thousands of houses lie in areas that are expected to be flooded to a depth of 3 to 15 feet.[13] The damage created by the next major hurricane will be immense. Plans for reconstruction and cleanup must be developed ahead of time for the restoration of damaged features, for redevelopment, and to identify the priorities for the purchase of particularly vulnerable features.

7. To maintain Point Judith harbor as a commercial fishing port and provide for expansion of port facilities.

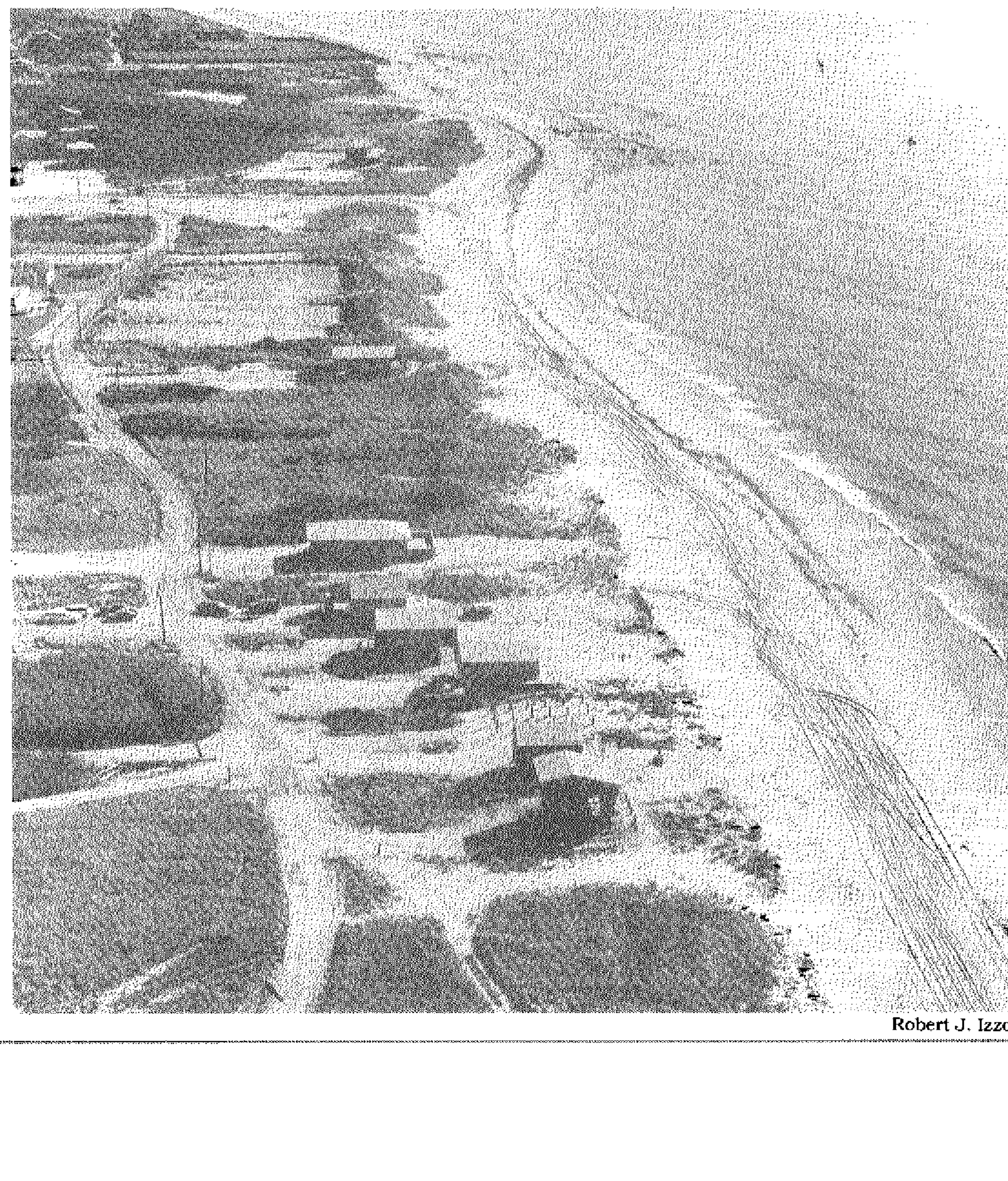
Point Judith harbor is the only full service fishing port in the state. In 1984 it was home port to some 160 fishing vessels and provided employment to more than 1,000 people.[14] The fleet is expanding rapidly and berthing facilities at Galilee cannot meet the demand. Future plans call for more berthing at Jerusalem and Snug Harbor and deeper channels connecting these facilities.

8. To create a decision-making process appropriate to the management of the region as an ecosystem.

The regulatory powers to manage the salt pond region are fragmented among many agencies of municipal and state government. A plan and management process is needed that will provide a common set of objectives for all agencies and replace an often isolated and sequential decision-making process with coordinated reviews and permitting. The plan should summarize the best available information on the ecosystem and provide for a balance among competing uses. It should provide a reference point for new information and changes in how the needs of the public are perceived. Amendments will be both necessary and desirable as new information on how the ecosystem functions and responds to human-induced stress becomes available and people react to the success or failure of adopted management strategies.

Chapter Two.

The Framework of Management



Robert J. Izzo

210. FINDINGS OF FACT

210.1 Management Authorities

A. The legislative mandate for ecosystem-based planning and management of Rhode Island's coastal region is set forth in the Coastal Resources Management Council's (CRMC) enabling legislation and describes the resource management process as follows:

1. Identify all of the state's coastal resources: water, submerged land, air space, finfish, shellfish, minerals, physiographic features, and so forth.

2. Evaluate these resources in terms of their quantity, quality, capability for use, and other key characteristics.

3. Determine the current and potential uses of each resource.

4. Determine the current and potential problems of each resource.

5. Formulate plans and programs for the management of each resource, identifying permitted uses, locations, protection measures, and so forth.

6. Carry out these resource management programs through implementing authority and coordination of state, federal, local, and private activities.

7. Formulation of standards where these do not exist, and reevaluation of existing standards.

An initial series of resource management activities shall be initiated through this basic process, then each phase shall continuously be recycled and used to modify the Council's resource management programs and keep them current.[1]

B. While the CRMC has direct and comprehensive authority over the salt ponds and their shorelines, its inland authorities are limited. The municipalities possess the primary authority for the watersheds that form the terrestrial portion of the salt ponds ecosystem. The authorities and responsibilities of the CRMC, municipal governments, the Department of Environmental Management, the Marine Fisheries Council and the Department of Transportation (see Table 2.1) are probably sufficient to effectively manage the salt ponds ecosystem. The challenge lies in coordinating these fragmented authorities in a united management strategy to which all these traditionally independently functioning bodies contribute.

210.2 The Lack of Incentives for Growth Management in the Region

A. Continuing residential development is the driving force behind all major problems in the salt pond region and the degradation of the ecosystem. The major factors that determine how and when

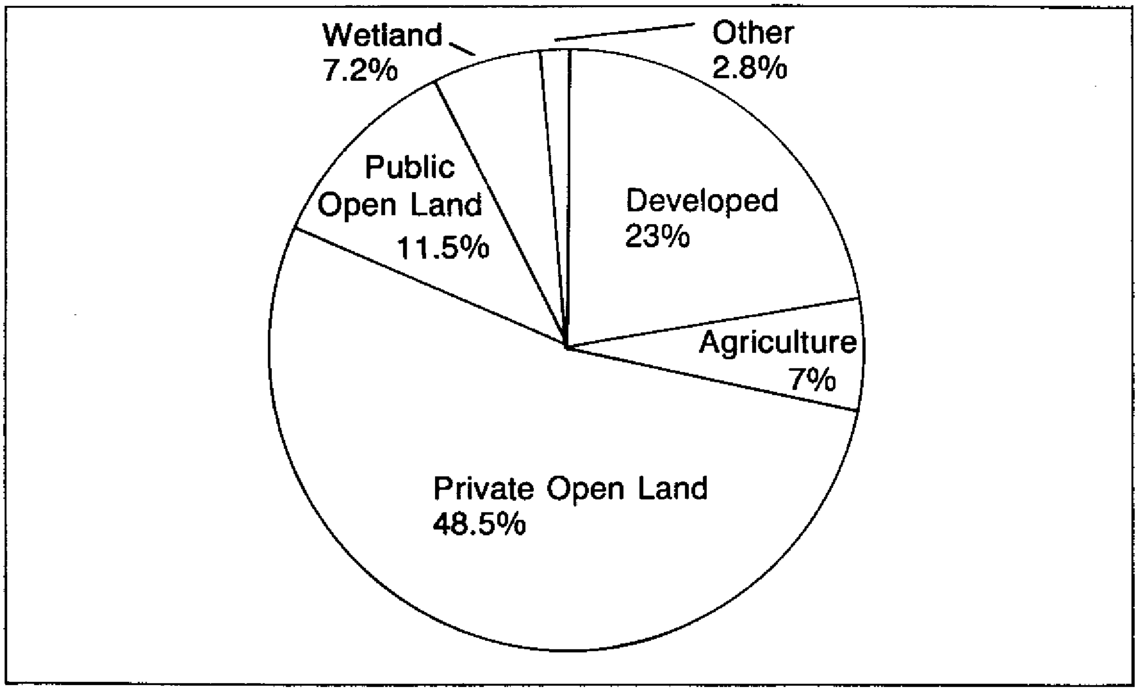


Figure 2.1. Land use in the salt pond region. A large proportion of the watersheds is in private ownership and is as yet undeveloped.

further development will proceed are municipal zoning regulations and the application of acquisition, conservation and municipal tax policies to undeveloped lands. Nearly 50 percent of the region is as yet undeveloped, and the majority of the undeveloped lands lie in Charlestown and South Kingstown[2] (Figure 2-1).

B. The manner in which remaining open lands are developed or preserved will be the principal determinant of future salt pond water quality and whether the region can be self-sustaining in potable water and domestic sewage disposal (see Chapter 3). These lands also hold the region's future as either a high quality environment of exceptional beauty or yet another suburb where the unique character of the environment is reduced or destroyed. At present the burden of maintaining undeveloped lands is borne primarily by the few individuals who own large parcels.[4] Yet the economic incentives to subdivide these holdings and sell them for residential development are powerful and are increasing. Land that commonly sold for a few hundred dollars an acre in the 1950s is worth several thousand dollars an acre in the 1980s. Such incentives to subdivide are compounded by periodic assessments required by state legislation to determine the value of property for municipal taxing purposes. This places the owners of large tracts under increasing pressure to sell off their holdings in order to avoid spiraling tax bills. An individual who owns 150 acres of farmland or woodland in South Kingstown, for example, may expect to face an annual tax bill in excess of $10,000. The Farm, Forest and Open Space Act permits municipalities to tax qualifying undeveloped lands at a rate based on their current use rather than their highest potential value, which in the region is as residential house lots. Enrollment in this program is increasing.

C. One of the many reasons for limiting further residential development is to reduce further demands for municipal services and the need to raise municipal tax revenues to support such services. The net costs of suburban development to local government have been documented by numerous studies. In South Kingstown a 1981 estimate showed that the average single family home in that town paid taxes that covered approximately half of its annual costs to the town.[3] The average deficit at that time was $925. Other estimates developed to illustrate the relative costs to South Kingstown of developing lands proposed for downzoning from 2 to 5 acre lots in 1983 showed that development of those lands at a 2 acre density would result in at least a 14.3 percent increase in the property tax burden for the average resident.[4] Development at a 5 acre lot size, on the other hand, would produce an estimated increase of 9.5 percent, and preservation as open space could result in at most a 5.4 percent increase. The costs of rapid residential development are likely to be most high in Charlestown, where potential for development is greatest and the infrastructure required to support substantial residential growth, particularly schools and public water systems, does not at present exist. Both Charlestown and South Kingstown are currently considering increasing the minimum lot size in some undeveloped areas.

210.3 Problems with the Present Permitting Process

Agencies of state and local government which are engaged in the review process grant permits in a sequential, usually isolated manner. This prevents the integration of the diverse concerns of individual agencies and inhibits opportunities for developing optimal, rather than simply legally valid decisions. Sequential decision making is also inefficient, and often frustrating for an individual desiring to undertake a project that requires permits from several agencies. A person wishing to develop a parcel within the region is often required to obtain approvals for the building or subdivision (from several town commissions), approval for on-site sewage disposal systems (from DEM's ISDS Section), a Water Quality Certificate (from DEM's Division of Water Resources), a wetlands permit (from DEM's Division of Land Resources) and, when all other permits have been obtained, a CRMC Assent processed by the DEM Division of Coastal Resources and granted by the CRMC. If variances or special exceptions have to be obtained anywhere along the line, the applicant's flexibility to respond to the concerns of other authorities become constrained. An applicant who has received some of the necessary approvals may be forced to renegotiate if an agency finds the constraints imposed by other permits unacceptable. The process takes months or even years and may involve several lengthy hearings before various permitting bodies. The process is expensive, since engineers, surveyors, planners and/or lawyers must be paid to shepherd the plan through the process. Expensive plans must be redrawn as the various permits are negotiated. Municipal government is frequently frustrated because, as the agency with primary responsibility over land development and often with the greatest concern for the potential impacts of the development, it is the first in line and must act without the benefit of the expert reviews of state agency staffs. Conversely, the ability of the state agencies to work with the developer to mitigate potential impacts and prepare an optimal plan is severely constrained once the applicant has received municipal approvals. The CRMC, which has the broadest powers to consider environmental impacts, is often the most constrained, since its procedures make it the last agency to grant a permit and it may be the last agency to be consulted.

220. MANAGEMENT REGULATIONS AND INITIATIVES

220.1 Management Objectives

A primary objective of this Plan is to provide new mechanisms that will coordinate the presently fragmented regulatory and planning process. This shall be accomplished through (1) assigning special responsibilities to the CRMC's Small Estuaries Committee, (2) a coordinated permit procedure for major activities through which all local, state, and federal permitting agencies commit themselves to a process of consultations to assess the impacts of major proposals within the salt pond region early in the planning process, and (3) creation of an Action Committee that is responsible for coordinating further planning, education programs and the other nonregulatory initiatives. The coordinated permitting procedure will not alter existing authorities or change the legal basis or sequence by which permits are issued. Agencies will continue to be constrained by their specific legislative authority to act upon limited aspects of a proposal, and applicants must continue to meet the requirements and criteria of each permitting agency. The purpose of the coordinated procedure is: (a) to evaluate major development proposals on the basis of shared expertise from each permitting agency, and (b) to identify and evaluate major impacts on the ecosystem at the beginning of the permitting process.

220.2 CRMC Small Estuaries and Salt Ponds Subcommittee

The CRMC's Small Estuaries and Salt Ponds Subcommittee shall serve as the coordinator of planning and regulatory activities in the salt pond region and promote its legislative mandate that states "that preservation and restoration of ecological systems shall be the primary guiding principle upon which environmental alteration of coastal resources will be measured, judged and regulated" (GLRI 46-23-1). The CRMC Small Estuaries and Salt Ponds Subcommittee shall:

A. Review all applications for contested Category B Assents and Special Exceptions within the salt pond region and prepare recommendations on these permitting decisions for the full CRMC's consideration and action.

B. Coordinate actions with local, state, regional and federal agencies and private interests; the Subcommittee shall act jointly with the Action Committee when implementing nonregulatory management initiatives contained in this plan (see 220.6 below).

C. Make recommendations to the full Council, which shall serve as an arbitration board "in any matter of dispute involving the resources of the salt pond region and the interests of two or more municipal or state agencies" [GLRI46-23-6C(e)]. The Subcommittee's recommendations shall be referred to the full Council for a binding decision.

D. Sponsor research on management issues in the salt pond region and advise the governor, General Assembly and public on coastal matters [GLRI46-23-6C(c)].

220.3 Coordinated Permitting Procedures

A. The CRMC shall designate a Permit Coordinator for the salt ponds region. Parties proposing an activity listed in Section 220.4 below shall notify the Permit Coordinator before a formal application is filed for any municipal or state permit.

B. The Permit Coordinator shall meet with the applicant to identify:

1. The permits and regulations that are likely to be required.

2. Potential environmental issues of significance, if any.

C. The Permit Coordinator shall notify all participating agencies, providing a locus map of the site, a general description of the proposal, and B (1) and (2) above.

D. If one or more participating agencies (Sec. 220.5) request a coordinated review, the applicant proceeds to step E; if not, the applicant may apply for the necessary permits.

E. Applicants shall submit the following information to the Permit Coordinator no less than three weeks before the pre-application conference.

1. A soils map of the property (suggested scale 1:200) with an accompanying analysis of the best use potential of the soils present; the soils map and use potential analysis prepared by the U.S. Soil Conservation Service should be used as the basis for this analysis.

2. An overlay map showing the principal vegetation types or any significant features identified by the Natural Heritage Program of the Department of Environmental Management and the Historic Preservation Commission on the property; the maps prepared by McConnell and Kupa and Whitman may be the basis for information on vegetation.[5,6]

3. A topographic overlay showing surface drainage patterns and information on the depth to groundwater and the estimated direction and volume of groundwater flows.

4. An overlay showing the proposed development, including, as appropriate, buildings, roadways, parking areas, drainage systems, sewage treatment and disposal facilities and undisturbed lands. Some of the above maps may be deemed unnecessary by the Permit Coordinator when activities other than subdivisions are considered.

F. All agencies that may be required to issue permits for the proposed alteration shall, in accordance with agreements made with the CRMC, review these materials and attend the pre-application conference. The purpose of the conference is to:

1. Identify and discuss the major design alternatives and the likely impacts of such alternatives on the affected ecosystem and the policies of this Plan.

2. Make available to all parties pertinent information generated through research on the region and the technical expertise of all involved agencies in a timely and coordinated fashion.

G. The Permit Coordinator shall distribute a summary of the meeting to all participants.

220.4 Major Activities Requiring Notification of the Permit Coordinator

1. New subdivisions of six units or more.

2. Facilities requiring one acre or more of parking or surfaced lay-down area.

3. Construction or extension of municipal or industrial sewage facilities or systems, conduits or interceptors.

4. All roadway construction and upgrading projects listed on the Rhode Island Transportation Improvement Plan.

5. Dredging and dredge material disposal involving 5,000 cubic yards or more of material in salt pond areas excluding the Galilee-Jerusalem-Snug Harbor port area as defined in Figure 4.4; dredging

and disposal within the Point Judith Port area shall be subject to review only if the depths created and means of disposal do not conform to this Plan.

6. Water distribution systems and supply line extensions.

7. Construction or extension of public or privately owned sanitary landfills.

8. Minerals extraction (to be defined by area).

9. Processing, transfer or storage of hazardous materials as defined by the Department of Environmental Management.

10. Electrical generating facilities of more than 10 megawatts capacity.[7]

11. Petroleum processing and transfer facilities of more than 2,400 barrels capacity; all residential and commercial in-ground petroleum storage tanks.

12. Any participating agencies (Sec. 220.5) may request a coordinated review of any proposal within the salt pond region that poses substantive environmental issues.

220.5 Agencies Participating in the Coordinated Permit Review

A. The following agencies of local, state and federal government shall be notified of all proposals listed in 220.4 above.

1. The Department of Environmental Management's Office of Environmental Coordination, which will in turn notify applicable departments within this agency.

2. The planning board, zoning board of review, conservation commission, town manager, town planner, and building inspector of the municipality within which the alteration is proposed.

3. The Statewide Planning Program.

4. The Historic Preservation Commission.

5. Soil Conservation Service.

B. Agencies (or divisions or boards) from whom a permit is necessary will attend individual pre-application conferences. The participation of all interested agencies will be encouraged.

220.6 The Action Committee

A. The chair of the CRMC Subcommittee shall chair the Action Committee, which has primary responsibility for acting upon the non-regulatory initiatives contained in this Plan.

B. Membership of the Action Committee is as follows:

- all members of the CRMC Subcommittee
- 5 members from each municipality appointed by their respective Town Councils
- a representative of the Department of Environmental Management
- a representative of the Statewide Planning Program
- a representative of the Historic Preservation Commission

C. The Action Committee shall identify its work priorities for each year. Candidate priorities for the first year are as follows:

1. To design, in cooperation with the DEM, an effective program for the maintenance of on-site sewage disposal systems (ISDS) and the upgrading of substandard and failing ISDS in the region.

2. To design and implement a public education program on the initiatives that individual homeowners can take toward maintaining and protecting water quality in the region. The primary focus of the program will be ISDS maintenance and fertilizer applications. Educational programs shall be carried out at the community level and enlist the cooperation of the DEM Division of Land Resources.

3. To develop strategies for the preservation of remaining open space and measures that will reduce the cumulative environmental impact of further small lot residential development in the region.

4. To develop a post-hurricane restoration plan for the region that will:

   - establish priority areas for acquisition
   - set guidelines for restoration of breachways, storm channels across barriers, removal of debris and sand from sensitive habitats, and other contingencies likely to require immediate action from state and local authorities
   - review hurricane preparedness plans for the three towns and promote coordination where appropriate

5. To promote the Fisheries Steward Program described in Chapter Five, section 520.1.

6. To seek funding for the sediment catch basin for the Ninigret breachway, as described in Chapter Four, section 450.1.

Table 2.1 Principal Management Authorities in the Salt Pond Region

The Rhode Island Coastal Resources Management Council

The CRMC regulates all activities in tidal waters and specified on-land activities where these may conflict with a CRMC plan or may damage the environment of the coastal region. Specific on-land authorities include sewage treatment and disposal, solid waste disposal, power-generating plants, petroleum storage, chemical or petroleum processing, mineral extraction, and all modifications to shoreline features and their contiguous zone. The CRMC is charged to develop plans for coastal ecosystems and to coordinate the actions of other government agencies that affect these systems.

Municipal Governments

The three municipalities in the region, through zoning plans and ordinances, have the primary responsibility for how the watersheds are developed. The density and distribution of houses, commercial development and construction standards are all primarily a local prerogative. The crucial decisions on where such public services as public water supplies and sewers shall be provided are initiated by municipal governments.

The Rhode Island Department of Environmental Management

Various divisions within the Department: (1) license individual on-site sewage disposal systems, municipal sewage treatment plants, and issue permits for point discharges of wastewaters; (2) manage state parks and beaches; (3) provide staff to the CRMC and manage the port facilities at Galilee; and (4) are responsible for the management of fish and wildlife.

The Marine Fisheries Council

The MFC establishes catch limits, minimum size limits, fishing seasons, fisheries management areas and gear limitations for all marine fisheries within the state's three-mile territorial sea. Staff to the MFC is provided by the DEM Division of Fish and Wildlife.

The Rhode Island Department of Transportation

DOT is responsible for planning, building and maintaining all state-owned public roadways.

The United States Army Corps of Engineers

The Corps is responsible for the maintenance of federal navigation channels (present only in Point Judith Pond) and issues permits for major shoreline and marine construction projects.

Chapter Three.
Water Quality


Robert J. Izzo

310. FINDINGS OF FACT

310.1 Threats to Water Quality

A. The major water pollution problems in the region are directly related to the density and distribution of development within the watersheds of the salt ponds. Since the watersheds, as mapped in Figure 3-1, are with minor exceptions zoned for residential development, bacterial contamination and nutrient enrichment are the primary threats to water quality. As development proceeds, these pollutants will increasingly threaten the quality of the salt ponds and the groundwater, which is the predominant source of fresh water to the ponds and sole source of the region's drinking water supply.

B. There are other potential sources of pollution that have not been examined in the salt pond region. These include such toxic compounds as gasoline and fuel oil that may be leaking from underground storage tanks, leachate from landfills, septic tank cleaners, herbicides and pesticides. As the region becomes more developed, stormwater runoff from roads and parking lots will become an increasingly important source of a variety of contaminants.

310.2 Bacterial Contamination

A. Definition and Extent of the Problem

1. In accordance with national guidelines, bacterial contamination is assessed by state health officials according to the concentrations of coliform bacteria in the water. Since 1970 state health officials have used the concentration of fecal coliform bacteria as the indicator of sewage contamination when determining whether water is safe for drinking, shellfish harvesting and/or swimming. Since the variation among samples taken from coastal waters is frequently high, the Department of Environmental Management closes areas to shellfishing only when coliform levels consistently exceed the limits listed in Table 3-1.[1]

TABLE 3.1. State of Rhode Island Water Quality Standards

Use	Highest Acceptable Bacteria Concentration (MPN/100 ml) Total Coliforms	Fecal Coliforms
Drinking Water	0	0
Shellfishing (salt water)	70	15
Water Contact Recreation (salt water)	700	50

2. Until recently, bacterial contamination sufficient to require the exclusion of shellfishing in the salt ponds was limited to northern portions of Point Judith Pond. Construction of a sewage treatment plant and sewering the town of Wakefield greatly reduced bacterial contamination in this pond so that in 1983 the size of the closed area was reduced by approximately 60 percent. By 1980, however, bacterial contamination was a developing problem in four other salt ponds (see Figure 3-2). According to a year-long survey by the Department of Health and Nixon et al., the concentrations of fecal coliforms during the summer of 1980 consistently exceeded the shellfishing standard not only in upper Point Judith, but also in Cards and Green Hill Ponds and portions of Potter Pond.[2] The safety limits for water contact recreation were exceeded during the summer in Cards, Green Hill, Upper Point Judith and portions of Green Hill.[2] Data collected by the Department of Environmental Management in Green Hill Pond in 1982 and 1983 confirmed the high levels of bacterial contamination during the summer and fall in that pond.[3]

3. Bacterial contamination is also polluting groundwater underneath the older, more densely developed communities within the watersheds. The high density of development and incidence of polluted wells in the communities of Matunuck and Green Hill made it necessary for South Kingstown to build the South Shore Water Supply System in the 1970s. Surveys of well water in the communities between Green Hill and Ninigret Ponds indicate that bacterial contamination of drinking water may also be an increasing problem here. According to Rhode Island Department of Health surveys of 163 wells in this area between 1966 and 1972, 30 percent were judged not safe as potable water supplies due to bacterial contamination.[4] By 1980, a survey in the same area by Rhode Island Programs for the Environment found that 50 percent of the 19 randomly selected wells were contaminated with coliform bacteria.[5]

B. Sources of Contamination

1. A number of studies in suburban coastal communities suggests that the principal sources of fecal coliforms to groundwater and surface waters may include leachate from failed septic systems, direct discharges of improperly treated sewage, fecal material from pets and livestock carried by runoff, leaking sewers, and sanitary landfills.[6,7,8,9] In the salt pond region, failing and substandard ISDS and contaminated runoff are probably the most important sources of bacterial contamination.[10] Trustom Pond Refuge is the only pond where dense flocks of waterfowl are likely to be the major source of bacterial contamination. However, this pond is a National Wildlife Refuge, where boating, swimming and shellfishing are prohibited.

2. In the salt pond region, individual inground sewage disposal systems (ISDS) are the principal means of treatment and disposal of domestic waste. In 1981 there were 5,502 ISDS in the water-

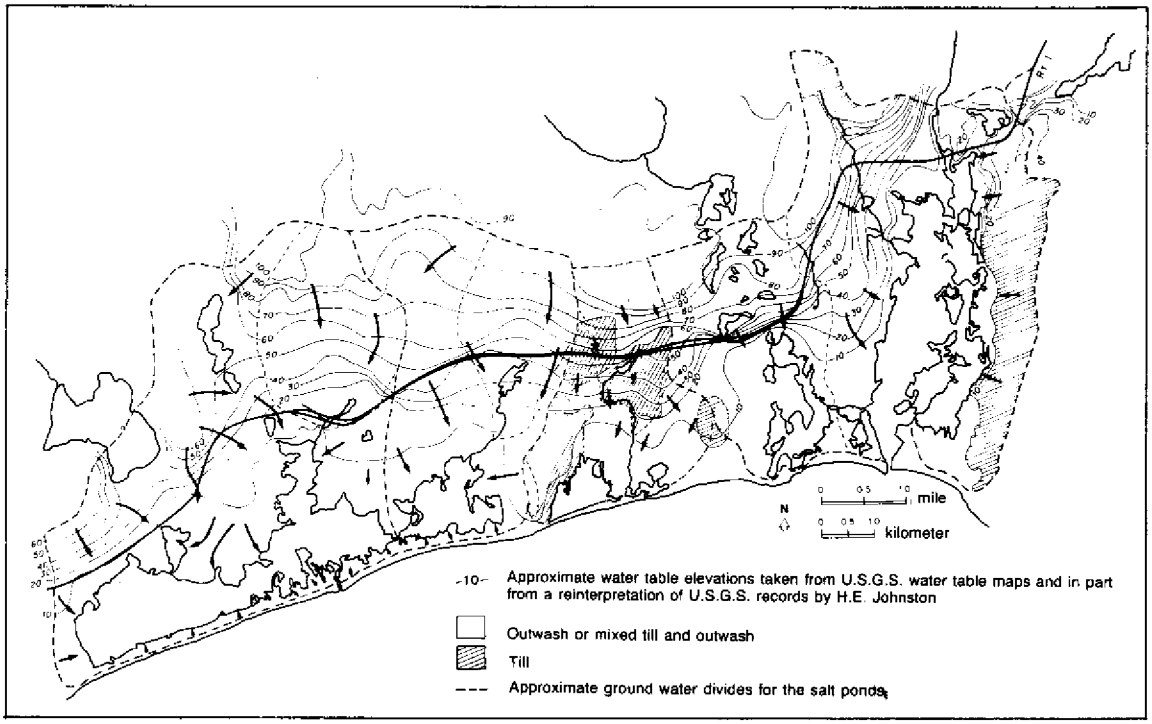


Figure 3-1. Watershed boundaries for the salt pond region. The arrows indicate approximate direction of groundwater flow. Data compiled from U.S.G.S. records by John Grace, 1981.

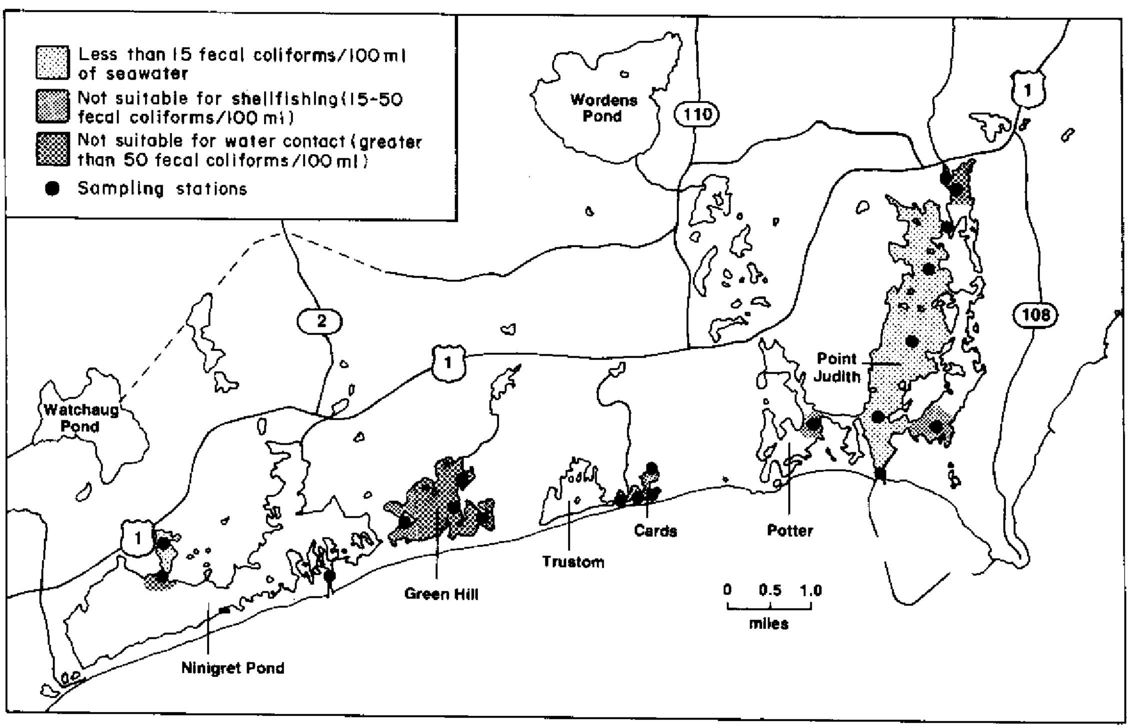


Figure 3-2. Median fecal coliform bacteria concentrations in the salt ponds 1980-1981, June through October. Adapted from Nixon et al., 1982.

sheds of the salt ponds.[11] Most of the ISDS in the region predate the adoption of state standards for the design and construction of modern septic systems.[6] Before state standards were adopted in 1969, domestic wastes were discharged in a variety of ways ranging from makeshift systems to dry wells and cesspools. At present a state-approved ISDS consists of a septic tank and a gravel-filled leaching bed designed and sited in accordance with strict engineering standards.

Watershed	% Houses (1980) Built Before 1969[11]
Pt. Judith and Potter	86
Cards and Trustom	75
Ninigret and Green Hill	54

According to the 1970 Rhode Island census, 49 percent of the houses in the Charlestown salt pond region, 29 percent of the houses in South Kingstown's salt pond region and 42 percent of the houses in the Narragansett salt pond region were seasonal units designed for summertime use only. These houses are being rapidly converted for year-round occupancy, usually without improvements to the sewage disposal system. By 1980 the number of seasonal dwellings in the region decreased by a third.[11]

3. Properly designed and sited septic systems effectively treat the bacteria in domestic waste. However, their useful life is limited, estimated by various studies to average 20 to 50 years.[12] A septic system is judged to have failed when the wastewaters are no longer absorbed below ground level, the system clogs up, and wastewaters pool on the ground surface. Septic systems fail as the capacity of the soil to adsorb effluent diminishes over time, when organics and silt accumulated from years of effluent flow clog the soil pores and the leaching field can no longer filter the wastewaters. According to national studies, it is not unusual for septic systems to fail before their designed lifetime due to lack of maintenance, unsuitable soil characteristics, seasonally high water table, or improperly designed leachfields.[13] Fecal coliforms from ISDS effluents have been documented to move over 200 feet in water-saturated soils or coarse soils with high permeability.[14] Dye studies have shown that septic systems in densely developed surburban areas can be the principal source of bacterial contamination to nearby coastal waters through both surface and subsurface flows.[15]

4. Stormwater runoff is also a significant source of bacterial contamination to the salt ponds, as is evident from the high concentrations of coliforms in the waters adjacent to developed areas after heavy rainstorms.[2] It has been documented that runoff becomes an increasingly important source of bacterial contamination as lands adjacent to coastal waters become densely developed.[9] Road runoff is also a source of several other pollutants including heavy metals, petroleum hydrocarbons, nutrients and sediment.[16]

5. Boats and marinas are seasonal sources of bacterial contamination. During the 1980-81 survey, coliform concentrations were elevated above safe shellfishing standards during the summer in upper Point Judith Pond and Snug Harbor.[2]

310.3 Nutrient Loading and Eutrophication

A. Definition and Extent of the Problem

1. Eutrophication occurs when nutrients, primarily nitrogen and phosphorus, trigger excessive plant growth. This growth can be aesthetically displeasing and a threat to environmental quality. Eutrophic conditions can cause oxygen levels to fall below 4 parts per million, the minimum required by most fish and shellfish to survive.[17] Eventually, fish and shellfish populations decline, waters become weed-choked and murky, the bottom becomes coated with black organic sediments, and anoxic conditions occur that frequently lead to the generation of toxic levels of hydrogen sulfide.

2. It is generally considered that in marine ecosystems nitrogen is the essential nutrient which limits plant growth, while in freshwater ecosystems phosphorus plays the controlling role.[18,19] As estuarine systems, the salt ponds are characterized by a range of habitats, from nearly marine close to the breachways to nearly fresh where stream flow or groundwater enters the ponds. Thus, nitrogen is limiting growth throughout most of the more saline Ninigret and Point Judith Ponds, while both phosphorus and nitrogen limit growth in Green Hill, Potters, Trustom and Cards.[20] In freshwater systems and deep estuaries where free-floating microscopic plants (phytoplankton) dominate, eutrophication is characterized by high nutrient concentrations in the water and a high phytoplankton biomass. It appears that in high salinity shallow estuaries like the salt ponds, however, where seagrasses and large algae dominate, these large plants remove nutrients so rapidly that nutrient concentrations in the water remain low. Fertilization experiments in Ninigret Pond confirm that sustained additions of inorganic nitrogen cause massive blooms of green nuisance algae, particularly of *Ulva* and *Enteromorpha* (Figure 3-3). Although less dramatic, growth of eelgrass was also stimulated by nitrogen additions.[21]

3. Symptoms of eutrophication are locally prevalent in the ponds during the summer months. Large rafts of algae entangle the grassbeds in Ninigret Pond, portions of Point Judith Pond, and Seaweed and Segar Coves of Potter Pond.[22] Dense growth of the green alga *Enteromorpha* occurs around the edges of the ponds, particularly on the southern flats of Green Hill and Potter Ponds.[22] Thick growths of the red alga *Gracilaria* cover parts of the bottom of Ninigret and Point Judith Ponds.[22] During the summer Cards Pond is choked with extensive beds of *Potomogeton*, and the low salinity water of Trustom Pond is murky because of high concentrations of phytoplankton. As temperatures rise in July and August and the algae decay, the amount of dissolved oxygen in the water declines,

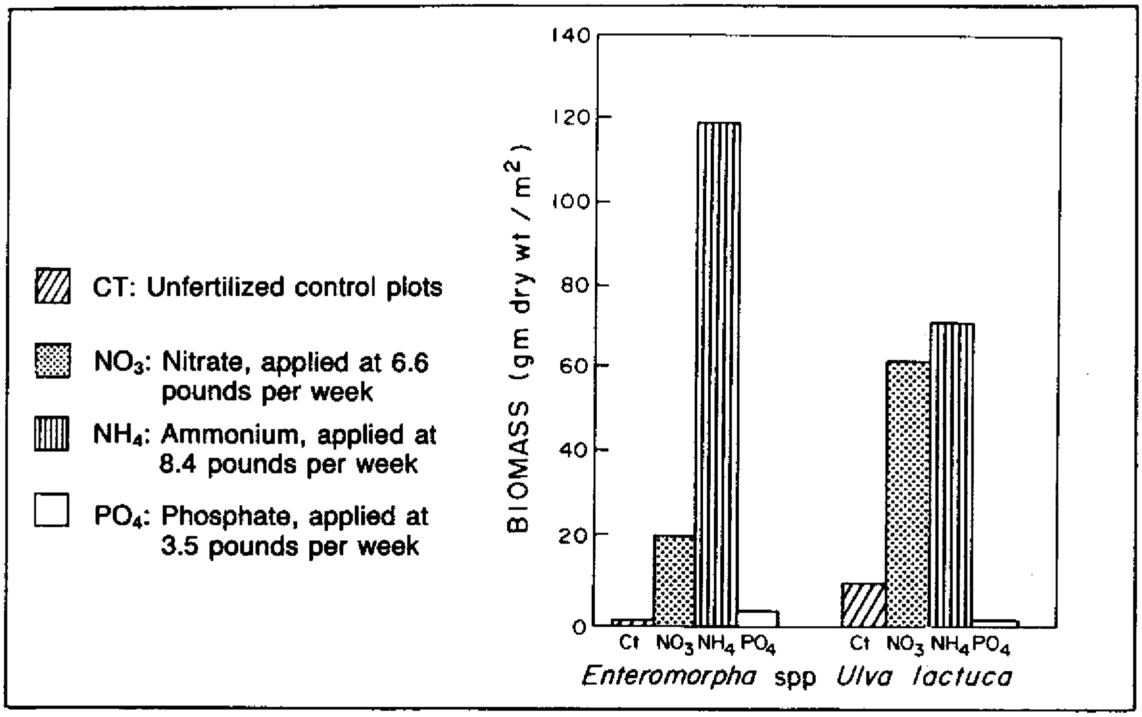


Figure 3-3. Response of green algae in Ninigret Pond to nutrient enrichment during the summer of 1980. Note the dramatic growth response to nitrogen additions compared to phosphorus. Data from Harlin and Thorne-Miller, 1981.

creating anoxic conditions in localized areas, particularly in the more restricted coves. Abundant plant growth decomposes on the bottom and changes the character of the sediment. Clean bottom sands and gravels are covered with organic mud, which decreases the suitability of the habitat for desirable shellfish and finfish. In the upper coves of Point Judith and Potter Ponds, for example, organic content of bottom sediments exceeds 8 percent, a level which is considered typical of eutrophic water bodies (see Chapter Four, Figure 4-3).[23]

4. Extensive sampling of the groundwater reveals that the concentration of total nitrogen beneath densely developed areas is elevated 100 times above the background levels found in areas unaffected by man [24] (Figure 3-4). Nitrogen in the groundwater of the salt pond region is predominantly in the form of nitrate.[24] A high level of nitrate in the groundwater is a public health problem, since groundwater is the sole source of drinking water for public water supplies and private wells in the region. The federal health limit for nitrate concentration in drinking water is 10 parts per million by weight (10 ppm).[25] Higher concentrations are considered a public health hazard and can cause infant cyanosis, a condition where nitrogen rather than oxygen is transported by the blood and the child suffers oxygen starvation which, in severe

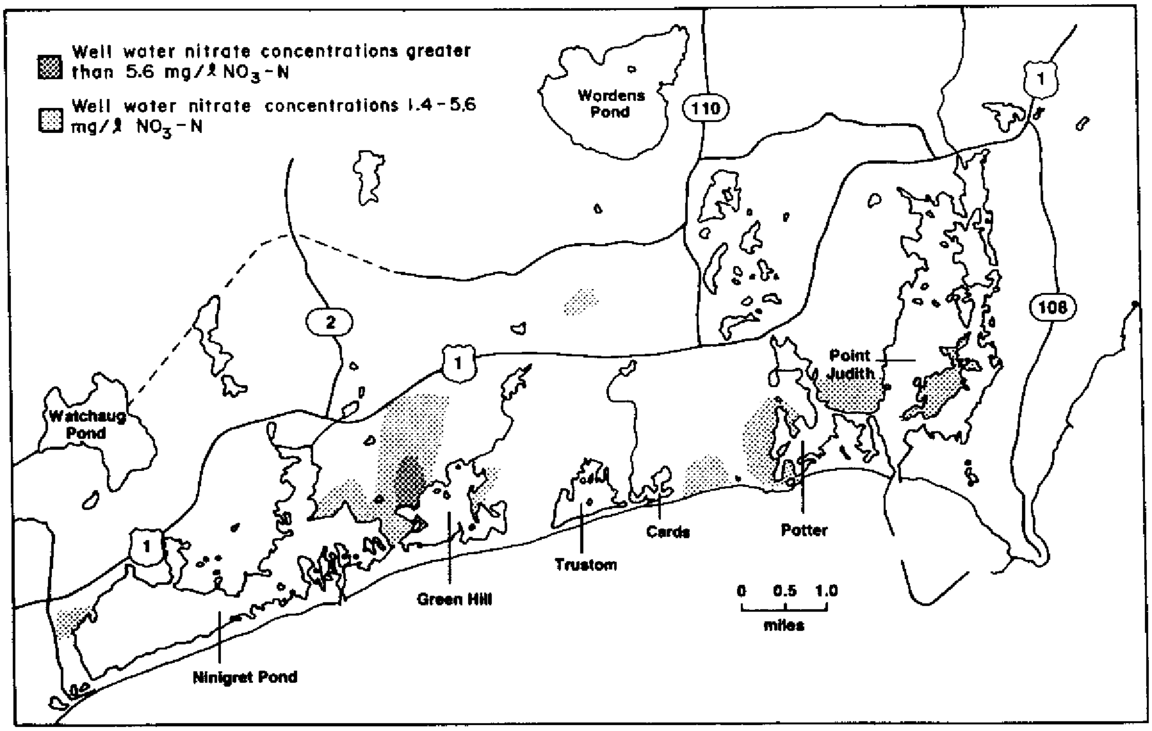


Figure 3-4. Distribution of elevated nitrate concentrations in the groundwater of the salt pond region. Concentrations are in milligrams of nitrate nitrogen per liter (ppm) and are mapped from data taken seasonally of groundwater from over 200 residential wells in the region. From Nixon et al., 1982. (See Figure 3-6).

TABLE 3-2. Preliminary Estimates of Inorganic Nitrogen Inputs to the Salt Ponds (lbs. N/yr.) (from field measurements by Nixon et al. 1982)

Source	Ninigret Pond	Green Hill Pond	Trustom Pond	Cards Pond	Potter Pond	Pt. Judith Pond
Groundwater	66,920	37,080	9,260	13,910	24,317	59,830
Precipitation on ponds surface	7,400	1,860	680	180	1,420	6,790
Storm runoff	500	230	70	150	140	810
Streams	2,800	2,460	0	570	0	16,000
Block Island Sound	6,000	3,000	0	0	in prep.	in prep.
TOTAL	83,620	42,540	10,010	14,820	25,880	83,440

cases, can lead to brain damage or death. In some areas around the ponds, nitrate levels in the groundwater approach, and in a few cases exceed, the national health standard.[24]

B. Sources of Nutrient Enrichment

1. Quantification of the principal sources of total inorganic nitrogen to each of the salt ponds demonstrates that groundwater is the dominant pathway by which nitrogen enters the ponds (Table 3.2).

2. It is evident from extensive research on Long Island and elsewhere that ISDS and lawn and garden fertilizers are predominant sources of nitrogen to the groundwater in residential areas.[9,26,27,28] For a three-person household on one acre of land with 15,050 square feet of lawn and/or garden, the ISDS is the largest source of nitrogen to the groundwater (Figure 3-5). The EPA estimates that the average person produces wastes containing 10 pounds of nitrogen and 3 pounds of phosphate each year.[25] When domestic sewage is discharged to an ISDS, phosphate is readily adsorbed onto soil particles, but approximately half the nitrogen leaves the leaching field in the highly soluble nitrate form and enters the underlying groundwater.[29,30] The gravelly glacial outwash soils that predominate in the salt pond region are particularly susceptible to this process. Nitrate-enriched groundwater then flows toward the ponds through glacial outwash soils at speeds ranging from one to four feet per day.[31]

3. Technologies are being developed that convert the dissolved nitrogen in sewage to nitrogen gas and release it to the atmosphere, a process known as denitrification. One promising design for denitrification units that are capable of removing 80 percent of the nitrogen and nearly 100 percent of the phosphate is being tested in Charlestown.[30] Wetlands are natural denitrifers and can play an important role in reducing the amount of nitrogen transported by groundwater into the salt ponds.

4. An analysis of land use practices in the salt pond region, combined with the predicted loadings taken from the scientific literature for various land use categories, suggests that ISDS effluents and lawn fertilizer are major sources of nitrogen loading to the groundwater.[20] These calculations (see Table 3-3) indicate that for Point Judith and Potter Ponds and Ninigret and Green Hill Ponds, residential development accounts for 80 percent and 75 percent of the annual nitrogen inputs, respectively. Agriculture dominates within the watersheds of Trustom and Cards Pond and is likely to be responsible for most of the nitrogen loading to these two ponds.

Table 3-3. Sources of Inorganic Nitrogen to Groundwater Predicted from Literature Values for Loading and Land Use and Housing Units in the Region in 1981. Loading units are pounds of nitrogen per year.

Watershed	Residential Use	Agricultual Use	Precipitation
Ninigret Pond	32080 (74%)	3863 (9%)	7620 (17%)
Green Hill Pond	31834 (77%)	5438 (13%)	4316 (10%)
Trustom Pond	2376 (31%)	4200 (55%)	1010 (13%)
Cards Pond	5735 (39%)	7763 (52%)	1584 (9%)
Potter Pond	17966 (74%)	3675 (15%)	2651 (11%)
Pt. Judith Pond*	51013 (87%)	2250 (4%)	5783 (9%)

Note: These data were calculated from land use and numbers of houses in each watershed measured from 1981 aerial photos. These data were combined with values for septage and lawn fertilizer loadings estimated by EPA and the Long Island "208" Program. Agricultural loadings were based on application rates as reported by local farmers, combined with loss factors estimated by Dr. William Wright, URI Department of Natural Resources.

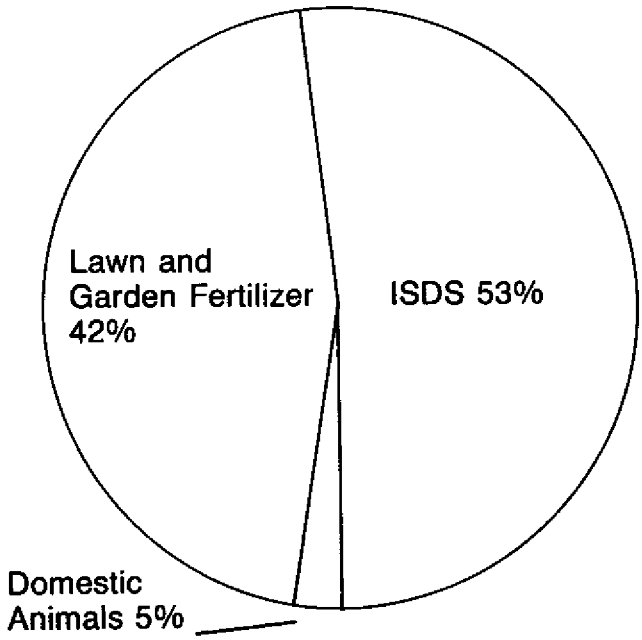


Figure 3-5. Estimated sources of nitrate nitrogen to groundwater from residential development. Based on loadings reported in the Long Island 208 Plan (1978), this figure shows the nitrate input from an average household of 3 people with 15,050 square feet of lawn and garden.

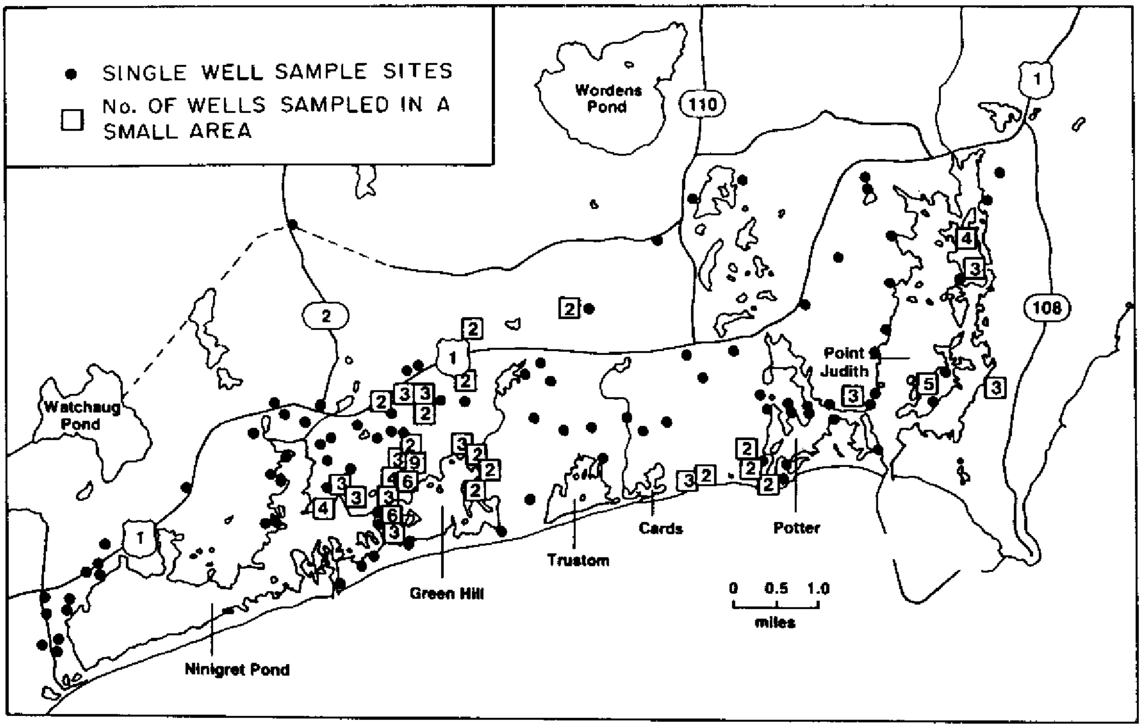


Figure 3-6. Distribution of groundwater sampling wells in the salt pond region. Numbers in boxes indicate the number of wells sampled in a small area. Nixon and Nowicki, 1982.

5. The nitrogen loading to the salt ponds calculated from values provided by the scientific literature for ISDS, residential fertilizers and other sources, and a detailed analysis of land use in 1980 yields estimated groundwater nitrate concentrations which are in good agreement with field measurements of nitrate levels in 200 wells sampled seasonally throughout the region (Figure 3-6).[2]

6. If there is no further residential development in the salt pond region and no steps are taken to address present problems, we may expect further declines in water quality. As ISDS failures become more frequent, coliform concentrations in the salt ponds are likely to cause the incidence of polluted wells to increase. The slow rate at which groundwater moves toward the ponds suggests that the impact of much recent development in the watersheds is not yet being expressed as increased annual loadings of nitrate to the ponds. The extent of eutrophication is, therefore, also likely to become more severe even if no additional houses are built in the salt pond region.

310.4 Future Trends

A. Additional Development in the Region

1. Further development throughout the region is inevitable. Estimates for saturation development based on current zoning, and

accounting for the number of grandfathered substandard lots and such constraints on development as wetlands and poorly draining soils, are shown in Table 3-4. These estimates are theoretically achievable and are a worst case under current zoning. They suggest that the number of residential units in the region could triple and that the human population could increase seven to ninefold.[11]

2. A seven to ninefold increase in the resident population is expected to increase nutrient loadings (Table 3-5) to the ponds and trigger more widespread eutrophic conditions. In densely developed areas the levels of nitrate in drinking water are already high and are projected to reach concentrations which would make it necessary to build public water systems. Further development anywhere in the region poses problems of increased nutrient loadings to the ponds and major issues concerning the region's capability to provide potable water and and absorb domestic wastes. Some areas are more susceptible to new development than others. Of major concern are areas of potential public water supply and as yet undeveloped tracts adjacent to poorly flushed portions of the salt ponds that are particularly susceptible to bacterial contamination and eutrophication (see Figures 3-7, 3-8, 3-9).

3. The Rhode Island 208 Program recommends a baseline minimum lot size of two acres in Charlestown and South Kingstown where wells and sewage disposal are on-site.[32] This base density for self-sustaining environments has, however, already been exceeded in many areas close to the ponds where houses are crowded together on 1/8 to 1/4 acre lots. In these areas nitrate concentrations in the underlying groundwater are high, many wells are polluted with bacteria, and adjacent pond waters frequently show the greatest evidence of pollution.[20] Every effort must be made to reduce the sources of pollution in these areas. Aquifers that are capable of providing a potable water supply to these communities must be protected. Lands upflow of densely developed areas should be developed at as low a density as possible so as to minimize the nitrate concentration in groundwater before it reaches those highly stressed areas. For these reasons the URI Coastal Resources Center has urged Charlestown and South Kingstown to amend their zoning plans to provide for as large lots as possible in areas of potential water supply and upflow of densely developed lands.[33,34]

B. Maintenance and Improvement of ISDS Systems

1. The life of an ISDS and the effectiveness with which the system treats sewage may both be substantially improved by regular pumping of the septic tank. The Rhode Island 208 Program recommends pumping every three years.[32]

2. A major problem in the salt pond region is that many homeowners are unaware of how their wastes are being treated and do not realize that an ISDS should be regularly maintained. South Kingstown offers rebates to encourage pumping, but this has not

TABLE 3-4. The Potential for Increases in Residential Units in the Salt Pond Region at Saturation Development

Watershed	Houses in 1980	Houses Projected at Saturation	Increase Factor
Ninigret	1,228	4.816	3.9
Green Hill	1,223	3,850	3.1
Trustom	80	246	3.1
Cards	202	1,095	5.4
Potter	755	1,902	2.5
Pt. Judith	2,028	5,050	2.5
Total Region	5,516	16,959	3.1

Note: Estimates of saturation development are based on a tabulation of lots of record (1983) and a determination of potential building sites in the salt pond region.

Tabulation of Existing Lots of Record: Tax maps and assessment records were used (vacant lots in existing "grandfathered" subdivisions). Zoning maps (1983) were consulted to determine the zoning category of vacant lots in developed areas.

Determination of Potential Building Sites: Lots in existing platted subdivisions were counted in each town. Lots of less than the applicable zoned lot size were counted as buildable lots in cases where lots were in separate and non-contiguous ownership. Contiguously owned lots were combined to conform as much as possible with present zoning categories. In developed areas lots exceeding minimum lot size were reviewed to see whether they could yield additional building sites. In undeveloped areas the acreage in large lots were recorded and divided by the applicable minimum zoning lot size, and adjusted for road requirements. Lots which were publicly owned and used for conservation purposes, such as the Federal Wildlife Refuges, state salt marshes, beach areas, and wildlife management areas, were not included in the calculation. Lots which occupied the sites of wetlands as presented in the National Wetlands Inventory, 1980, in excess of 3 acres were not included in the calculation since they are protected by state wetlands protection laws and ISDS regulations.

TABLE 3-5. Projected Nitrogen Loading to the Salt Pond Watersheds at Saturation Development. Loading Units are in Pounds Per Year and Nitrate Concentrations in Groundwater are in Parts Per Million.

Source	Ninigret Pond	Green Hill Pond	Trustom Pond	Cards Pond	Potters Pond	Pt. Judith Pond
Residential	119,975	94,313	5,216	30,348	50,753	153,757
Septic	72,240	57,750	3,690	16,425	28,530	101,775
Lawns	41,811	31,827	1,223	12,576	19,884	43,636
Pets	5,924	4,736	303	1,347	2,339	8,346
TOTAL	119,975	94,313	5,216	30,348	50,753	153,758
Agricultural fertilizer	0	0	0	0	0	0
Precipitation	7,620	4,316	1,010	1,584	2,651	5,783
Total Loading	127,595	98,629	6,226	31,932	53,404	159,540
Estimated Groundwater Concentration At Saturation Development	5.1	6.9	1.9	6.1	6.1	7.4

Note: The estimated concentrations of nitrate in groundwater at saturation development are average values in each watershed. Nitrate concentrations were already at the 1-5 ppm range by 1981 in many densely developed areas. Here additional loadings are expected to result in nitrate concentrations in the 10 ppm range.

brought an appreciable increase in this form of maintenance. Another problem is that people are reluctant to report on a neighbor whose system is failing. At workshops on this plan, residents of the older, densely developed communities around the ponds have acknowledged that ISDS failures are common during the summer season and that even direct discharges to the ponds exist, but they are very reluctant to report these problems to the authorities.

3. The DEM Division of Land Resources issues permits for ISDS to insure that minimum standards are upheld in the siting, design and construction of such systems. According to state regulations, an ISDS must meet siting standards that include a minimum depth to groundwater, a minimum and maximum soil percolation rate, and setbacks from lot lines, drinking water wells, wetlands and coastal features.[35] These standards relate primarily to public health considerations. The CRMC regulates ISDS for their potential impacts on the coastal environment.

4. Alternative technologies for small-scale waste treatment are being used successfully by communities throughout the country and by at least one housing complex in the salt pond region.[36] When these systems are properly maintained, they provide important alternatives for wastewater treatment problems in localized areas. A variety of types of treatment are available, ranging from package sewage treatment systems for clusters of development to facilities designed for individual dwellings. The DEM does not encourage such package systems, since experience in both Rhode Island and Massachusetts demonstrates that many of those systems fail or are prone to problems. The poor record is attributed to lack of maintenance and poor operating procedures.

5. In response to the need for regular maintenance and, where necessary, repair and replacement of ISDS in the salt pond region, the DEM, the CRMC and the local town governments are working together on: (1) delegation of authority to local governments for ISDS maintenance programs and identification of failed or substandard systems, (2) faster response by state agencies to reported failures, (3) the establishment of standards for rehabilitation of substandard systems, (4) options for municipally owned package sewage treatment plants, and (5) public education programs and identification of sources of funding for ISDS repair.

C. Public Sewer Systems

1. A common response to the pollution of surface water bodies and groundwater by suburban development is to build sewers. Sewers, however, are too expensive to be a realistic solution for much of the region, and they raise another set of issues.

Once an area is sewered, many of the constraints that presently limit development disappear (soils that meet percolation standards, minimum distances between ISDS and wells or roads). The experience of many communities nationwide demonstrates that sewer systems encourage high density development and increase runoff contamination of adjacent water bodies[25,32] Increased runoff may be expected to carry sediments, nutrients,petroleum, metals and other contaminants to the ponds. Sewers are an appropriate solution for urban areas where other alternatives are no longer available, but not for areas where less dense development is a feasible and desirable alternative.

D. Public Water Systems

1. A common response to widespread groundwater pollution is to construct public water systems. This option, however, brings the problems that sewer construction entails; it encourages development, and is expensive to build and maintain. Increasing the level of development increases the likelihood of polluting the region's groundwater which supplies both public water systems and private wells. If contaminated, groundwater aquifers in the region would require hundreds of years to recharge and cleanse pollutants. There are no significant alternative sources of drinking water within the salt pond region. When groundwater supplies on Long Island became contaminated with high nitrate levels from dense suburban development in the 1970s, municipalities drilled through clay layers to a deeper uncontaminated aquifer.[9] There is no such option in the salt pond region, where the glacial aquifer extends down to bedrock.

2. Providing freshwater systems for expanding residential development has the additional problem of altering the flow of fresh water into individual salt ponds. A public water supply system that draws from the watershed of one pond and exports it to the watershed of another alters the flow of freshwater to the two ponds. This can have potentially profound impacts on their ecology. The wells that supply the existing South Shore Water System presently withdraw 6 percent of the freshwater flow to Green Hill Pond.[20] If all the houses that can legally request tie-ins to the existing water mains do so, the annual freshwater flow to Green Hill will be reduced by 17 percent, and the freshwater inflow increased to other ponds to the east.[20]

E. Buffer Zones

1. Undisturbed zones along the perimeter of salt ponds, their tributaries and associated wetlands play an important role in preserving the qualities of the coastal environment. These benefits are summarized in Section 150 of the R.I. Coastal Resources Management Program and include erosion control, checking the flow of pollutants, protection of flora and fauna, and the preservation and enhancement of scenic qualities. Wide buffer zones will

be particularly important on lands designated in Figures 3-7, 3-8 and 3-9 as Lands of Critical Concern. These as yet undeveloped or sparsely developed tracts abut poorly flushed portions of the salt ponds, which are therefore particularly susceptible to pollution. Their undisturbed shorelines are valuable natural habitats with high scenic values. Wide buffer zones are also needed in these areas to minimize flood damage, and have the additional benefit of protecting the numerous archeological sites that are clustered along the pond's shorelines.

2. Many states require or recommend buffer zones of widths ranging from 150 to 1,000 feet to protect water bodies from pollution. Buffers 100 to 300 feet wide are recommended to protect surface water bodies from sedimentation and 300 to 1,000 feet are recommended for 50 percent to 90 percent nutrient removal from runoff waters.[40,41,42,43,44] The Rhode Island 208 Program recommends a minimum buffer width of 100 feet along all ponds and streams, and a minimum of 300 to 400 from critical areas such as public water supplies. According to surveys conducted by the R.I. Historic Preservation Commision, around Potter Pond two-thirds of the important archeological sites are within 650 feet of the shoreline and 80 percent of the artifacts within 300 feet of the shoreline.[45]

310.5 Other Contaminants

A. A great number of substances, if present at sufficient concentrations, can be toxic to people or salt pond organisms. In the salt pond region, where residential and recreational uses dominate, candidate pollutants in drinking water include the chemicals from septic system "conditioners," petroleum hydrocarbons from leaking fuel oil and gasoline storage tanks, leachate from sanitary landfills, herbicides and pesticides.[9]

B. There is growing recognition nationally that underground storage of petroleum is a serious threat to groundwater quality.[37] As buried gasoline or heating oil tanks age and corrode, they develop leaks that are difficult to detect. The average life span of underground petroleum storage tanks is estimated to be 20 years. There have already been several cases in Rhode Island where petroleum leaking from a storage tank has contaminated drinking water aquifers.[37] The Department of Environmental Management is taking steps to regulate commercial underground petroleum storage tanks in order to protect groundwater resources statewide.[38]

C. In the ponds, petroleum hydrocarbons, copper from antifouling paint, creosote from pilings, and a variety of substances carried by surface runoff can degrade water quality. These pollutants have not been assessed in the salt pond region, but it is evident from studies done elsewhere in the nation that they are potentially important.[25,32]

320. MANAGEMENT REGULATIONS AND INITIATIVES

320.1 Land Use Classification for Watershed Protection

See Figures 3-7, 3-8, and 3-9.

A. Self-sustaining Lands

1. Definition. These lands are undeveloped or developed at a density of not more than 1 residential unit per 2 acres. In these areas, the nutrients released to groundwater by ISDS, fertilizers and other sources associated with residential activities may be expected to be sufficiently diluted to maintain potable groundwater.

2. Management Policies and Regulations

(a) In order to be in conformance with this plan, subdivisions shall not exceed a density of 1 residential unit per 2 acres.

(b) Cluster development is recommended as a means to preserve open space, aesthetic qualities, and agricultural lands, reduce the costs of development, and minimize the environmental impacts of development. For CRMC purposes, the number of units in a cluster shall be calculated on the basis of developable land within the subdivision in accordance with all DEM regulations and local ordinances, and exclude wetlands, soils that do not meet ISDS standards, and lands included within setbacks from lakes, stream beds and wetlands.

(c) Public water service is considered a low priority. Where a public water supply is deemed necessary, the source wells and the distribution lines shall remain within a single watershed (as defined in Figure 3-1) and not divert groundwater from one salt pond watershed to another.

(d) Sewers are prohibited.

(e) Where lands in this category abut salt ponds or their tributaries, a wide buffer zone shall be provided in accordance with Section 150 of the Coastal Resources Management Program, as amended.

B. Lands of Critical Concern

1. Definition. These lands are undeveloped or developed at a density of not more than 1 residential unit per 2 acres and (a) abut sensitive salt pond areas that are particularly susceptible to eutrophication and bacterial contamination and/or (b) overlie aquifer recharge areas for existing or potential water supply wells.

2. Management Policies and Regulations

(a) Policies and regulations (a) through (d) above apply.

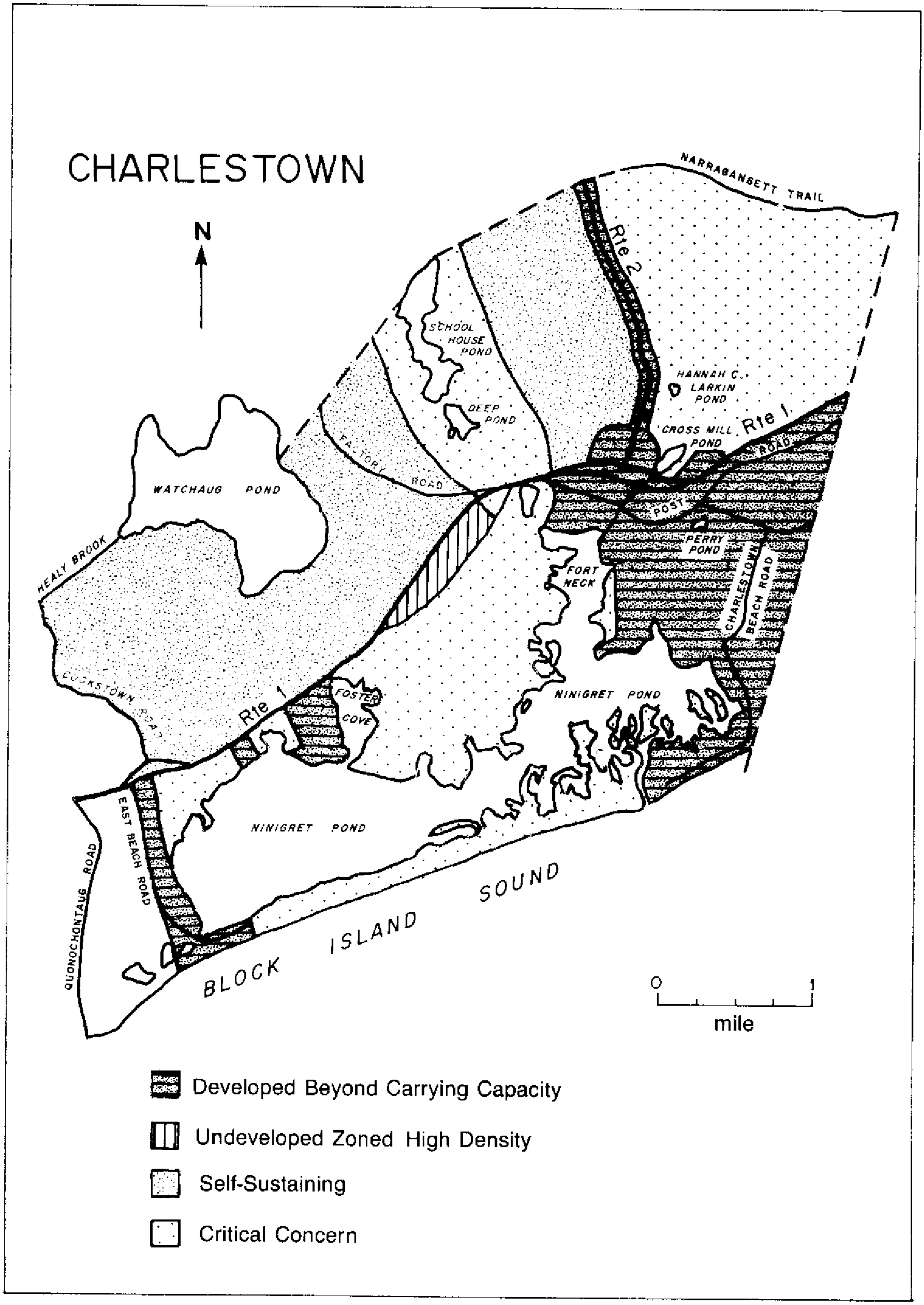


Figure 3-7. Land use classification for water quality protection in the town of Charlestown.

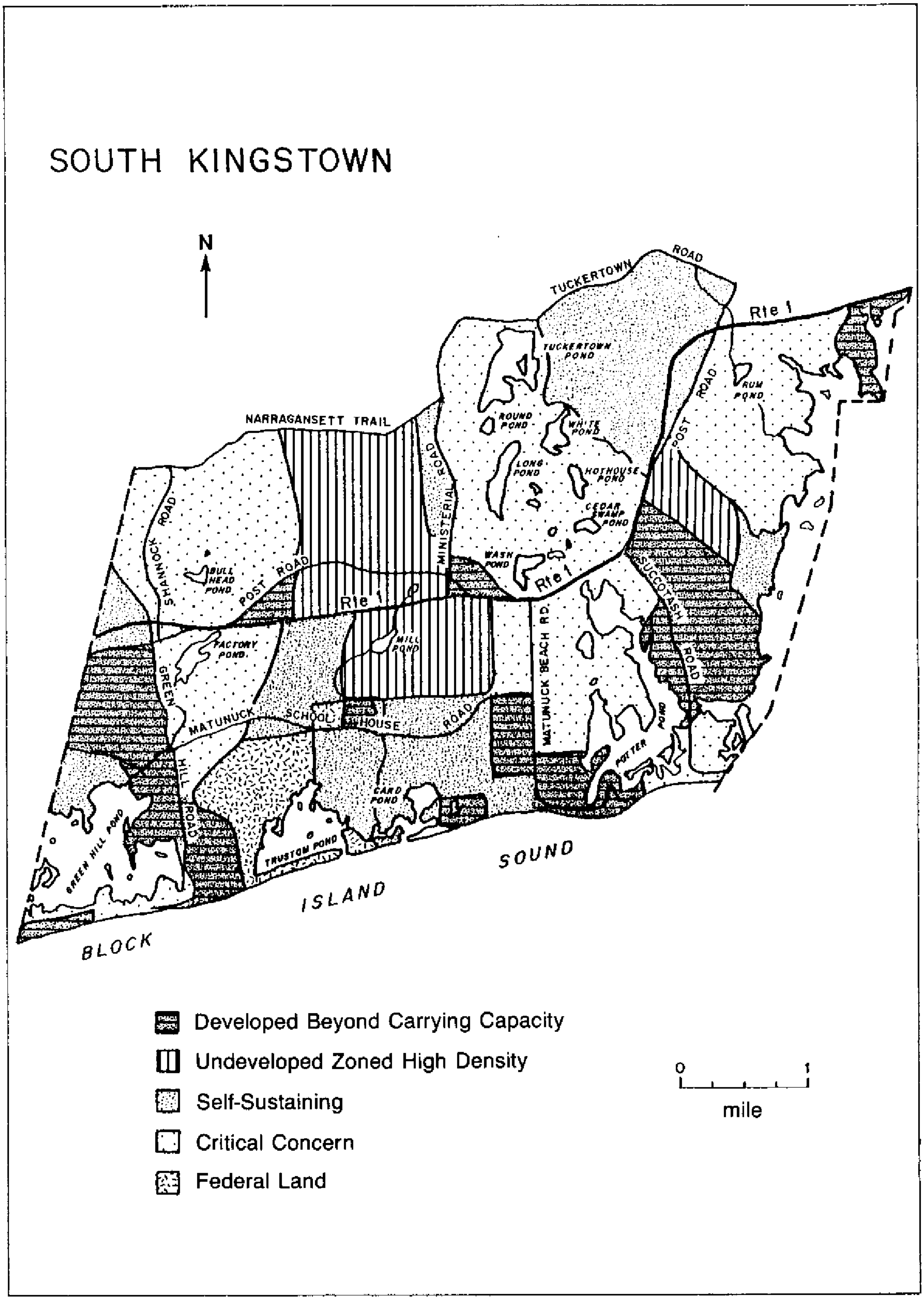


Figure 3-8. Land use classification for water quality protection in the town of South Kingstown.

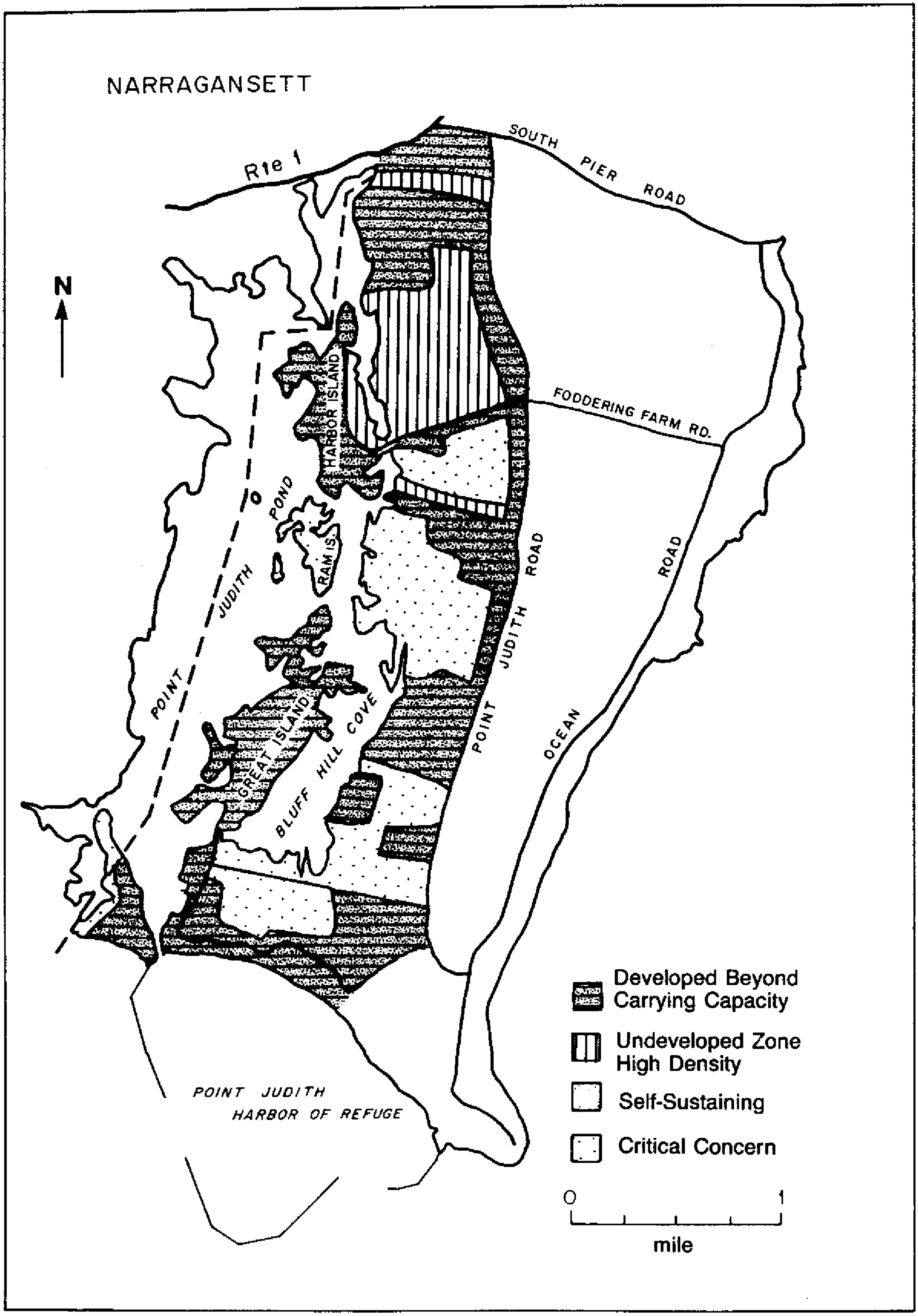


Figure 3-9. Land use classification for water quality protection in the town of Narragansett.

(e) These areas are priorities for additional measures to minimize pollution loadings from development through acquisition, conservation easements, tax relief and aquifer protection ordinances.
(f) A 200-foot-wide natural buffer zone shall be provided in those areas that abut the salt ponds, their tributaries and contiguous wetlands.
(1) Activities permitted within the buffer strip may include the cutting and maintenance of foot paths and rights of way, selective thinning of trees, placement of duck blinds, and, in Type 2 waters, one dock per lot of record as of January 1983.
(2) Activities prohibited within the buffer strip include the construction of buildings, sewage disposal systems or leachbeds, surfaced roadways, culverts, bulkheads, riprap and lawns. Fertilizers shall not be applied within buffer zones except where necessary to establish vegetation in areas that are eroding or need to be restored.
(g) Denitrification units shall be required in accordance with Section 320.2B.

C. Lands Already Developed Beyond Carrying Capacity

1. Definition. These lands are developed at densities above carrying capacity, frequently at one residential or commercial unit per 1/8 to 1/2 acre. Such intense development is the major source of contamination to groundwater and the salt ponds. High nutrient loadings and contaminated runoff waters are resulting in a high incidence of polluted wells and increasing evidence of eutrophic conditions and bacterial contamination in adjoining salt pond waters. Most of the individual sewage disposal systems in these areas predate state-enforced siting and design standards and are approaching their expected life span.

2. Management Policies and Regulations

(a) Regular maintenance and, when necessary, the upgrading of ISDS are of the highest priority in unsewered densely developed areas (see Section 320.2C).
(b) Densely developed lands on Great Island and Harbor Island in Narragansett and at the northern end of Point Judith Pond in South Kingstown are in close proximity to existing sewer lines; in these areas extension of sewer service is a priority.
(c) Public water service is a high priority. Where practical, the supply wells and service areas for public water supplies shall be kept within individual watersheds; the export of groundwater from one watershed to another shall be minimized.
(d) Buffer zones along the perimeter of salt ponds and tributaries shall be negotiated by the CRMC in accordance

with Section 150 of the Coastal Resources Management Program, as amended.

D. Undeveloped Lands Zoned for High Density Development

1. Definition. These as yet undeveloped lands are zoned or subdivided for residential or commercial development at a density of 1 acre or less. Such dense development is expected to become a source of contamination to the groundwater and the salt ponds.

2. Management Policies and Regulations

(a) Regular maintenance and, where necessary, the upgrading of ISDS are high priorities in unsewered areas (see Section 320.2C).
(b) Sewers shall not be permitted by the CRMC in lands of this category along the eastern shore of Point Judith Pond.
(c) Wide buffer zones abutting salt ponds, their tributaries and contiguous wetlands shall be negotiated by the CRMC in accordance with Section 150 of the Coastal Resources Management Program.
(d) These are priority areas for amendments to zoning plans to provide for a minimum 2 acre lot size, conservation easements, and cluster development.
(e) Denitrification units shall be required in accordance with Section 320.2B.

320.2 Controls to Minimize Sources of Pollution

A. Point Sources of Runoff

1. Definition. A point source of runoff is a direct discharge of rainwater, melted snow or irrigation water to a salt pond or tributary stream through a pipe or similar conduit.

2. Management Policies and Regulations

(a) New or enlarged point discharges of runoff to the salt ponds and their tributaries are prohibited.
(b) Drainage swales or holding basins shall be designed to permit sediments to precipitate and runoff water to be cleansed as it moves through the soil and then to an adjacent waterbody. Drainage swales and basins shall be regularly maintained and cleaned of sediment and obstructions.
(c) Priority sites for construction of drainage swales to treat existing major discharges of highway runoff are identified on Figure 3-10 and shall be required by the CRMC when these roadways are upgraded.

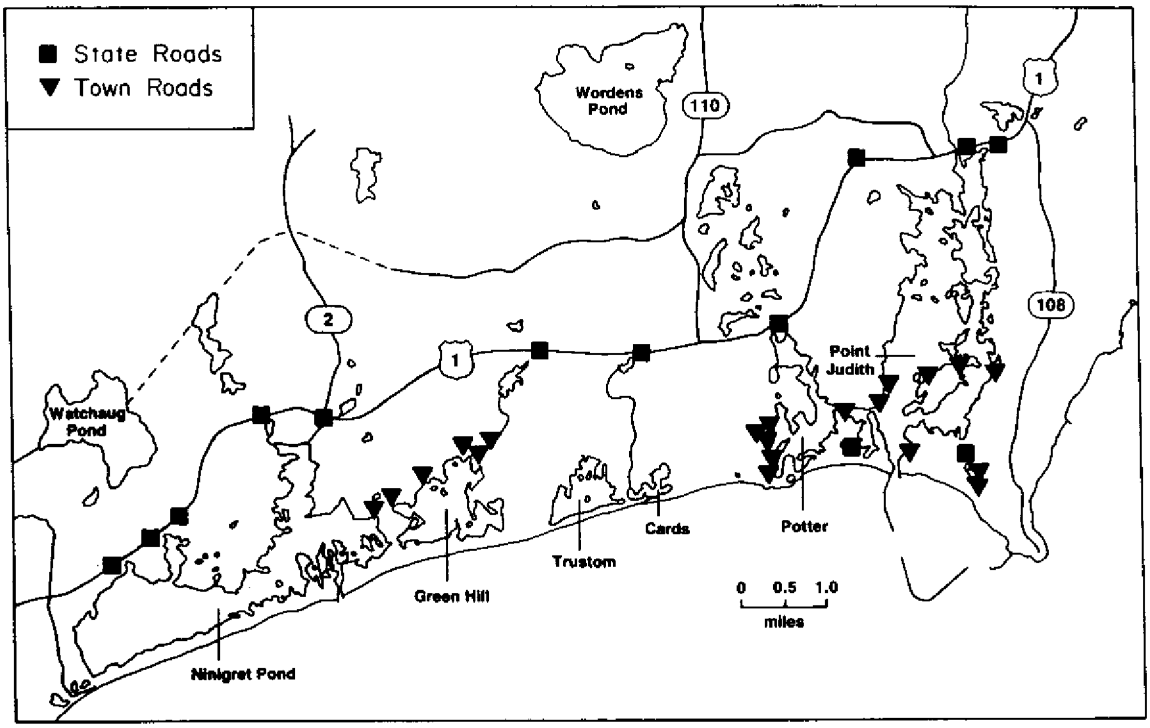


Figure 3-10. Direct discharges of stormwater runoff from roads and highways in the salt pond region.

B. <u>Denitrification of Domestic Sewage</u>

1. Definition. Denitrification is that process by which the nitrogen in sewage is converted to nitrogen gas and released to the atmosphere.

2. Management Policies and Regulations

(a) The CRMC shall evaluate the effectiveness and maintenance requirements of denitrification systems suitable for use with ISDS by September 1985. If such systems are found to significantly reduce nutrient loadings to groundwater they shall at a minimum be required for all new and upgraded ISDS in Lands of Critical Concern (Section 320.1B), Lands Already Developed Above Carrying Capacity (Sec. 320.1C) and Undeveloped Lands Zoned for High Density (Section 320.1D).

C. <u>ISDS Upgrading and Maintenance</u>

1. ISDS Upgrading. A large proportion of the ISDS in the salt pond region predate state construction standards, and many are approaching the expected life span of an ISDS. Densely developed

older communities are the priority sites for upgrading and replacing existing ISDS. With technical assistance from the DEM Division of Land Resources (ISDS office), the municipalities are encouraged to target problem areas for intensive educational programs and phased replacement of failed or substandard ISDS. Tax credits could be provided to help offset the expense to homeowners, and federal funds may be available to provide low interest loans or grants for such initiatives.

2. ISDS Maintenance Pumping Program. The municipalities are encouraged to support educational programs such as those initiated by the Action Committee (Section 320.3A) and to promote regular maintenance pumping of ISDS systems within the salt pond region. Economic incentives such as municipal tax rebates or reduced community rates from private pumpers are important incentives for the success of such a program. Educational material should be distributed to inform residents of the importance of maintaining their ISDS systems, how such maintenance should be carried out, and the role of effective on-site sewage treatment in maintaining potable groundwater and reducing the risks of bacterial contamination and eutrophication in the salt ponds. The program may include pamphlets, workshops, site visits by DEM officials and media spots.

D. Control of Pollution from Petroleum Storage Tanks

1. Definition. In-ground petroleum storage tanks include tanks for gasoline, heating oil, diesel fuel or other petroleum compounds for commercial establishments and for household use.

2. Management Policies and Regulations

(a) Burial of domestic fuel oil storage tanks is prohibited in the salt pond region.
(b) All persons proposing to install a buried storage tank for gasoline, fuel oil or other petroleum product, or any other substance defined as hazardous by DEM shall apply for a CRMC permit. Applicants shall be required to demonstrate an adequate construction design and means for monitoring for leakage, and shall replace all leaking tanks according to standards set forth in DEM regulations for underground storage facilities for petroleum products.[38]

E. Pump-Out Facilities at Marinas

The Coastal Resources Management Council shall seek to make provisions for the installation of sewage pump-out facilities for recreational craft and appropriate pretreatment at the head and mouth of Point Judith Pond. Those facilities shall be reqularly maintenance-pumped or connected to public sewer lines.

F. Oil Spill Contingency

Oil spills shall be treated in accordance with the Rhode Island Oil Spill Contingency Guide.[39]

1. Point Judith and Potter Ponds. A spill in lower Point Judith Pond should if possible be contained within the port area. However, there are both substantial fishing boat traffic and strong currents in the port which will complicate oil cleanup operations. In many cases the best practical containment strategy if oil enters the lower pond will be to divert oil to the shore on the Jerusalem side of the channel. Every effort shall be made to keep the oil from entering Potter Pond through Goosebery Hole or East Pond under the Great Island Bridge.

2. Ninigret and Green Hill Ponds. Every effort shall be made to deflect an offshore oil spill away from the breachway and the ponds and toward the ocean beaches. The fast currents in the breachway make it a difficult place to deploy booms or mops. If oil cannot be kept out of the breachway, it should be contained along the banks just inside the breachway where the channel widens and currents are slower. A boat launch ramp and access for heavy equipment are available from the parking lot on the east side. Sand from the area should be used to block small channels and create impoundments.

3. Trustom and Cards Ponds. Since these ponds are only temporarily breached, there is little danger of oil entering them. If a spill occurs when the breachways are open, every effort should be made to fill them in with sand from the adjacent beach.

320.3 Public Education Programs and Future Research

A. Public Education

The CRMC recognizes that public education is one of the most effective means for decreasing pollution loadings and preventing contamination in the salt pond region.

A priority for the Action Committee shall be to initiate a public education program to set forth what a homeowner and developer can do to minimize pollution in the salt pond region. Such a program would include educational materials explaining how septic systems work and why they should be routinely maintained (Section 320.2C); the importance of minimizing use of fertilizers, pesticides and herbicides; the option of seaweed harvesting and its use as a garden fertilizer, and techniques to minimize runoff.

B. Further Research

The CRMC recognizes that further research is needed to help protect the salt ponds. As funding becomes available, research priorities shall include the following:

- Small-scale community sewage treatment systems. Optimal design, maintenance, and siting requirements need to be investigated to evaluate whether these systems may be used to improve the water quality problems that exist in densely developed areas. Portions of the south shore drain offshore instead of into the ponds and they should be considered as sites for multi-unit systems using inground discharge to leaching beds to dissipate treated waters.

- Future sources of drinking water. The sites and estimated yields for systems to supply lands developed above their carrying capacity should be identified.

- Elimination of nuisance algae. The possibility of removing unaesthetic algal growth from the salt ponds should be evaluated.

- Runoff control. As the pond region becomes more developed, runoff will become a larger source of contamination to the ponds and their tributaries. Much work is needed to assess pollutant loadings from runoff and to develop cost-effective means to control and purify this source of pollution.

- Understanding the causes of eutrophication. More research is needed on the dynamics of eutrophication in shallow, saline estuarine systems dominated by macrophytes. Research utilizing microcosms is likely to be particularly useful.

- Long-term monitoring of water quality parameters. Monitoring and research projects by the University, state agencies, and other institutions should be encouraged. A data bank for water quality information accessible to management agencies and the research community should be established and maintained.

Chapter Four.

Breachways, Channels and Sedimentation

Jon C. Boothroyd

410. FINDINGS OF FACT

410.1 The Breachway Problem

A. The permanent alteration of the breachways that connect the ponds to the ocean and one pond to another have brought greater changes to the ecology of the ponds than any other human activity. Permanent breachways and associated dredging have changed the ecology, chemistry and biology of the ponds by increasing the rate at which sand accumulates within them and radically altering their salinity and flushing characteristics.[1]

B. It is difficult to balance the benefits of maintaining breachways and channels for boat access and the flushing of polluted waters against the costs of increased sedimentation and changes to fisheries habitat. A lack of appreciation for the complexity of the changes brought by such actions has produced management issues that defy easy solution. As human activities in the ponds increase, pressure will mount to make further changes to breachways and channels. These will require careful evaluation if further miscalculations of their eventual impacts are to be avoided.

410.2 The Evolution of the Breachways

A. The coastal barriers that lie between the salt ponds and the ocean are dynamic features that are constantly being reshaped by wave action and gradually rising sea level. In the 1700s all the ponds, including Green Hill and Potter, had their own direct, seasonally open connections to the ocean. Coastal vessels could negotiate both the Point Judith and Ninigret breachways. Subsequent hurricanes have eroded the shoreline, shifted the breachways and deposited large shoals in the ponds.

B. During the 1800s and early 1900s all the salt ponds were managed with great skill by the local fishermen-farmers to maximize harvests of oysters, white perch, bass and alewives. The key to this form of aquaculture was how they manipulated the breachways. The basic pattern was to open the breachways in the spring, when water levels in the ponds were high, salinity low, and large populations of alewives, flounder and bass had to migrate between the ponds and the ocean. Usually the breachway would remain open through the summer and fall. If not, the breachways were redug in order to keep salinities in the ponds high enough to optimize the growth and flavor of the abundant oysters and to permit the passage of migrating fish. In the winter the breachways would close, sealed off with sand carried by longshore currents and storms. The water level in the ponds would then rise, and salinities would fall until the ponds were breached again in the spring.[2]

C. The first permanently stabilized breachway was built at Point Judith Pond. By the late 1800s the extensive oyster beds in that pond were declining, due, it was believed, to a rapid accumulation of silt within the pond. The solution was thought to lie in increasing the flushing by building a permanent breachway. The benefits in terms of increased commerce were probably the principal motivation, but the official arguments focused on "restoration of fisheries."[2] The work began in 1902, and by 1910 Point Judith was permanently connected to the Harbor of Refuge by a large navigable breachway. This made the way for subsequent dredge and fill projects that formed the harbor that exists today. The seasonal breachway between Potter and the ocean was allowed to fill in. A man-made channel was dredged a third of the way up the pond connecting Potter to Point Judith through Gooseberry Hole.

D. By the late 1930s, the oyster beds in Point Judith had virtually disappeared, but this did not prevent the same arguments for enhancing fisheries from being used in the 1950s to justify building a stabilized breachway for Ninigret Pond.[3] Once again, the principal motivation, however, was to improve boat access to Block Island Sound. The present breachway and jetties were built by the state in 1952, and in 1962 the so-called Link Channel was dug to provide a direct boat route to the breachway from Green Hill Pond. Direct connections between Green Hill and the Sound have not been dug since the 1940s.

410.3 Impacts of the Permanent Breachways

A. The effects of changing the breachways have been far-reaching, and, with few exceptions, the benefits that the permanent breachways were to produce have not materialized. The first obvious change was that the water level in the ponds equilibrated with sea level and this produced a loss of two to three feet in water depth in the ponds.[4] Permanent breachways brought other major changes to the hydrology of the ponds, including more rapid flushing and periodic episodes of extremely low water when sustained northwest winds in the winter months force much of the water out of the ponds. Alterations in water circulation have been accompanied by a shift to sustained high salinity from the seasonally pulsed highs and lows characteristic of the pre-breachway era. These changes have had a dramatic impact on the ponds as habitats for fish and wildlife. Before permanent breachways were built, dense "meadows" of widgeon grass grew over large areas of Ninigret, Green Hill, Potter and Point Judith. This is a preferred food of many waterfowl, unlike the eelgrass that replaced widgeon grass when salinities increased. The permanent breachways contributed to the decline of several important fisheries by reducing the range of habitat types in the ponds, changing the type and abundance of food organisms, reducing the ability of areas near the breachway to conserve eggs and larvae, and permitting important shellfish predators to become residents in the ponds. Conversely, the increased salinity brought about by the permanent breachways have made the salt ponds more suitable for such species as scup and scallops. Today the most obvious problem is the rapid increase in the rate of sedimentation around the breachways. The importance of the commercial fishing fleet justifies the expense for the Army Corps to fund periodic maintenance dredging of the harbor in Point Judith Pond. But in Ninigret, where only recreational boats ply the breachway, there has been no dredging since the breachway was built.

B. The principal motivation for building permanent breachways was easy boat access between the ponds and the ocean. Permanent breachways, however, greatly increase the sedimentation rate on the tidal deltas. Consequently, navigable channels to the ocean can only be maintained by frequent dredging.

C. Since breachways and dredged channels determine the patterns of water circulation, sedimentation and salinity, they are the primary determinant of the species and abundance of plants and animals that are present in the salt ponds.

410.4 <u>Hydrology and Sedimentation in Point Judith and Potter Ponds</u>

A. Point Judith Pond, with its elongated shape, a large stream discharging freshwater at the northern end, and a large breachway at the southern end, has many of the characteristics of a riverine estuary. A computerized hydrodynamic model developed by Licata at the URI Department of Ocean Engineering provides detailed information on currents in Point Judith Pond.[5] The model and the data collected for its development and verification are the source of the findings on the hydrology of Point Judith Pond and provide a valuable tool for assessing the impacts of major dredge and fill projects.

B. Tidal currents in the southern part of the pond are substantially larger than in the portion north of Ram Island and in restricted coves. In the lower pond and the Harbor of Refuge, strong tidal currents of 1 to 3 knots (.5 to 1.5 m/sec) progress north and south every 12 hours, and a particle of water moves long distances on each tide. The daily exchange between the southern region and the Sound is approximately 5 percent of the volume of waters in the southern portion of the pond. Tidal currents in the lower pond are complex, with significant lags between flood water at the breachway and flood water in various coves. Such lags occur between East Pond and the Harbor and Potter and Point Judith, which create particularly conservative circulation patterns in Potter Pond and East Pond.

C. In the northern region of Point Judith Pond the water level rises and falls in a simple pumping motion in response to the tides. As a consequence, the currents are weak and flushing slight. The difference in the waters between the northern and southern regions of Point Judith Pond is often visually apparent, with upper pond water noticably more turbid than that of the lower pond. In the upper pond the two-layered flow of nontidal currents typical of an estuary is frequently present along the main channel to Ram Point. Saline water from the lower pond flows slowly up the pond along the bottom, while on the surface a compensating layer of fresher water flows gradually seaward. The upper pond, with its poor flushing and sluggish circulation, is more prone to eutrophication and the retention of pollutants than the lower pond. These same characteristics, however, make this area particularly well suited as a spawning and nursery ground for fish and shellfish, since planktonic life forms are not likely to be transported out of the pond. Deepening of the channel through this area would increase flushing and radically alter the ecology of the upper pond. Similar hydrologic patterns of restricted flushing occur in Seaweed and Segar Coves and the upper pond in Potter, as well as Long Cove and Bluff Hill Cove in Point Judith, making all these areas particularly susceptible to pollutant loadings.

D. Construction of the Point Judith breachway and related dredging and filling in the lower pond to create port facilities resulted in many acres of filled salt marsh and radical changes to the hydrologic and sedimentary patterns within the pond6 (Figure 4-1). Before the breachway was built, water depth in the pond averaged nine feet, some three feet more than today, and shoals extended half a mile seaward of the breachway.[4] Water circulation throughout the pond was probably similar to that which exists today in the portion above Beef Island. Powerful tidal currents presently carry some 16,000 cubic yards of sand each year through the breachway into Point Judith Pond.[6,7] This makes it necessary to dredge the harbor every five to ten years. The flood tidal delta includes the turning basin, the bars south and northwest of Little Comfort Island, and the flats of Beef Island. Accumulation is most rapid in the turning basin. Ebb tidal currents in the lower pond achieve the 20 cm/sec threshold for moving sand, and have therefore created an ebb tidal delta along the Jerusalem shore and the west wall of the Harbor of Refuge in the main access channel. Expansion of port facilities to service the expanding commercial fishing fleet based in the Galilee-Jerusalem-Snug Harbor port area are being developed by the Department of Environmental Management. Increasing water depths within the port area should not cause a significant increase in the flow of sediments into the pond unless the access channel to the Harbor of Refuge is enlarged. The suspension of sediments during the dredging process, however, can cause transport of materials into adjacent areas.

E. Sedimentation rates in areas other than on the flood tide delta are low. The conservative circulation of the restricted coves is reflected in the increased organic matter in the bottom sediments (Figure 4-2). North of Harbor Island, the organic content of the sediments increases dramatically (from .15 to 8.3 percent) to levels characteristic of eutrophic waters.[6] North of the narrows, the high organic content of the sediments reflects the pollution from urban loading to the Saugatucket River.

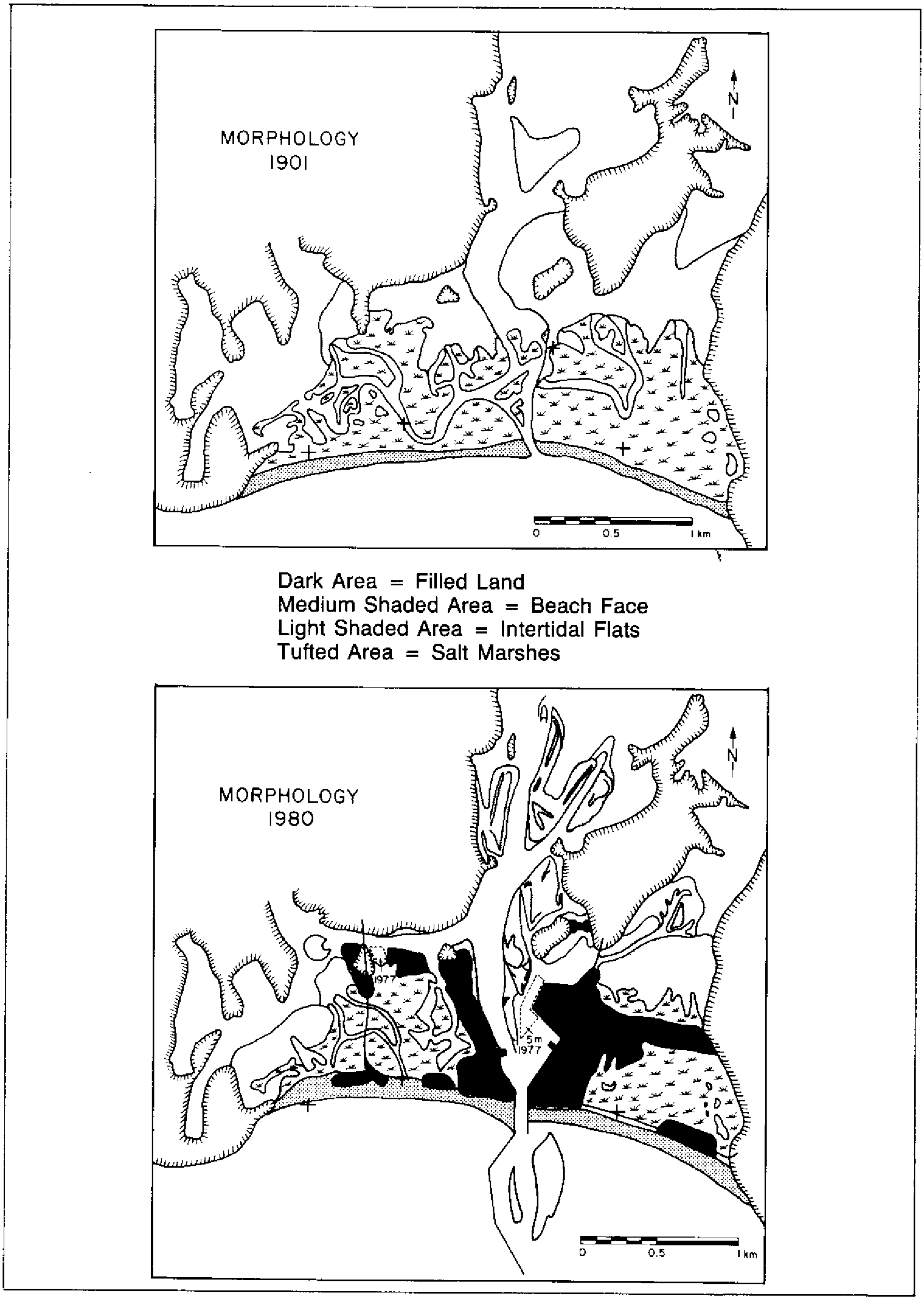


Figure 4-1. Changes in the morphology of Point Judith and Potter Ponds due to breachway stabilization and dredging projects. Adapted from Friedrick, 1982.

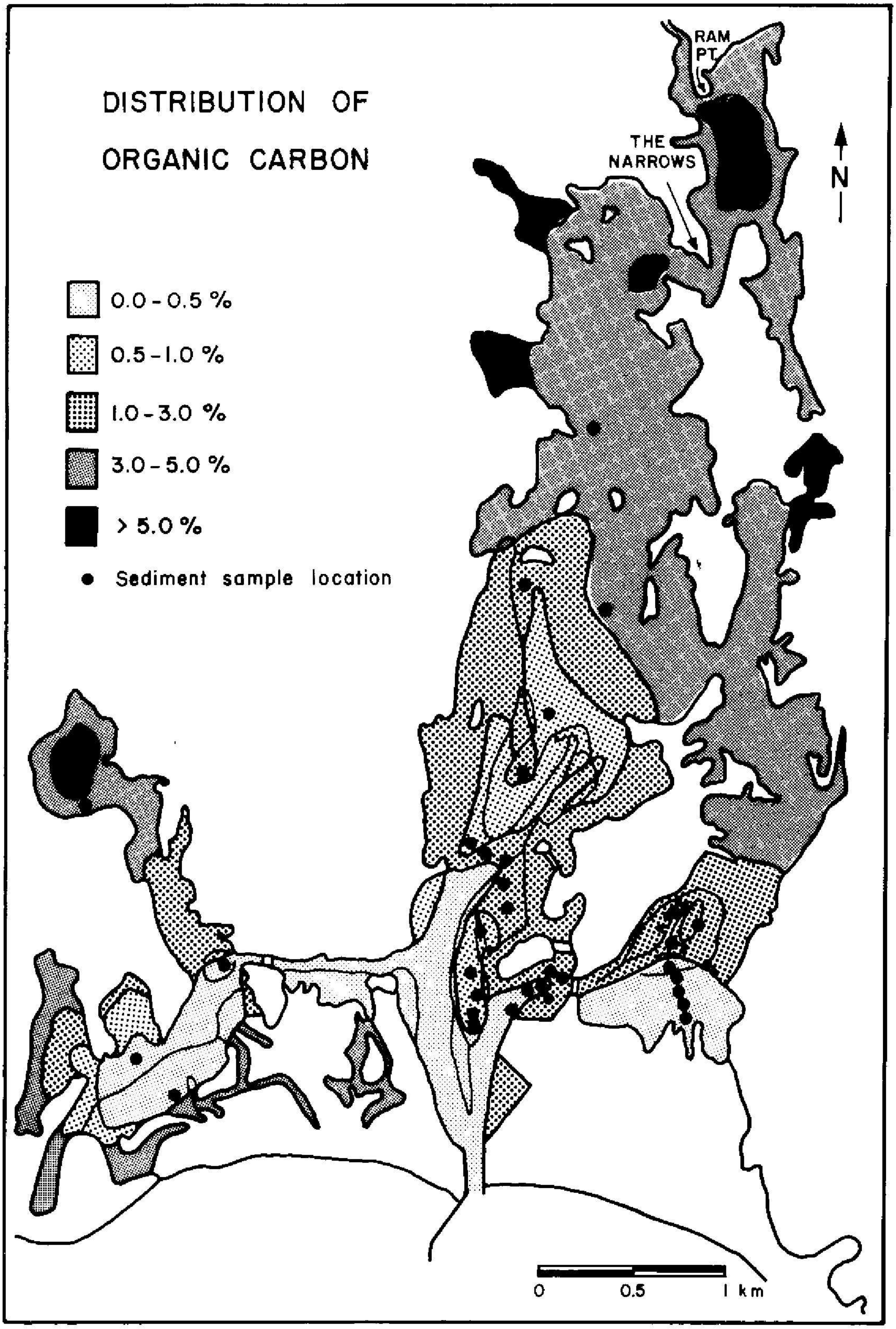


Figure 4-2. Distribution of organic carbon in the bottom sediments of Potter and Point Judith Ponds. From Friedrick, 1982.

410.5 Hydrology and Sedimentation in Ninigret and Green Hill Ponds

A. The Ninigret breachway (1952) and Green Hill channel (1962) were built purportedly to enhance water quality and fisheries. In fact, they have dramatically altered circulation in both ponds, which has contributed to declines in several important fisheries and greatly accelerated the rate of sedimentation on the tidal delta.

In response to the stabilized breachway, water depths decreased in both ponds as they equilibrated with sea level. When compared to a detailed Army Corps survey conducted in 1909 water depths have fallen 2.5 feet in Ninigret and 2.7 feet in Green Hill.[4] Water depth now averages 3 feet in both ponds.[8]

Stabilizing the Ninigret breachway and dredging a straight channel to Green Hill have brought dramatic increases in salinity and tidal flushing in these two ponds:[9,10,11]

	Average Salinity (in parts per thousand)		
	Before Breachway (1948)	After Breachway (1957)	After G.H. Channel (1975)
Ninigret Pond	22	28	29
West Basin	23	27	28
Central Basin	--	30	30
Fort Neck Cove	9	27	28
Green Hill Pond	6	17	23

These increases in salinity have made it possible for species such as oyster drills and starfish, which are major predators on oysters, to become permanent residents in the ponds and reduced the range of the estuarine habitats.

B. Circulation is primarily tidally driven, creating the following characteristics in the ponds:

	Ninigret Pond[12]	Green Hill Pond[12]
Av. Salinity	28 ppt	23 ppt
Av. Tidal Range	14 cm	4 cm
Max. Breachway Tidal Velocity	130 cm/sec	100 cm/sec
Max. Current Velocity		
Main Delta Channels	50 cm/sec	20 cm/sec
Inside Pond	Less than 10 cm/sec	Less than 10 cm/sec

C. Wind speed and direction as well as changes in sea surface in response to barometric pressure are also important forces driving circulation in the ponds, and are sometimes more important than tidal effects.[13] Sustained northwest winds during the winter occasionally force much of the water in the ponds out through the breachway; this "blowout" phenomenon exposes large areas to freezing temperatures that are otherwise submerged and can cause widespread mortality of oysters.

D. Sophisticated numerical hydrodynamic models have been developed by researchers at the URI Department of Ocean Engineering to quantify water movements in the ponds and through the breachway.[14] The models demonstrate that under average conditions flushing of the ponds is very conservative. On average, tidal exchange between Ninigret Pond and the ocean is 5 percent of the total volume of water in the pond, and the daily exchange between Green Hill Pond and the ocean is 1 percent.[14]

E. Numerical hydrodynamic modeling and field verification demonstrate that current speeds and directions and the extent of flushing are controlled by the dimensions of the breachway and the major channels in the delta.[15] Even a small increase in the depth or width of the channels across the delta flats or into Green Hill Pond will significantly change current patterns and increase sediment transport into the ponds. Dredging to clear navigational channels results in a greater volume of flow and increased sedimentation within the ponds.

F. Sand eroded off the barrier beaches is the principal source of sediment in the ponds. In the periods between major hurricanes, most of the sand that enters Ninigret Pond is transported through the breachway. Long-term records show that sand is accumulating on the flood tide delta in Ninigret at the rapid rate of 7 cm/year.[7] The overwash flats along the southern edge of the west basin and the small tidal delta at the inlet to Green Hill Pond are shoaling more slowly at 0.2 cm/yr and 0.9 cm/yr, respectively.[16] Shoaling due to erosion and sedimentation from the landward side of the ponds is minimal. Rates of sedimentation due to production of organic material within Ninigret Pond are also low, averaging 0.18 cm/yr.[16]

G. The rate of sedimentation in the Ninigret flood tide delta has doubled in response to construction of the permanent breachway. Since 1952 the long-term sedimentation rate has averaged nearly 5,000 cubic yards per year.[7] Sand grains are moved by strong currents through the breachway and along the flood channels, and deposited on the delta flats when currents slow to less than 20 cm/sec. The areas of most rapid sedimentation on the delta shift frequently and this makes navigation difficult. If the present rates of sedimentation are permitted to continue unchecked, sand flats will extend across to the northern shore within 35 years, reducing water circulation to Green Hill and the east basin of Ninigret.[7] This estimate does not take into account the additional volumes of sand that will be washed into the pond by major storms or hurricanes.

H. The sedimentation rate in Green Hill Pond is low. Some sand was added to the delta near Creek Bridge after the channel was dredged in 1962, when water velocities were much greater than they are now that the channel has silted in. At present the major source of sediment is overwash from the barrier during storms.

420. MANAGEMENT REGULATIONS AND INITIATIVES

420.1 Breachways and Dredging in Point Judith and Potter Ponds

A. Dredging Navigation Channels and Basins in Point Judith Pond

1. Improvement dredging for navigation shall be confined to the harbor area designated on Figure 4-3 and to depths listed in 420.1B below.

2. Applicants for Assents to dredge in the port area shall demonstrate to the CRMC that the action will not cause significant sedimentation outside the port area, particularly in Bluff Hill Cove and the segment of Potter Pond adjacent to the Gooseberry Hole inlet.

3. Maintenance dredging of the channel from Snug Harbor to Ram Point shall be limited to the channel as shown on NOAA Nautical Chart 13219 with a maximum depth of 5 feet below mean low water. Particular care shall be taken to avoid damage to known winter flounder spawning sites (see Chapter Five) in the upper pond. Dredging of the channel and the upper pond should be avoided during the January-through-March flounder spawning season.

B. Expansion of Port Facilities in Lower Point Judith Pond

1. The following improvements to port facilities are considered to be compatible with this Plan:

(a) Bulkheading state-owned property north of the state pier at Jerusalem and widening the present channel to the west sufficiently to service new docks along the bulkhead. A new bulkhead shall not extend eastward of the mean high water mark, since filling will force the existing ebb spit farther into the navigation channel. Depths of the access channel and new berthing areas shall not exceed 15 feet.

(b) The access channel to Snug Harbor and High Point may be increased to a depth of 15 feet.

(c) The present Galilee turning basin may be extended to the west and south as indicated on Figure 4-3.

(d) The channel along the north side of the Galilee bulkhead may be deepened to a maximum of 10 feet to permit berthing of larger vessels.

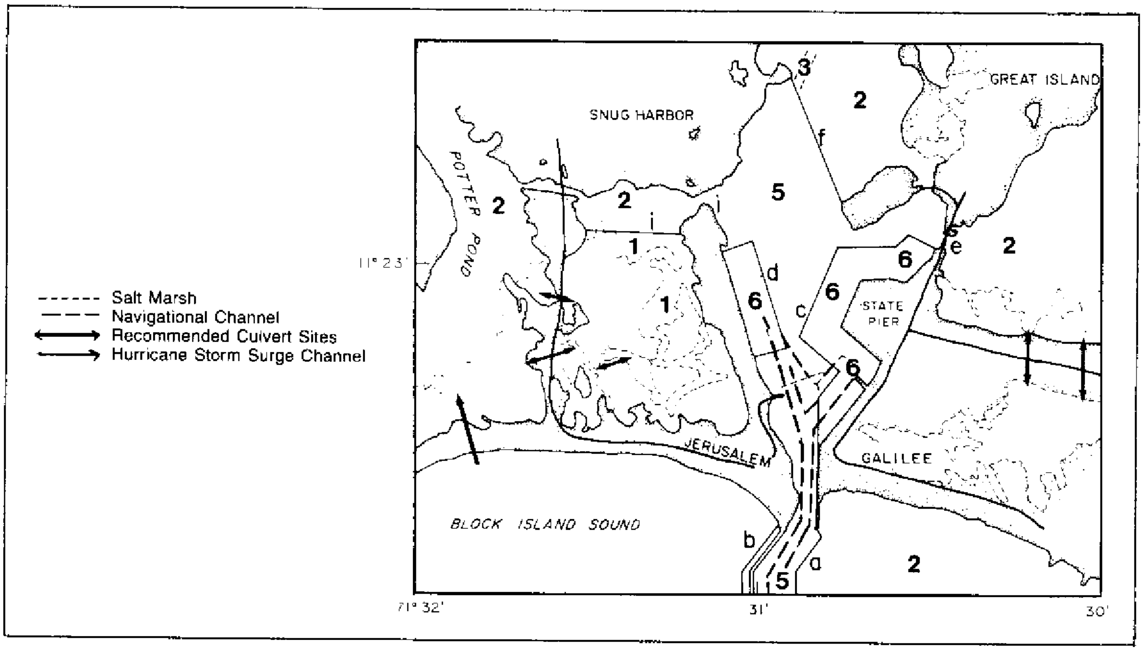


Figure 4-3. The port area of Point Judith Pond. Numbers denote water use categories as defined in Section 200 of the CRMP. Letters denote boundary line designations. These supercede the designations in the CRMP pp 102-103 and are defined as follows:

(a) A line running southerly from the southern end of the eastern jetty of the Point Judith Pond breachway and following the eastern side of the navigation channel, as designated by the U.S. Army Corps of Engineers, to the East Gap of the Harbor of Refuge.
(b) A line running generally southerly along the seaward side of the western jetty and breakwater of the Harbor of Refuge.
(c) A line running generally northerly and then westerly 200 feet into the pond and parallel to the Galilee bulkhead to the southwestern end of the Great Island bridge.
(d) A line running generally northerly along the Jerusalem shoreline 200 feet into the pond and parallel to state-owned property.
(e) A line along the eastern side of the Great Island bridge.
(f) A straight line running from the western tip of Little Comfort Island to the eastern tip of High Point.
(i) A straight line from the border between the RL80 and open space zones on Gooseberry Island westerly to the boundary between the open space and commercial zones southerly of Kenport Marina on Succotash Road.
(i)[1] A line running south from Gooseberry Road across Gooseberry Hole to the northern-most tip of Gooseberry Island.

(e) The state-owned property on Great Island (see Figure 4-3) may be bulkheaded and the area between the bulkhead and the channel dredged to a depth not exceeding 10 ft.

C. Disposal of Dredged Material

1. The preferred option for the disposal of sands dredged from lower Point Judith Pond is replenishment of the Sand Hill Cove and East Matunuck beaches (Figure 4-3) in the configuration shown in Figure 4-4.

D. Dredging and Channels in Potter Pond

1. All navigation dredging is prohibited in Potter Pond.

2. Non-navigational dredging shall be limited to habitat restoration and enhancement.

E. Restoration of Water Circulation

1. Dredging to restore flow at the following sites is a priority, since it will restore water circulation and salt marsh habitat in areas adversely affected by port filling:

(a) Potter Pond-Succotash Salt Marsh selected tidal channels as shown in Figure 4-3

(b) Segar Cove-Seaweed Cove Causeway
(c) Stone Bridge over Buckie Brook

2. Other habitat restoration and enhancement projects shall be undertaken only after an evaluation of the impacts has been made by a competent coastal geologist and biologist and it is demonstrated that the project conforms to the management goals for this Plan.

F. Modification to the Potter Pond Breachway

There is considerable information suggesting that substitution of a permanent channel between Potter Pond and Gooseberry Hole with a seasonal breachway directly to the Sound adversely affected the fish and shellfish populations in this pond. If a major storm or hurricane forms a new breachway between Potter and the Sound which remains open after the storm, it shall not be filled in until salinity and current measurements, at a minimum, have been made to determine the effects of a direct connection to the Sound. Such information will be used to evaluate whether a seasonal breachway to the Sound, combined with a tide gate at Succotash Bridge, is desirable. The trade-offs are likely to be between improved water quality in lower Potter and improved fisheries versus the buildup of a flood tidal delta inside the pond and reduced boat access between Potter and Point Judith Pond.

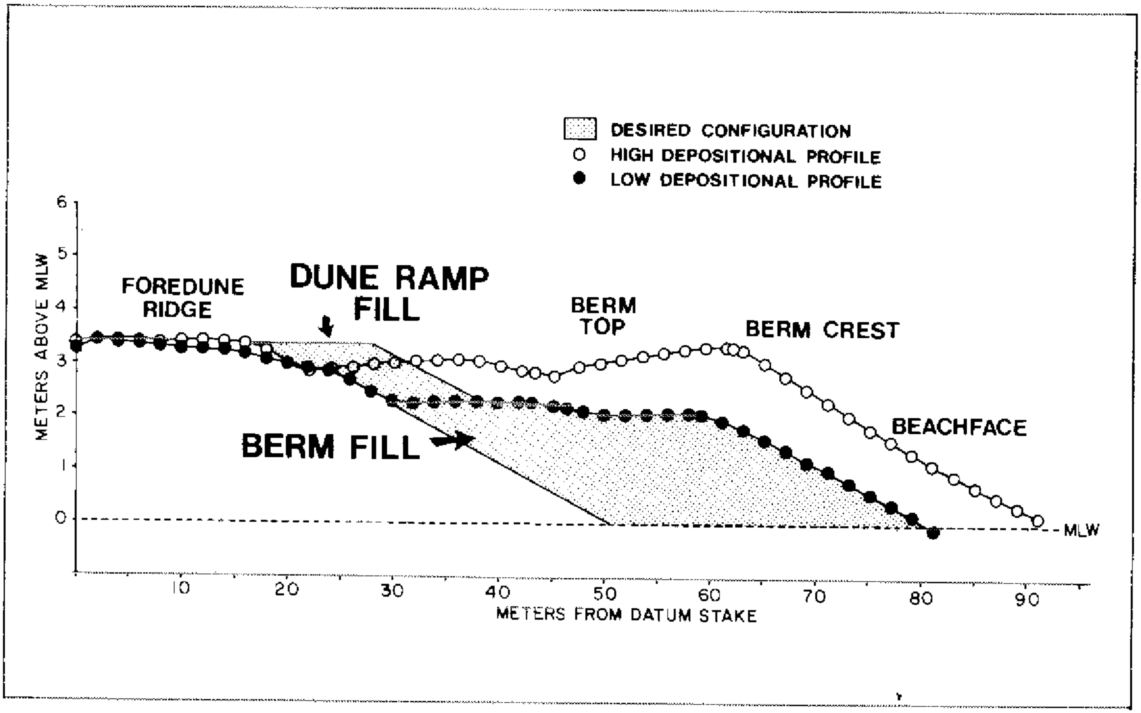


Figure 4-4. Preferred design for beach fill for beach nourishment projects on Rhode Island barrier spits. From Boothroyd et al., 1981.

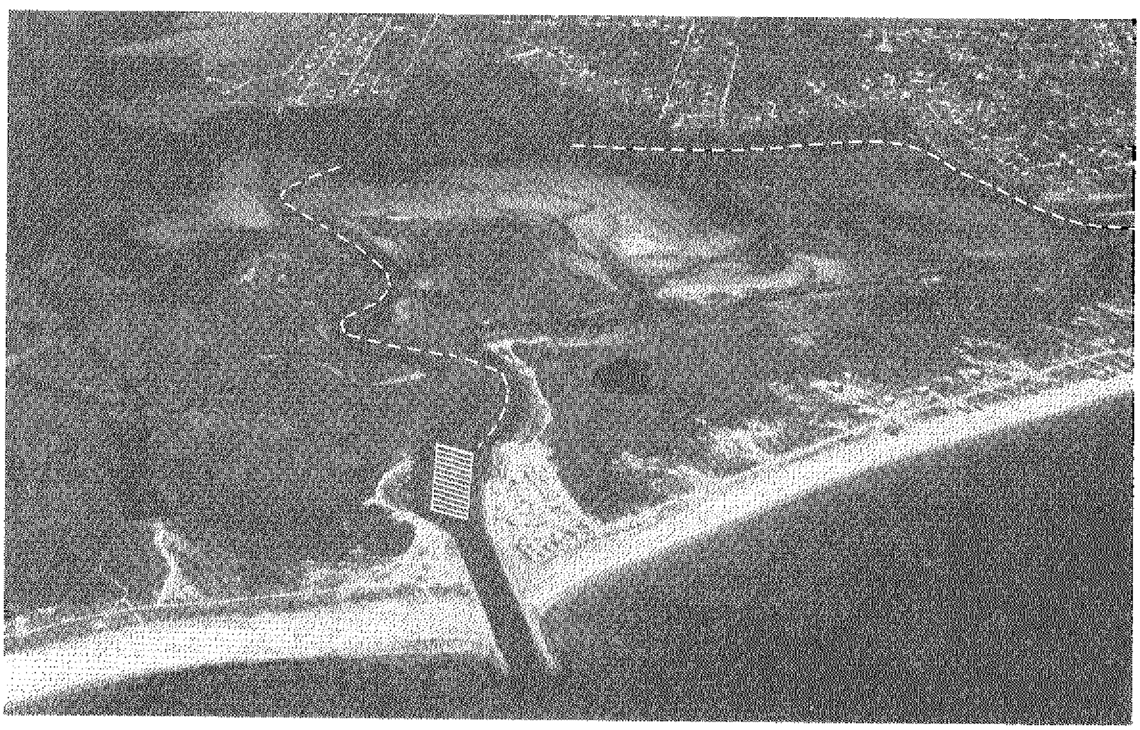


Figure 4-5. Proposed dredging areas and disposal sites for Ninigret Pond. The sediment catch basin, which should be routinely dredged, is located just inside the stabilized breachway. Photo by Jon C. Boothroyd.

420.2 Breachways and Dredging in Ninigret and Green Hill Ponds

A. Sediment Catch Basin for the Ninigret Breachway

A sediment catch basin on the north side of the Ninigret breachway shall be constructed and maintained. The preliminary design plans (Figure 4-5) call for a basin with a maximum depth of 10 feet and a capacity of 10,000 cubic yards. Sand removed from the basin shall be used to nourish Charlestown Beach. Sands shall be placed on the beach in the configuration shown in Figure 4-4.

B. Channel Dredging

1. Channel dredging shall be limited to the restoration and maintenance of a single channel no more than 30 feet wide and 3 feet deep across the breachway delta in Ninigret and of a channel no more than 2 feet deep and 12 feet wide to Creek Bridge through Tocwotten Cove (see Figure 4-5). Such channels must follow the winding path of the major existing channel at that time. The channel across the tidal delta may be maintained only when the catch basin has accumulated less than 50 percent of its capacity of sand.

2. Non-navigational dredging in Ninigret and Green Hill Ponds shall be limited to habitat restoration and enhancement. Such projects may be undertaken only after an evaluation of the impacts has been made by a competent coastal geologist and biologist and it is demonstrated that the project conforms to the objectives of this Plan.

C. A Ninigret Breachway Tidal Gate

Construction of a tidal gate in the Ninigret Breachway is considered fully compatible with this Plan. The expense of such a structure, lack of experience in operating such facilities, and uncertainties as to how much it would reduce the rate of sand accumulation in the catch basin make it a secondary priority after dredging and maintaining the catch basin described in (A) above. It is expected that a channel between the pond and the ocean would be open during the boating season. It may be feasible to provide an opening in the gate that will provide for movements of fish in and out of the breachway when the gate is closed. By adjusting the height of the gate when closed, the water level in Ninigret and Green Hill need not be increased above its present range. If this option is pursued, detailed construction and management plans will be evaluated by the CRMC in accordance with the following objectives:

- provide for boat traffic between the ocean and the pond during calm weather in the summer months
- minimize the flow of sand into the catch basin
- reduce or prevent the "blowout" phenomena which exposes large areas of pond bottom to freezing temperatures

- manipulate flushing and salinity for the maintenance or enhancement of water quality and fisheries habitat in the ponds
- provide for a suitable governing body responsible for maintaining and operating the gate

D. Creek Bridge Inlet to Green Hill

1. A rebuilt Creek Bridge shall have a span of 25 feet, with a central support and bridge abutments designed to accommodate stop logs. When built, one span shall be closed with stop logs and the other left open in order to maintain the present conditions and water exchange through the inlet. In order to discourage an increase in the size of boats in Green Hill, the clearance between the bridge and the channel shall be no more than present height of 4 feet 6 inches above the mean high water level in the inlet. As conditions in Green Hill require, the CRMC subcommittee may order placement or removal of stop logs in order to manipulate flushing and salinities in Green Hill Pond.

420.3 Breachways and Dredging in Trustom and Cards Ponds

A. All dredging activities in or adjacent to Cards Pond are prohibited by the Council excepting those activities whose purpose is to (a) permit more efficient seasonal flushing between Cards Pond and the ocean, or (b) improve or restore fish habitats in Cards Pond Stream. Habitat restoration (b) may be undertaken only after an evaluation of the impacts has been made by a competent coastal geologist and biologist and it is demonstrated that the project conforms to the objectives of this Plan.

1. More frequent breaching of Cards Pond by the town of South Kingstown is encouraged during summer months to help alleviate eutrophic conditions and reduce bacterial contamination.

2. The breachway should be opened in the evening hours during the summer bathing season in order to minimize possible safety hazards in this popular beach area. Lifeguards should be given a day's notice so they can extend patrols to cover the breachway.

B. The U.S. Fish and Wildlife Service is encouraged to consider more frequent breachings of Trustom Pond. This could improve the growth of macrophytes preferred by waterfowl and, if accompanied by appropriate data collection, would provide much needed data on the effects of increased flushing and salinity on a hypereutrophic system.

Chapter Five.
Fish and Fisheries

Scott W. Nixon

510. FINDINGS OF FACT

A. A few decades ago the fisheries of the salt ponds were considered their most important feature. Today few topics excite more interest and controversy than the condition of fishery resources. With the exception of scallops, which reappeared after a 20-year absence, it is widely perceived that the stocks of the most popular species, the quahogs, oysters and flounder, are all declining. How the blame for this condition should be apportioned among recreational fishermen, out-of-staters and residents, commercial fishermen and loss or degradation of habitat is hotly debated. Such perceptions are difficult to prove or discount. Long-term records of annual harvests from the ponds do not exist, and the scattered data that can be found give only general indications. A major portion of the URI Salt Pond Project was devoted to developing a better understanding of these issues and gathering the baseline information against which further changes in resources and fishing efforts may be compared. This research [1,2] is the source for all data presented in this chapter for the period 1978-1982.

B. It is indisputable that the annual landings of certain species from individual ponds can be very large and that the sustained yields of species such as white perch and oysters were far larger in the past than they are today. The only data on catches in the past century were collected by Clark in Point Judith Pond.[3] He reported that oyster landings had already declined significantly by the time of his one-year survey in 1879 but that 70,000 pounds of meats (10,000 bushels) had been harvested in 1870.

Table 5.1. Estimated Point Judith Catches of Finfish and Shellfish in 1879

Finfish		
Alewives		450,000
Smelt		60,000
White Perch and Flounder		60,000
Bass		4,000
Eels		Many
	TOTAL	574,000 lbs.
Shellfish		
Oysters		Not significant
Softshells		6,500
Quahogs		None recorded
Scallops		None recorded
	TOTAL	6,500 lbs. (meats)

The following conversion factors were used for Clark's data: 1 barrel of fish = 225 lbs. meat[4]; 1 bushel oysters = 7 lbs. meat[5]; 1 bushel softshells = 13 lbs. meat.[5]

A century later fisheries for alewives, smelt and oysters had disappeared from the ponds. Some 250 pounds of white perch were taken in 1979. That year the recreational and commercial flounder harvest was estimated at 12,000 pounds and there was a flourishing eel fishery. No softshell catches were recorded in 1979, while quahogs totalled some 6,000 pounds of meats and scallops produced a harvest of 161,000 pounds of meats.

510.1 Year-to-Year Variability in Fish Populations and Fisheries

A. A crucial characteristic of salt pond fisheries is the rapidity with which the condition of stocks and fisheries change. During the period of the URI investigations (1978-1982), a flourishing and lucrative eel fishery collapsed. In 1979 some 60,000 pounds worth some $60,000 were harvested from all south shore ponds (Point Judith through Winnapaug), but by 1982 the catch was less than 5,000 pounds. It is not known whether the decline was caused by changes in market conditions or stock abundance, or both. The dynamics of this fishery were not reflected in official fishery statistics, which listed Rhode Island eel landings at several hundred pounds for each year during this period. Another example is the skiff dragger fishery for flounder in Ninigret. For more than a decade, two fishermen seasonally worked small areas of open bottom predominantly near the breachway. In 1982, the situation changed radically; a number of other fishermen began dragging, and a change in the fishery regulations made it legal to set fyke nets. Fishing effort, the amount of area fished, and probably the number of flounder subpopulations affected by commercial fishing all changed in a single season. A third example is the Point Judith Pond quahog fishery. In 1983 the area closed to shellfishing by pollution was reduced by more than half, and an abundant, formerly protected population that may have been important as a brood stock providing seed for heavily exploited beds in the southern part of the pond became open to exploitation. A huge set of softshelled clams in Green Hill Pond, conservatively estimated in 1978 at some 6 million individuals, had almost entirely disappeared two years later without significant fishing pressure. Scallop populations are highly unstable. In occasional good years Point Judith Pond alone can produce more than 20,000 bushels. Long-term records indicate, however, that during the past century there have been 20- to 25-year cycles in abundance separated by long periods when adult scallops were practically absent.[6]

510.2 The Ponds as Fishery Habitats

A. The characteristics of the salt ponds as fishery habitats have changed radically in recent decades. The construction of permanent breachways, as described in Chapter Four, lowered the water level and increased the flushing, which changed the salinity regime from one of seasonally pulsed high and low salinity to one of relatively constant high salinity. Thus, the range of habitat types has been reduced so that low salinity waters preferred by some species for spawning are now restricted to a few small areas in back coves close to the mouths of streams or upwelling groundwater. Permanent breachways also make it possible for sustained northwest winds in the winter to force much of the water out of the ponds and expose large areas to freezing temperatures. In Ninigret Pond, this periodically kills off oysters. The breachway there has also increased the rate of sedimentation in the tidal delta and transformed formerly deep water habitat into shallow sand flats.

B. A second series of changes to the ponds as fisheries habitat has been brought about by the two principal forms of water pollution. Bacterial contamination causes loss of access to shellfish beds, while eutrophication affects the abundance and distribution of the major fish and shellfish species. Episodes of low oxygen in Ninigret and Green Hill, today the remaining oyster producers, appear to limit these shellfish to near-surface waters. Eutrophic conditions are probably also the cause of the extension of areas of soft, highly organic bottom sediments that are virtually devoid of shellfish over areas of formerly productive sandy bottom. The effects of eutrophication on finfish stocks are less obvious but may be equally significant. Localized fish kills caused by low oxygen and high temperatures are known to occur and, if they become more common and widespread, could have a significant impact on juvenile flounder and other fishes that are abundant in the lagoons during the summer. Another threat of increasing water pollution to fisheries is indirect. If the lagoons become more polluted by high levels of bacterial contamination and eutrophic waters, there may be mounting public pressure to increase water circulation and flushing. This could be accomplished by dredging out channels and inlets and by cutting new connections between adjoining lagoons and the ocean. Such modifications can have profound implications on the qualities of the lagoons as nursery areas for finfish, and could have major impacts on the productivity of shellfish stocks as well. Such modifications will also in many instances accelerate the already severe problem of rapid shoaling of the lagoons by sand carried in by fastflowing tidal currents.

C. The salt ponds contain large seasonal populations of winter (blackback) flounder, which support sizable recreational and commercial fisheries. The salt ponds are believed to be the spawning grounds and nurseries for a major portion of the Block Island Sound winter flounder population, which is an important resource for trawlers working out of Point Judith and nearby Connecticut ports.[7] One of the most exciting results of the extensive research conducted through the ponds project on flounder is the strong evidence that within Ninigret, Point Judith and Potter Ponds there are distinct subpopulations, each of which feed and spawn on distinct home grounds.[8] In Point Judith Pond a major spawning ground is the gravel bar known as Rocky Island in the upper pond. Spawning is also known to occur near Gardner Island (Figure 5-1). Extensive sampling during 1981 in other areas of potentially suitable spawning habitat in this pond yielded no eggs. In Point Judith Pond a principal feeding ground is in the basin near the islands north of the sand flats. In Ninigret Pond, the basin immediately inside the

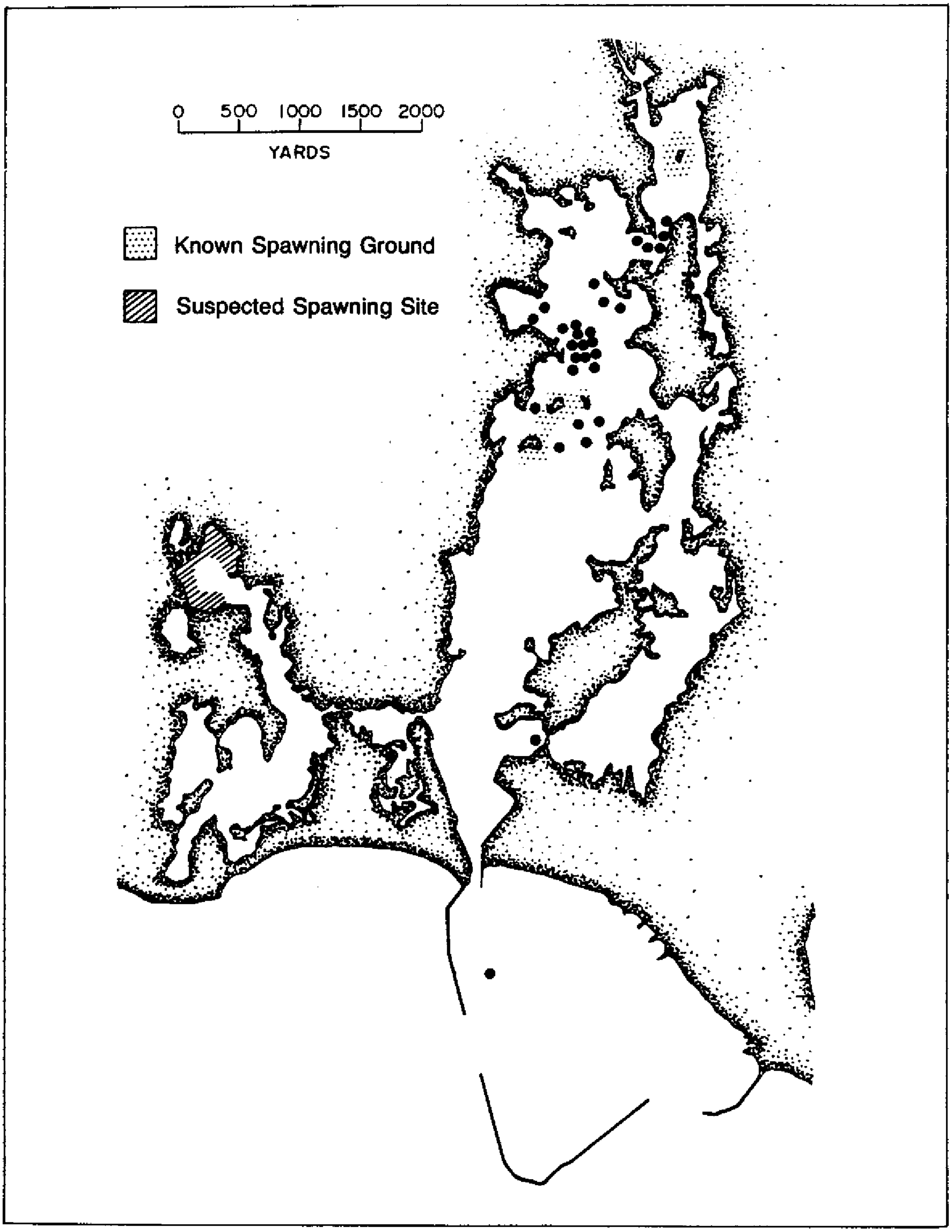


Figure 5-1. Winter flounder spawning grounds in Point Judith and Potter Ponds. The dots indicate locations of tagged adult flounder recaptured when they returned to the pond after a single migration season. All flounder were tagged in the upper basin between Gardner Island and the Narrows at least three months before the recaptures.

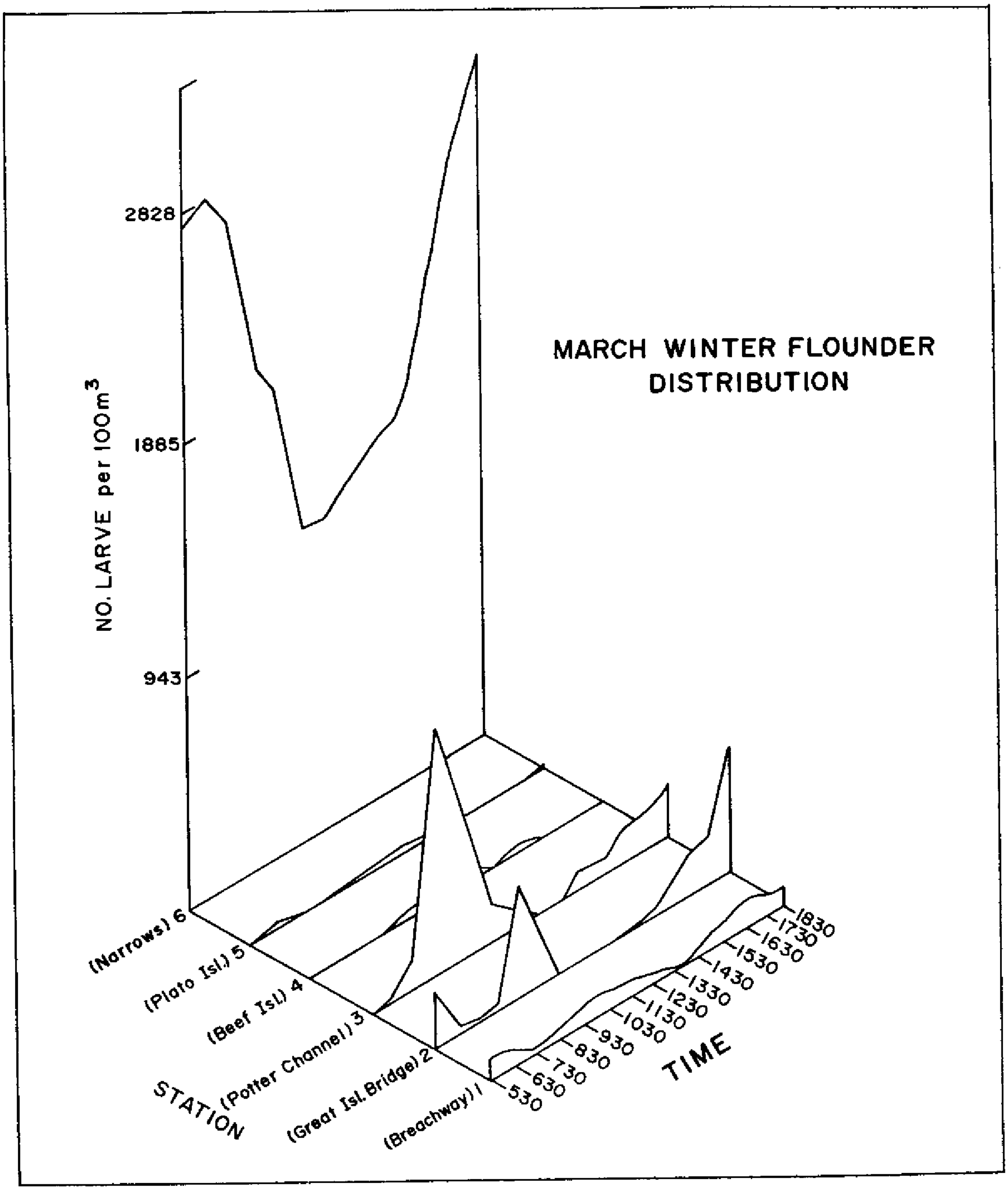


Figure 5.2. The distribution and abundance of flounder larvae in Point Judith Pond during the daylight hours of March 27, 1981. The samples were taken early in the flounder spawning season of that year. Annual plankton surveys between 1978 and 1980 revealed that flounder larvae first appear in the northern reaches of this pond. Similar observations have also been reported for Mystic River, Connecticut.[10] The densest larval flounder concentration in Point Judith Pond was near the spawning site identified in Figure 5-1.

breachway delta west of Fort Neck Cove appears to be an important feeding ground for flounder in Ninigret. Further tagging studies of adult flounder suggest that fish caught in one area do not range about the ponds but feed and spawn in a limited home area and return to it each fall, much as salmon return to the parent stream.

Spawning information, when coupled with what we have learned about the hydrography of the ponds,[7] suggests that slow exchange of waters between the ponds and the ocean is one of the most important reasons why the ponds provide particularly good flounder spawning and nursery habitat (Figure 5.2). For the month-long period that the larval flounder are free-floating plankton, they are in danger of being swept out into the ocean, where their chances for survival are largely reduced. In Point Judith, the waters above Beef Island mix slowly with the lower pond waters, which are swept in and out of the pond by strong tidal currents. Slight tidal currents and conservative circulation make the upper pond particularly suitable for spawning and larval development. This would be lost, however, if by dredging channels or other manipulations the flushing rate of the upper pond was increased or the spawning sites themselves were physically destroyed. Areas of Potter and Ninigret are hydrodynamically similar and are equally important to the character of these ponds as nursery habitat.

510.3 Overfishing

A. There are two forms of overfishing. The first, and the one illustrated by the oyster and quahog fisheries of the salt ponds, is growth overfishing. This occurs when heavy fishing pressure removes individuals of the desired size so efficiently that the population becomes dominated by juvenile, undersized animals. The second form, recruitment overfishing, is a more severe problem and occurs when the adult stock is so reduced that they produce too few offspring to sustain the maximum potential population. Recruitment overfishing is far more difficult to detect, since it may be impossible to account for the host of environmental variables that, independent of fishing pressure, may be the cause of declining recruitment of juveniles into the stock.

B. Although there is wide variation among the various types of bottom found throughout each pond, it was typical during the years of the URI pond project for 50 percent of the quahogs, 75 percent of the softshells and 90 percent of the oysters to be undersized. The high mortality of both softshells and oysters may apparently be attributed to environmental conditions as much as fishing pressure, but for the nearly ubiquitous and long-lived quahogs, fishing pressure appears to be the dominant factor controlling abundance and size distribution. The greatest densities and highest proportions of legal-sized quahogs were found in areas permanently closed to fishing by bacterial contamination and in gravel or eelgrass-covered bottom, which is difficult to harvest. Figure 5.3 suggests that

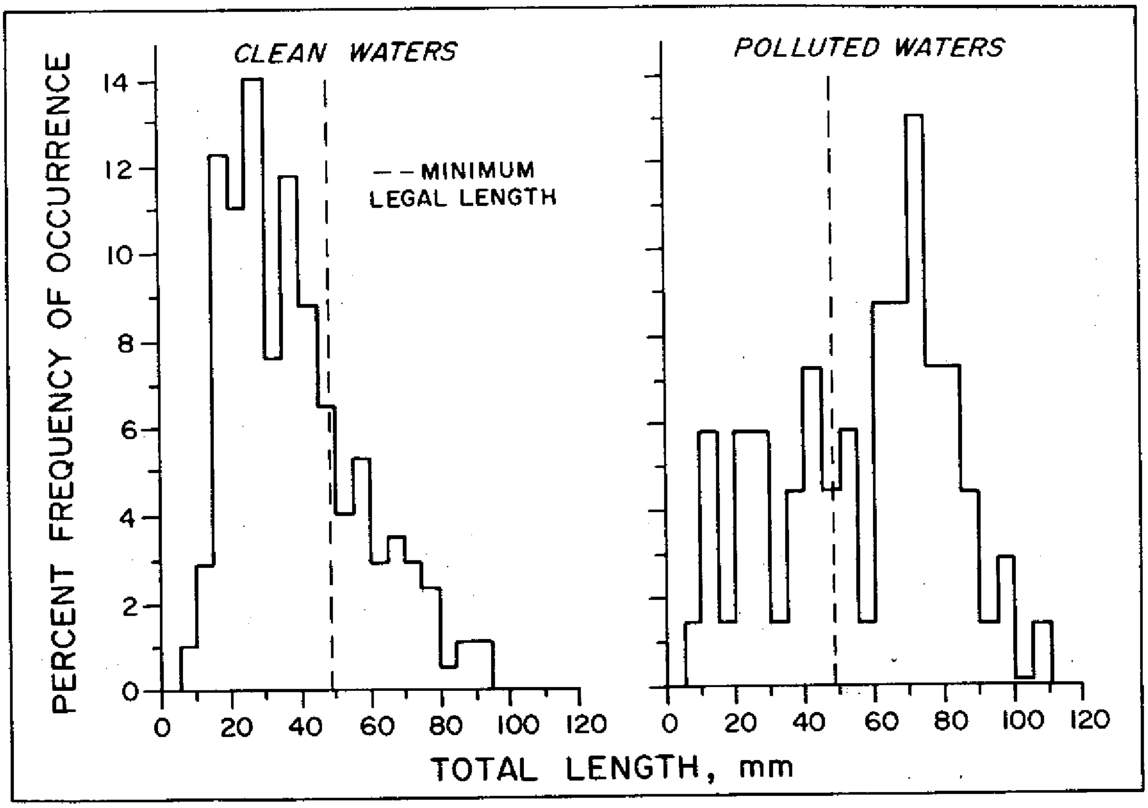


Figure 5.3. The effect of growth overfishing on sizes of quahogs in Point Judith Pond. In 1979 there were significantly more legal sized quahogs within areas of Point Judith Pond closed to shellfishing by pollution than were present in the heavily fished portions of the pond that were open to shellfishing. The dashed line shows the minimum legal size.

chronic growth overfishing typifies the accessible quahog populations in the ponds. Fishing pressure has undoubtedly also played a major role in the decline of oysters. Because they grow on the surface of rocks or other hard substrate, they are usually visible and easy to harvest. Even if habitats were manipulated to once again favor oysters the current abundance of eager fishermen would keep the population at a low level.

C. While growth overfishing of popular shellfish appears to be an established problem, recruitment overfishing of the major shellfish population does not appear to be a problem at present. It is possible, however, that protected populations of quahogs in the grass beds of Ninigret and above the pollution line in Point Judith contribute seed to the heavily fished beds in those ponds. Recent studies in Great South Bay, New York, suggest this may be a major reason why the open beds sustain the present rapid rate of exploitation without becoming more severely depleted.[11] No such protected brood stock was found in either Potter or Green Hill Pond, and here the densities of quahogs are much lower.

D. There is no evidence that the flounder in the salt ponds are overfished, but careful monitoring of subpopulations will be needed if this issue is to be objectively assessed. According to a survey of recreational fishermen in Point Judith, Potter, Green Hill and Ninigret between April 1978 and January 1979, the total catch was some 60,000 flounder (about 30,000 pounds), and catches were similar in the two pairs of ponds. The magnitude of the Ninigret commercial trawl fishery varied considerably from one year to another, but in peak years, such as 1977, some 20,000 pounds were caught. Commercial catches were comparable to the recreational catch in Ninigret between 1979 and 1981. Beginning in the spring of 1982, however, commercial fisheries in Ninigret changed drastically as more draggers began working and a change in the fishery regulations allowed fyke nets in the pond. Fyke nets are staked traps that are less affected by seagrass and algae than draggers and can therefore be operated in areas where draggers cannot work. They are a more efficient and effective means of catching flounder, since they are inexpensive to operate and, once in place, catch fish continuously. Fykes have the potential to expose subpopulations previously unaffected by commercial fishing to heavy pressure. Recreational fishermen have complained bitterly that flounder stocks in their favorite fishing areas in Niniget are being depleted by the trawlers, but the perception of competition is not always confirmed by observations. In 1982, for example, recreational fishermen complained that their catches were unusually low and that the draggers must have captured the available fish. Direct observations showed, however, that flounder were abundant but that there was so much forage available they were not biting on baited hooks. There is no commercial flounder dragging fishery in Point Judith, but there is a small new fyke net fishery there. Fykes are also operated in Potter. Recreational fishing in Point Judith is active most of the year. The flounder fishery is concentrated at a few well-known sites in the spring and fall in the upper pond and is part of a mixed-species summer fishery in the lower pond.

510.4 Preservation and Enhancement of Fisheries

A. The difficulties of managing a multiple-species, free, and common recreational fishery, where all state residents have an equal right to harvest a publicly owned resource, are particularly challenging in the salt ponds. The small size of the ponds, their high productivity, and their accessibility make them particularly vulnerable to misuse and overexploitation. These difficulties are heightened by the great concern for the condition of fishery stocks of local residents and the thousands of recreators who come regularly from all over the state, as well as Massachussetts and Connecticut, to fish and shellfish in the salt ponds.[12]

B. The management techniques that may be used to control a free and common fishery and protect the resource from overexploitation include catch and minimum-size regulations, closed areas, gear regulations, and a variety of methods that may enhance the natural productivity or abundance of selected species. These techniques have been used for a number of years in the ponds by the Marine Fisheries Council and the DEM. A large proportion of the energies of the DEM Division of Fish and Wildlife Marine Fisheries Section are devoted to the salt ponds, particularly to the re-establishment of bay scallops. Enforcement of shellfishery regulations, however, is weak. During the period of the URI studies, DEM enforcement officers were rarely seen except during the scallop season, undersized shellfish were common in recreational catches, and daily recreational catch limits for quahogs were greater than most fishermen could fill. Enforcement of catch and minimum-size regulations for shellfish is made difficult by the absence of a shellfish licensing requirement for state residents. Residents are permitted larger daily catch limits than licensed non-residents, but there is no way to discriminate between the two on a shellfish flat. There is also no license to revoke from the violators of regulations, which would otherwise provide a simple and effective form of punishment. Public sentiment against licensing residents, however, is strong, and legislation calling for licensing would have little chance of passage in the R.I. General Assembly.

C. On Cape Cod and in Maine, where similar problems have faced the managers of municipally controlled shellfish flats for many years, shellfish managers have concluded that regulations over catches, size limits and seasons are not enough. They have learned that if growth overfishing of popular shellfish is to be curtailed, regulations must be complemented by public education and cooperation. Proponents of this approach stress that effective enforcement of regulations will be achieved only if it is based on a cooperative, educated public that actively supports and participates in management. If this approach was adopted in the salt ponds, it would be important to select small areas with a known high potential for productivity, and to concentrate on enhancing the productivity of these areas to demonstrate that it is possible to sustain improved recreational catches if regulations are strictly adhered to and the resources are actively managed. Techniques to enhance productivity, which may include seeding, predator control, special fishing restrictions and "cultivation" of the bottom, should be tested to select those that prove to be most effective in producing enhanced yields of harvest-sized shellfish. Central to the success of such a program is a fisheries steward, a person who devotes all their attention to salt pond fisheries, is competent in the techniques of fisheries management and stock enhancement, believes in what he or she is doing, is willing to experiment, and can work successfully with the public. In Maine and on Cape Cod, shellfish wardens are employees of the municipalities that control the shellfish beds. In Rhode Island, fisheries stewards would answer to the chief of the DEM Division of Fish and Wildlife. Their salaries could be provided by municipal, state and/or federal funds. A fisheries steward program for the salt ponds could provide for a sustained level of monitoring and education and a level of management that cannot be provided by the DEM and Marine Fisheries Council alone.

520. MANAGEMENT INITIATIVES

520.1 Fisheries Steward

A. DEM and Municipal Government Initiative

One or more salt ponds fisheries stewards should be hired and charged with the following responsibilities:

1. Monitor salt pond fisheries resources and fishing effort, particularly in areas known to be productive. The assistance of volunteer "pond watchers" and university researchers should be encouraged.

2. Select small areas known to be productive of quahogs and softshells and intensively manage for sustained yields to the recreational fishery through seeding, predator control, controlled fishing effort, and special regulations such as reducing the minimum length of softshells harvested from these areas. A major purpose of such initiatives would be to demonstrate the potential of such areas to produce sustained annual harvests if the public cooperates.

3. Assist in the development of public education programs on the salt ponds and their fisheries. Managers on Cape Cod have established a public awareness program which involves participation with such groups as scouting, 4-H, and local school programs as well as the distribution of literature to the general public at marinas and boat-launching facilities. The steward would promote such initiatives.

4. Identify major issues requiring research and monitoring by the DEM and/or university researchers.

5. Prepare annual reports on the conditions of the fisheries, activities undertaken, and the priorities for the following year. This report would be presented to the Marine Fisheries Council, funding agencies and the public.

6. Assist in the enforcement of fisheries regulations. The steward's primary role is not enforcement, but he or she should be authorized to issue citations to violators of fishery regulations.

520.2 Periodic Closures and Reduction of Quahog Daily Catch Limits

A. Marine Fisheries Council Regulations

The MFC is encouraged to reduce the daily recreational catch limit for quahogs to two quarts per person. Closing beds to shellfishing when the average hourly catch falls below half a quart per person is recommended. Beds should be reopened to fishing when the population has recovered.

520.3 Protection of Quahog Brood Stocks

A. DEM/Marine Fisheries Council Initiative

Prudent management suggests that careful consideration be given to the potential importance of quahog brood stocks in areas closed to shellfishing by regulation or areas physically difficult to exploit. These populations may play an important role in sustaining heavy fishing in accessible areas. Brood stocks may include the population in the dense grass beds in Ninigret and, until September 1983, areas north of the former pollution line off Beef Island in Point Judith Pond. DEM is encouraged to support research to identify such brood stocks. In light of the present level of exploitation, recruitment in traditional grounds should be carefully monitored in Point Judith and Ninigret Ponds and appropriate steps taken if there is evidence of a significant decline in these populations.

520.4 The Scallop Season

A. Marine Fisheries Council

The physical disturbance caused by scallop dredges has a high potential of disrupting flounder spawning and damaging eggs and juveniles. When scallop beds overlap areas known to be important for flounder spawning, the scallop season should not be extended beyond December 31, or if an extension is deemed desirable, harvesting with dragged gear should be prohibited.

520.5 Management of Commercial Flounder Fisheries and Protection of Spawning Grounds

A. DEM, Marine Fisheries Council, and CRMC Initiative

Monitoring and management of flounder fisheries in the salt ponds must recognize that discrete subpopulation exists within individual ponds. A special effort should be made to identify the range of subpopulations and the location of discrete spawning grounds. The protection of spawning grounds should be a priority.

520.6 Monitoring of Eel Populations and Fisheries

A. DEM/Marine Fisheries Council Initiative

Experience with eel fisheries worldwide has demonstrated that this species is particularly susceptible to overfishing. The south shore eel fishery can be important and merits careful monitoring and management.

520.7 Consideration of Tide Gates as a Tool for Fisheries Enhancement

A. CRMC/DEM/Municipal Initiative

A tide gate is a structure that is held to the height of a moon tide and maintains water levels at that level in the ponds when in place. Storm waves and freshwater buildup in the ponds flow over the top. Such structures are easily amenable to opening to allow for the passage of boats at some seasons and to permit maximum exchange of pond and ocean waters when this is desirable. A subsurface opening could provide for the passage of fish when the gate is closed. When in place, a tide gate would prevent the "blowout" phenomenon, minimize losses of larval fish and shellfish, expand the aerial extent of low salinity waters required by several species for spawning, and check the inflow of sand into the ponds. Tide gates should be considered for the breachways of Ninigret, Green Hill and Potter Ponds.

Chapter Six.
Storm Hazards

Wilking Studio

610. FINDINGS OF FACT

610.1 The Problems of Coastal Flooding and Storm Damage in the Salt Pond Region

A. For a number of reasons, the salt pond region is particularly susceptible to flooding and damage from coastal storms.

1. The ocean shoreline runs east-west and lies exposed to the full force of any storm approaching from the south. It is directly in the path of most major hurricanes that reach New England before they veer east over the North Atlantic, and is unprotected by large islands such as Long Island, Fisher's Island or Martha's Vineyard, which lie off the mainland to the north and south. In the hurricane of 1938 the southern shore of Rhode Island experienced winds and waves of the greatest speed and height recorded anywhere in New England.[1]

2. The glacial sediments of the south shore are highly susceptible to the erosion that occurs when major storm surges lift the water level 10 to 20 feet and subject the unconsolidated sediments of bluffs, headlands and dune fields to the direct attack of waves.[2] Within a few hours during the 1938 hurricane, the cliffs at Watch Hill receded some 35 feet, and the dune scarp at Weekapaug receded 50 feet.[1]

3. The south shore barrier beaches are sand-starved and have an exceptionally narrow and low profile, which leaves them susceptible to erosion and overwash. The dunes have not recovered substantially since the hurricanes of 1938 and 1954 so that the beach profile is now lower than the height of the storm surge flood waters of those major hurricanes.[6,7] As the first line of defense, they will be less effective than in the past in protecting salt pond shorelines from severe wave damage and erosion.

B. Throughout Rhode Island's history, hurricane-driven storm surges and tidal flooding have caused enormous destruction, killing hundreds of people and causing millions of dollars in property damage along the coastline. In the Great Atlantic hurricane of 1938, 262 lives were lost and $100 million in property damage was sustained statewide. After many of the coastal areas had been rebuilt, another major hurricane in 1954 again swept over the barriers, took the lives of 19 people, cut back the headlands, and caused $90 million dollars in property damage.[4] According to accounts compiled by the Army Corps of Engineers, 71 hurricanes have struck Rhode Island's shore since 1635, with an average frequency of one every seven years.[3] There is, however, no regularity to their occurrence; while no major hurricanes have swept across the state in the last 30 years, four hurricanes struck Rhode Island in the decade from 1944 to 1954. It is difficult to plan for an event that occurs so sporadically yet with extraordinary force and devastation.

C. In response to the devastation of the 1954 hurricane, several of the salt pond region's coastal communities were among the first to join the Federal Flood Insurance Program. All three of the region's towns now participate in the Federal Flood Insurance Program and have adopted building codes and local ordinances in accordance with the federal standards. As in many states, the national flood insurance program has often encouraged development in hazardous areas of the coastal zone.[5] Land values in high hazard areas along the barriers continue to appreciate. Houses on 50-by-100-foot lots on the Charlestown barrier which were undermined by storm waves in the blizzard of 1978 and lost value immediately afterward were on the market for as much as $160,000 five years later. The federal insurance program has made it easier to build houses in hazardous areas where the local banks were refusing to grant mortgages after the hurricanes of 1938 and 1954.[5] The "floodproof" regulations have improved the construction standards and increased the investment in structures built more recently in the flood zones of the salt pond region.

610.2 Susceptibility to Future Storm Damage in the Salt Pond Region

A. Today several of the barriers and much of the low-lying coastal plain around the ponds are densely developed. Instead of fields and open space where debris can accumulate and flood waters can rise harmlessly, there are now three times more houses than were present at the time of the last major hurricane in 1954. According to 1981 aerial photographs, there were more than 2,000 houses and 6,000 residents in the flood zones designated by the Federal Emergency Management Agency (FEMA) in the salt pond region (Figure 6-1). Although aware of the occurrence of hurricanes and the destruction they have caused in the past, most of the people now living in the region have never experienced the force of a major hurricane. Many consider themselves safely removed from the destructive power of an ocean that is a mile away beyond a placid salt pond and coastal barrier.

B. In addition to the resident population, there are thousands of summer tourists that visit the region during the hurricane season. Many of the out-of-state tourists that live in rental houses during the summer may not be familiar with local authorities, evacuation routes, location of designated shelters, or know what to expect if police-enforced evacuation becomes necessary.

C. The state of Rhode Island's Coastal Resources Management Council has adopted a comprehensive set of findings and regulations which deal with many of the issues that a statewide regulatory program can address for flood hazard areas. However, the soundest regulations are useless if they go unheeded or unenforced. Officials acknowledge that enforcement of the building regulations in flood zones has been uneven.

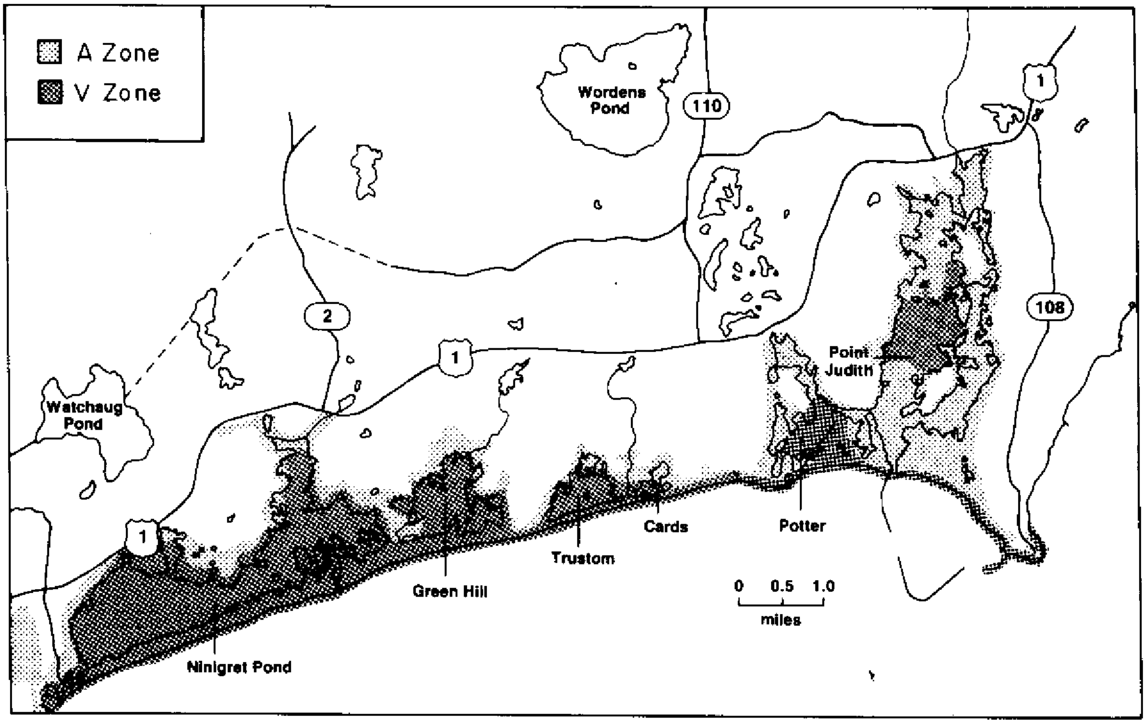


Figure 6-1. Zones of severe flood hazard. Adapted from Federal Emergency Management Agency maps prepared for the region in 1984.

D. The boundaries of the flood zones are being redefined on 1984-1985 FEMA flood insurance maps of the south shore of Rhode Island. The maps incorporate more accurate estimates of the extent of flooding and change the location of the high hazard, or V zones, where waves three feet or higher may be expected to form on top of the flood waters.[6] Since CRMC construction standards are tied to the federally designated flood zones, they will need to be redefined to reflect the changes in the final adopted FEMA maps. For instance, large areas on the barrier beaches formerly denoted as V zones are classified as A zones on the new maps. Portions of the inland shore of the salt ponds that were A zones are designated as V zones.

E. The acquisition of highly vulnerable areas by state and private groups is one of the most effective means of minimizing storm damage in flood hazard areas. Acquisition and maintenance of south shore barriers as open space by private groups and state agencies has reduced the amount of potential property damage and, in some areas, restored the dunes that are the main line of defense against erosion and storm damage. With careful management of access, grass plantings and fencing, sand accumulation on the dunes can be accelerated, increasing the capacity of the barrier to protect the ponds and their shorelines from the full force of storm waves. State-owned barrier properties, however, have proved difficult to police and to maintain, and there have not been sufficient funds available for boardwalks, dune restoration, beach nourishment and education.[7]

F. The creation of temporary storm surge channels, erosion of the barriers, and extensive transport of sediment into the ponds that occur in hurricanes cause major changes to the salt ponds by altering water circulation and fish and shellfish habitats as well as creating shoals that impede boating. The manner in which cleanup, restoration and repair proceeds after a hurricane will have a major impact on the subsequent ecology and condition of the ponds.

610.3 Findings of Fact for Point Judith and Potter Ponds

A. There are several features of Point Judith and Potter Ponds that make them different from the other ponds in their susceptibility to storm damage.

1. The inlet and ocean shoreline of Point Judith Pond are protected by the breakwaters of the Harbor of Refuge. As a result, the Sand Hill Cove and Galilee shoreline has been accreting rather than eroding over the long term.[8]

2. Much of the shoreline of these ponds is steep; therefore, the amount of shoreline submerged during major storm or hurricane flooding is not as extensive as it is around the other ponds. However, the unconsolidated bluffs on Harbor and Great Islands and along portions of the western shores of these ponds are subject to wave erosion during large storms.[10]

3. Because of their more densely developed shorelines and large numbers of private docks and marinas, Point Judith and Potter Ponds are particularly vulnerable to property damage caused by the destructive force of hurricanes. In spite of the breakwaters, during Hurricane Carol in 1954 Point Judith and Potter Ponds sustained more property damage than other ponds in the region ($3.3 million).[7]

B. The areas of these ponds that experienced the most destruction in the past are the most susceptible to future hurricane damage. When Hurricane Carol hit the coastline in 1954, houses were swept off their foundations at Matunuck, Jerusalem and Sand Hill Cove, and there was nearly complete destruction of boats and docks at marinas in Galilee, Snug Harbor and the upper pond.[9] Flood waters rose 15 to 20 feet above mean sea level throughout the pond, damaging buildings, eroding bluffs, destroying power lines, water mains and contaminating wells. The bridges to Great Island and to Jerusalem across Potter Pond inlet were destroyed. Roads through Matunuck, Jerusalem, and Galilee were buried by several feet of sand

and wreckage from destroyed structures.[9] In 1938, 1944 and 1954 a storm surge channel was reestablished across Sand Hill Cove Beach through the Roger Wheeler beach pavilion at the site of the pre-1815 breachway. In each of these hurricanes, a storm surge channel into Potter Pond was also reactivated across East Matunuck Beach. In 1944 this channel stayed open for several weeks, and it could become the location of a more permanent breachway after the next hurricane. The main line of the South Shore Water System traverses this area and tends north to Snug Harbor across the Succotash Road Bridge. The bridge washed out and the barrier breached in both the 1938 and 1954 hurricanes.

C. The potential expense and amount of destruction in the next major hurricane is now much greater than in the past. Since major erosion and flooding was last experienced, there has been a dramatic increase in development within the flood zones of these two ponds. The numbers of houses around the ponds has more than doubled since 1954. In 1980 there were 885 houses within the flood zones, a commercial fleet of 238 boats berthed in the port of Galilee, and over 1,000 recreational boats moored at marinas and private docks along the shoreline during the summer season.[10]

D. Hurricane-driven waves and currents are major forces for carrying sediment and creating shoals farther into the ponds, to areas where tidal currents are usually low. This has created the subtidal shoal inside the Potter inlet as well as the flats extending along the channel and into Bluff Hill Cove in Point Judith Pond.[11]

610.4 <u>Findings of Fact for Ninigret and Green Hill Ponds</u>

A. Ninigret and Green Hill Ponds lie on a low and level outwash plain separated from the ocean by narrow barriers that have not recovered from past storm damage. As a consequence, the ponds and the lands around them are particularly susceptible to coastal flooding.

B. Because the beaches are sand-starved and in part because of intense recreational and development pressures, the dunes have not rebuilt along the barriers in the years following the last major hurricane in 1954. The dune crest is now several feet below the stillwater height of the 1938 and 1954 hurricanes, and overwash occurs frequently in winter storms.[7,12]

C. Damage to lives and property was extensive in the hurricanes of 1938 and 1954 when the ocean swept over the barriers, raised the water level in the ponds 18 feet higher than normal high tides, and flooded large areas around the ponds and their tributaries. The hurricane of 1938 caused in excess of $2.5 million property damage and took the lives of several people.[7] Hurricane Carol, a less severe storm, caused approximately $400,000 of property damage.[7]

D. The potential for destruction is now much greater than before. In the 30 years since hurricane Carol in 1954, approximately four times more houses have been built around these ponds south of Route 1. Many low areas that were open fields in 1954 are now residential communities vulnerable to flood waters and destruction from wind and wave-tossed wreckage. In 1981 there were more than 700 houses around Green Hill and Charlestown Ponds within the designated flood hazard zones.[10] Many of the houses on the barrier beaches were severely damaged in the blizzard of 1978 and they may be damaged again in severe winter storms of less force and more frequent occurrence than hurricanes.[13]

E. Cleanup after a major hurricane has been and will be a very costly operation. Vast amounts of debris will once again have to be removed from the oceanfront communities and from residential developments along inland shores of the ponds. Tons of sand and debris will have to be cleared from the roads leading to and along the barriers. Based on past experience and the 1984-85 FEMA maps, damage is expected to be particularly severe on the barrier beaches, in the Tocwotton Cove area and the East Beach Road communities of Ninigret Pond.[6] In Green Hill Pond most severe damage from coastal flooding is expected to occur on the barrier, and in the communities that border the Allen Cove and the Flat Meadow Cove-Limber Point regions.[6] Since most of the houses in the flood zones of these two ponds rely on private wells, contaminated drinking water supplies may persist long after the storm has passed.

F. As they have in the past, hurricanes are expected to cause major changes to the environment of the ponds. Previous hurricane waves and storm surge swept the sand dunes into the ponds, creating the extensive back barrier shoals that are now heavily used as shellfishing flats. At least six temporary inlets were cut through East Beach and several through Green Hill Beach in 1938. Future hurricane surges will bring large volumes of sand further inside the ponds, accelerating shoaling of the flood tide deltas. There are several active overwash sites along Charlestown Beach and Green Hill Beach that may become temporary inlets in the next major hurricane. It is highly likely that overwash may block off the Perry Creek inlet to Green Hill Pond and that the stone jetties stabilizing the Charlestown breachway will again be damaged.

610.5 Findings of Fact for Trustom and Cards Ponds

A. The lands around these ponds are very low and susceptible to extensive flooding. There was nearly $2 million in property damage in the hurricane of 1938.[7] However, most of this land is presently open space, either publicly owned as a wildlife refuge or in private hands and used for agriculture. Future storm damage is expected to be minimal when compared to the other ponds.

620. MANAGEMENT REGULATIONS AND INITIATIVES

620.1 Construction Standards in Flood Zones

A. Construction in coastal high hazard flood zones (V zones) as defined by federal flood insurance rate maps are listed as follows in Section 300.3 D (3) of the R.I. Coastal Resources Management Program, as amended.

1. All new construction and substantial improvements shall be elevated on adequately anchored pilings or columns, and securely anchored to such piles or columns so that the lowest portion of the structural members of the lowest floor (excluding the pilings or columns) are elevated above the base flood level.[14]

2. If timber pilings are used, they shall meet the American Society for Testing and Materials (ASTM) standards for Class B piles and shall have a minimum tip diameter of 8 inches. Wooden pilings shall be treated with a wood preservative. It is recommended that creosote not be used, however. Bracing between piles is required.[15]

3. Pilings in oceanfronting areas and on barrier beaches shall penetrate no less than 10 feet below mean sea level.[14] Pilings in pond shore areas shall penetrate no less than 5 feet below mean sea level.[15]

4. The primary floor beams spanning between pilings shall span in the direction parallel to the flow of potential flood water and wave action. Floor joists shall be secured with hurricane clips where each joist encounters a floor beam. These metal fasteners or straps shall be nailed on the joist as well as on the beam. Cross bridging of floor joists is required.[15]

5. To secure the exterior wall to the floor joists, galvanized metal strap connections shall be used connecting the exterior wall studs to the joists.[14]

6. Roof trusses or rafters shall be placed 16 to 24 inches on center and, as required by the Rhode Island Building Code, shall be connected to the exterior wall with galvanized metal straps.

7. As required by the Rhode Island Building Code, all windows shall meet manufacturers' standards for wind loads of 110 mph.

8. As required by the Rhode Island Building Code, the space below the lowest floor and between pilings shall be kept free of obstruction, or they shall be enclosed with "breakaway walls" designed to collapse under stress so that the impact on the structural integrity of the dwelling by abnormally high tides or wind-driven water is minimized. Such temporarily enclosed spaces

shall not be used for human habitation, or for the enclosure of any utility or item essential to the structure, unless such items are floodproofed.

9. All residential and commercial structures shall be set back not less than fifty (50) feet from the inland boundary of the coastal feature as set forth in the CRMP Section 140. In critical erosion areas, the setback shall be not less than 30 times the calculated annual erosion rate (Table 2 CRMP Section 140).

10. All plans submitted to the CRMC for buildings proposed for V zones shall be stamped by a registered professional engineer or architect.

B. Construction in Areas of Special Flood Hazard (A Zones)

1. In all other A zones, the following regulations as listed in Section 300.3 D (4) of the R.I. Coastal Resources Management Program, as amended, apply.

(a) Lowest floor elevation including basements of new or substantially improved residential buildings in A zones shall be elevated to or above the 100-year level as established on flood insurance rate maps and the Rhode Island Building Code.

(b) Parallel concrete walls or pilings rather than fill shall be used to elevate habitable residential structures when the difference between the original ground elevation and the flood elevation is more than 50 percent of the flood elevation.

(c) Standards (5), (6), and (7) for residential buildings in V zones also apply to A zones.

(d) New construction or substantial improvement of any non-residential structure shall either have the lowest floor, including basement, elevated to the level of the base flood elevation or, together with attendant utility and sanitary facilities, be floodproofed so that below the base flood level the structure is watertight, with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy.

(e) A registered professional engineer or architect shall certify that these standards will be met.

C. Filling, Removing or Grading of Shoreline Features

Filling, removing or grading is prohibited on beaches, dunes, undeveloped barrier beaches, coastal wetlands and banks in the salt pond region except for the port area of Point Judith Pond and unless the primary purpose of the alteration is to preserve or enhance the feature as a conservation area or buffer against storms (see CRMP Section 300.2).

D. Reconstruction After Storms

1. A CRMC Assent is required of all persons proposing to maintain or rebuild shoreline structures which have been destroyed 50 percent or more by storms, waves, or other natural coastal processes in the salt pond region.

2. Structures shall be rebuilt according to the standards required for the flood zone in which the structure is located.

620.2 Restoration of Overwash Channels and Temporary Inlets

A. New inlet channels breached to Potter Pond through East Matunuck Beach may be filled in with sand or gravel only after an evaluation of the impacts of a direct connection between Potter and the ocean has been made (see Section 420.1 of this Plan).

B. New inlet channels cut across the beach to Green Hill Pond, Ninigret Pond or to Point Judith Pond through Sand Hill Cove may be immediately filled in with sand or gravel.

C. Dredging of overwash shall be permitted for navigation in the Green Hill Pond Inlet, the Bluff Hill Cove Inlet and in the main breachway channels. Any dredging of overwash sand elsewhere within the ponds shall be limited to habitat restoration and enhancement in conformance with Section 450.1 of this Plan. All dredged sand shall be placed on the adjoining ocean beach.

D. When overwash accumulates on roads, driveways and parking lots on the barriers, the preferred practice shall be to leave the overwash in place and thus build up the profile of the barrier. If necessary, gravel surfacing may be placed on top of the overwash to accommodate automobiles. Priority sites that need additional elevation because they are particularly susceptible to overwash or temporary breaching include the parking lots at East Matunuck Beach, Roger Wheeler Beach, Charlestown Breachway (parking lot), Charlestown Beach and Green Hill Beach.

E. Sand transported onto paved roads leading to the beaches shall be plowed back onto the beaches and not into adjacent wetlands. Sand shall be placed on the beaches in the manner described in Section 420.1 of this Plan.

620.3 Preparation of a Post-Storm Restoration Plan for the Region

The CRMC salt ponds subcommittee, with the Action Committee, shall develop a comprehensive post-storm restoration plan that will coordinate state and municipal restoration plans. A salt pond region restoration plan shall include the following elements:

A. Plans for the reconstruction of roads, bridges and other facilities in conformance with current FEMA standards. In order to be eligible for federal funding to rebuild state and town roads, plans must be available before the flood damage occurs. These plans must incorporate current flood protection construction standards. Bridge reconstruction plans should be prepared for Succotash Road Bridge, Great Island Bridge, Harbor Island Bridge and causeway, the Seaweed Cove causeway (Potter Pond) and the Charlestown Beach Road bridge, including provisions for relocating or reconstructing the public water mains and power lines that cross these bridges.

B. Plans for debris removal and disposal which designate disposal sites for the large volumes of debris, recognizing that all landfills in the three towns are closing and that no offshore site has been approved. Temporary sites for piling shall be identified. They should be located conveniently near areas where large amounts of debris are expected to accumulate.

1. Sites that may be considered in the Point Judith and Potter Ponds area include: Galilee—Fishermen's Memorial State Park, Upper Pond—Marina Park, Snug Harbor—Water Tower Park, Matunuck—DEM field north of Succotash Road, Jerusalem—land west of the State Pier.
2. Candidate sites for the Ninigret and Green Hill area include: In Green Hill and Limber Point Area—Green Hill Beach Association parking lot, North Green Hill Pond, and Sea Lea Colony areas—Baptist Church lot, Tocwotton Cove, Cross Mills, and East Beach Road—Naval Air Base.

C. Priorities for the acquisition of features most vulnerable to storm-caused erosion and flood damage. Candidate sites include Charlestown Beach, Green Hill Beach, Matunuck Beach and the eastern end of East Matunuck Beach.

D. <u>Post-Storm Restoration</u>

Within 2 to 3 days of a hurricane, local and state officials must provide the regional FEMA office with dollar assessments of damage for prescribed categories of structures in order to obtain a formal declaration of disaster and federal disaster relief funds. Within 180 days of receiving disaster reflief funds, a report must be prepared summarizing the history of storm damage and mitigation efforts in the past and detailing effective storm hazard mitigation strategies for the future. Local teams of experts should be organized ahead of time to assist officials in each town with these tasks.[8] Tasks for such teams include:

1. Within 48 hours of the hurricane a "Wind Shield Survey" must be made to estimate the dollar value of damages. These estimates are used by the Governor in seeking federal disaster relief. The people responsible for the survey to document the immediate damage should escort federal officials on subsequent damage assessment surveys.

2. The major cause of flood damage (water, waves, structural weakness or floating debris) must be assessed at given locations in order to effectively prevent future storm damages. Recommendations should be made to town building inspectors for phasing of reconstruction. Structures assessed as 50 percent destroyed need to be identified for CRMC permitting and for eligibility in the FEMA Section 1362 program.

3. Shoreline changes must be assessed and recommendations made concerning new setbacks and siting for reconstruction, and priorities for shoreline and flood zone protection.

4. An acquisition program should be organized to coordinate with state and private organizations and the FEMA Section 1362 Acquisition Program.

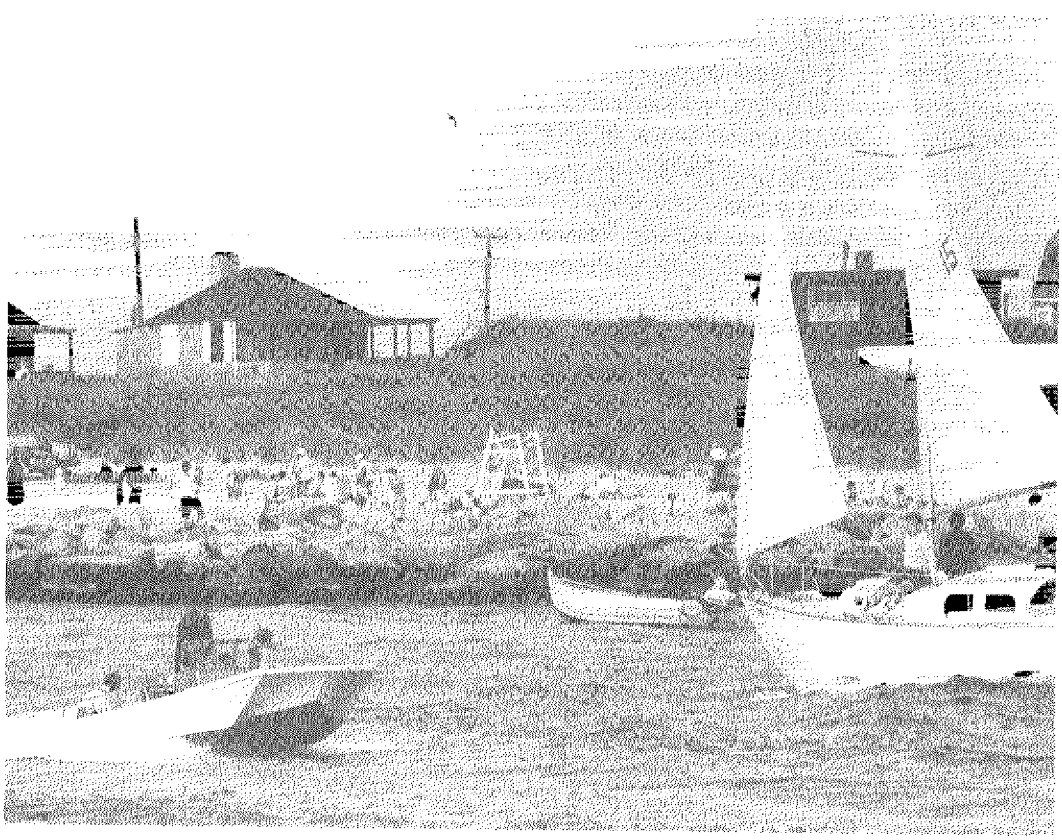
620.4 Public Education Programs

A. Together with the Action Committee, the CRMC Subcommittee shall prepare and distribute education materials to instill an appreciation for the immense destructive energy of a hurricane and to disseminate information through various media on the following topics:

- the importance of healthy coastal barriers as storm buffers
- the role of setback regulations and flood zone construction standards in minimizing damage to structures and costs to the community
- escape routes, shelter locations, shelter regulations and post-storm first aid and assistance programs

B. Financial support for these programs shall be a priority for Special Area Management Plan funding through the proposed OCS Revenue Sharing Bill.

Chapter Seven.
Intensifying Use



Robert J. Izzo

710. FINDINGS OF FACT

The measures set forth in this Plan will go far in protecting the unique qualities of the region as a desirable place for people to live, work and recreate. By protecting water quality, minimizing sedimentation and erosion, preserving fishery resources and minimizing the damage caused by periodic hurricanes, the groundwork has been laid to provide future generations with a high quality environment in which a number of activities can simultaneously occur. The perpetuation of the region's present outstanding amenities, as reflected by healthy, self-sustaining ecosystems, must be achieved, however, while accommodating further growth and more intense use of the region's resources. Much remains to be done to determine how and where more houses, more tourists and an expanded fishing fleet can be fitted into the existing ecosystem. The analysis of the region as an ecosystem and consideration of the present uses has produced a number of ideas for more intense use that merit further consideration.

720. MANAGEMENT INITIATIVES

720.1 Further Residential Development

If the areas recommended on Figures 3-5, 3-6 and 3-7 for low density development retain their present open space characteristics, they will in the future contrast more sharply with the areas of concentrated development. Such contrasts should be accentuated by developing distinct villages with community-centered commercial development and public services. Small-scale sewer treatment facilities and water systems are likely to become necessary, but should be scaled to the needs of the immediate area. Townhouses and cluster development are an efficient use of limited space, are amenable to small-scale, commonly owned services, and should be seriously considered for future development within the region.

720.2 Expansion of the Port of Galilee

Plans are being prepared by the Department of Environmental Management that will provide for improved services to an expanding commercial fishing fleet. The potential scope of future improvements to the port are described in Chapter Four.

Galilee and Jerusalem are also a major tourist attraction and much could be done to capitalize on this. Facilities and programs designed to educate visitors about the rich heritage of fishing along the south shore and the nature of the present industry have been initiated by DEM and could be expanded by providing visitor viewing facilities overlooking unloading and packing operations, displays, and demonstrations. The Galilee area is an ideal location for a museum or small aquarium and tourist center that focuses on the past and future of the port and the changing Rhode Island fishing industry. The attractiveness of Galilee and Jerusalem for recreational fishing would be much enhanced if the jetty walls of the breachway were surfaced for pedestrian access and additional parking and public facilities were provided.

720.3 Additional Public Access

Bathing and fishing are the major activities enjoyed by out-of-town visitors, while enjoying the beauty of the salt pond environs is the major attraction for residents.[1,2] Much can be done to improve the quality of these activities while accommodating more people without degrading the salt ponds. A priority for the CRMC and the Advisory Committee is to explore and initiate programs to enhance the variety of uses and diversity of activities that make the salt pond region such a valuable resource for residents and tourists alike. As development proceeds, public access to the ocean shoreline and the salt ponds will become an increasingly prized privilege. Recommended public access points within the salt pond region may be placed in the following categories.

A. Beaches

Rhode Island's south shore is graced with some of the best beaches in southern New England. Since beach-going is increasing and the beaches are high hazard areas unsuited for permanent structures, they are priority sites for acquisition for public recreation. Matunuck Beach, Charlestown Beach and Green Hill Beach in particular should be the focus of coordinated efforts for acquisition, since they sustained immense damage in the last two hurricanes. Charlestown Beach and Green Hill Beach were severely eroded during the blizzard of 1978. The principal constraint to providing for more beach users is parking space. Expansion of existing beach parking facilities should not consume precious shorefront but be located inland. Jitneys could be used to transport people from satellite parking lots at such sites as Matunuck School, the Naval Air Base and acquired sites near Rte. 1. Jitney service is proving successful for handling overflow from the Narragansett Town Beach. Since it is likely that the present parking lot at East Matunuck will be overwashed or gouged out by a storm surge channel in the next hurricane, the state should consider expanding parking facilities on the accreting eastern end of the barrier.

B. Recreational Fishing Access

The need for more intensive management of fisheries is discussed in Chapter Five and could be complemented by improved access and parking at selected popular fishing spots such as the Narrows in Ninigret Pond adjacent to the Naval Air Base property. The bridge to Great Island in Point Judith Pond, the Succotash Road Bridge over Potter Pond Inlet and Creek Bridge on Charlestown Beach Road have long been favorite sites for line fishing. Their value and safe use could be improved by providing small fishing platforms along the side of the bridges and by purchasing or designating nearby parking space.

C. Boat Launch Sites

Most of the boat launch sites in the ponds are presently in private ownership at marinas and yacht clubs. There is a need for public boat access to each of the larger salt ponds. Candidate sites for state-owned and state-maintained launch sites and parking lots in the Potter-Point Judith area are the western side of the causeway to the Great Island Bridge and the Wakemo Park area of Potter Pond, a prime site for acquisition after the next hurricane. In Charlestown and Green Hill Ponds, there is a single state-owned launch ramp on the eastern side of the breachway. In order to keep traffic and trailering of boats to a minimum along the barrier beach, a ramp and small parking lot north of Creek Bridge over Green Inlet should be considered.

D. Parks and Campgrounds

There are several cases where expansion of state park facilities would benefit the salt pond environment and expand opportunities for low intensity recreation. There are long stretches of salt pond shoreline that are as yet undeveloped and could be preserved as linear parks. Candidate sites include portions of the northern end of Potter Pond, and the Long Cove area in Point Judith Pond. The Fishermen's Memorial Campground could be readily expanded to the north along Bluff Hill Cove in eastern Point Judith Pond. The eastern shore of Flat Meadow Cove in Green Hill Pond is the only stretch of yet undeveloped shoreline that offers a view of the pond from a public road. It is a priority for acquisition for public access and for low intensity use. A large proportion of the Ninigret Pond shoreline is in public ownership. Public lands bordering the pond should be managed for low intensity use and maintained in a natural state.

720.4 Development Compatible with the Natural Features and Heritage of the Region

The natural resources and heritage of the coastal ponds are unique precious assets. The enormous appeal of the salt ponds, their ocean shore, and cultural heritage reflected in the varied landscape provide the driving force behind the region's rapid development.

A. Agricultural Resources

The outwash plain of the salt pond region contains some of the finest agricultural soils in the state. These level, well-draining, relatively stone-free fields have been formed for generations and are an important aspect of the heritage of the region. The tilled fields of the south shore farms also provide some of the best vistas of the salt ponds and sense of open space in the region. However,

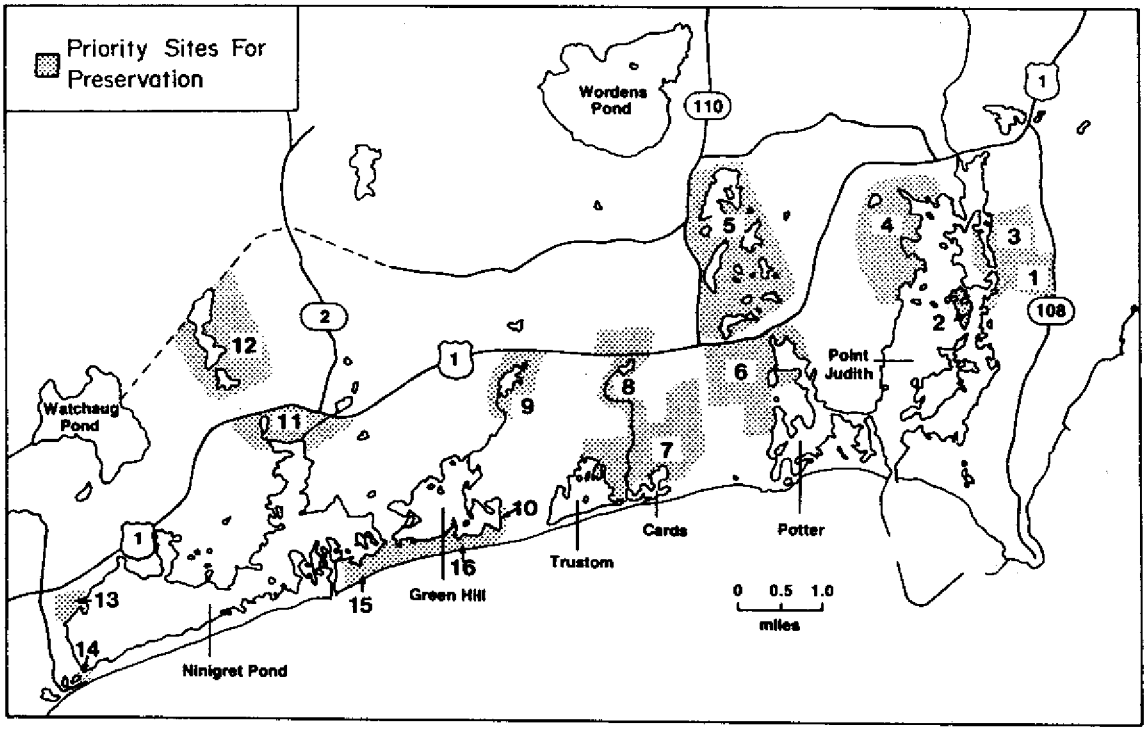


Figure 7-1. Priority sites for preservation in the salt pond region. The sites on this map are named and their important characteristics identified in Table 7.1.

changing economics and increasing property taxes are causing more and more farmland to be subdivided for residential or commercial development. Continued use of farmland for a variety of crops as well as pasturage should be encouraged. The Action Committee agenda should pursue all opportunities to preserve farmland through special agricultural zones and leasing arrangements or purchase of conservation easements. Important farmland located north of Trustom and Cards Ponds may be considered for an agricultural district. There are smaller fields along the eastern shore of Fort Neck Cove on Ninigret Pond and the western shore of Potter Pond that should be preserved as farmland.

B. Historic Resources

The salt pond region is rich in unique historic resources that extend from prehistoric Indian occupation 3,000 years ago, through colonial times, the rum running era, and the Narragansett Indian community that recently reclaimed ancestral lands north of Ninigret Pond in Charlestown. Many of these historic sites are largely unheralded today. If popularized and promoted, they could form the basis for tourist attractions that would also provide funds for their upkeep and protection.

A priority for the Action Committee shall be to assemble and publish information together with state and local historical societies about the rich heritage of the region. Tours of the region could be initiated and perhaps integrated with the DEM summer naturalist programs.

The Rhode Island Historic Preservation Commission conducts surveys of the state's historical and archeological resources and recommends significant properties for protection by the National Register of Historic Places. Many are within the critical resource areas designated in Chapter Three and add to the importance of preserving these lands. There has also been extensive archaeological excavations of important prehistoric Indian encampments on Ninigret and Potter Ponds.[3] Preliminary findings of a recent survey by the Rhode Island Historic Preservation Commission suggest that at least eight Indian burial grounds are located within the salt pond region.[3] These important archeological sites are priorities for acquisition and preservation.

720.5 <u>Priority Sites for Preservation</u>

There are many governmental and private programs whose purpose is to preserve lands and structures with exceptional qualities. These include the Department of Environmental Management's Open Space Program, the Natural Heritage Program, the R.I. Historic Preservation Commission and the Nature Conservancy. Sites that are priorities for preservation through outright acquisition, conservation easements or other means are identified in Figure 7-1 and Table 7-1. These sites all possess exceptional scenic qualities and include naturally sensitive areas, prime agricultural lands and concentrations of historic resources. Preservation of these sites will go far toward maintaining the unique qualities of the region.

TABLE 7-1. Priority Areas for Preservation in the Salt Pond Region.

Map Key No.	Site	Exceptional Scenic Qualities	Important Historical/Archeological Resources	Primary Aquifer Recharge	Prime Agricultural Lands	Prime Wildlife Habitat	Unique Plant Assemblages	Abutting Pollution Sensitive Salt Pond Areas	Abutting Important Spawning/Nursery Areas	High Hazard Flood Zone	High Development Pressure
1.	East Farm	X	X			X		X			
2.	Ram Island	X				X		X	X		
3.	Long Cove	X				X		X			X
4.	N.W. Pt. Judith	X	X		X	X		X	X		
5.	Matunuck Hills	X	X	X		X	X				
6.	Northern Potter	X	X		X	X		X	X		X
7.	Agri. Lands	X	X		X	X	X	X		X	X
8.	Cards Stream	X	X			X		X	X		X
9.	Factory Pond/Stream	X		X	X		X	X	X		
10.	Flat Meadow Cove	X				X		X	X	X	X
11.	Cross Mills-King Tom	X	X	X		X		X	X		X
12.	School House Pond	X	X	X		X					
13.	Reeds Point	X				X		X	X	X	X
14.	East Beach	X						X	X	X	X
15.	Charlestown Beach	X							X	X	X
16.	Green Hill Beach	X						X	X	X	X

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