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Wastewater Management Alternatives for the Salt Pond Region of Westerly, Rhode Island (With Special Emphasis on the Winnapaug Pond Watershed)

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WASTEWATER MANAGEMENT ALTERNATIVES FOR THE SALT POND REGION OF WESTERLY, RHODE ISLAND

(With Special Emphasis on the Winnapaug Pond Watershed)

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ABSTRACT

As people move toward the coasts in growing numbers, the coastal zone is faced with ever increasing development pressures. The Town of Westerly, Rhode Island is experiencing many of the problems associated with these pressures. In order to expand a motel in the Misquamicut section of Westerly, the current owner of the property has proposed to extend city sewer lines to this area at his own cost. Afterward the line would be turned over to the town. While extension of sewer lines may relieve some local septic system failure problems, it could also spur more rapid and extensive growth. Overdevelopment may lead to irreparable damage to the sensitive barrier beach - salt pond environment. Furthermore, this area is susceptible to extensive storm damage, flooding, and high rates of erosion, which make it unsafe for development. Thus, sewer lines may not be the best wastewater management alternative. Rhode Island is currently considering legislation that would enable local communities to develop Waste Water Management Districts. This alternative has been proven to be an effective method of managing septic system related pollution in other communities. In order to address septic system problems, the Town of Westerly should develop a Waste Water Management District for its salt pond watersheds. In this manner, wastewater problems could be mitigated without encouraging intensified development.

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I. Introduction:

Between 1950 and 1980, the coastal population of the United States increased by over 30 million people.[1] This trend is expected to continue, and by 1990, 75 percent of the nation's population will live within fifty miles of the coast.[2] The continued migration of population toward the coastal zone is placing additional development pressures on these areas. This has intensified the conflict between those interested in preserving the coasts and those interested in their development.

With the flood of new inhabitants to the coastal zone, increased residential and commercial development is inevitable and necessary. Although this growth is unavoidable, the parameters for expansion can be set in such a manner as to minimize environmental problems that accompany development. Development should be directed away from environmentally sensitive salt marshes, coastal ponds, and dune fields, and toward more suitable areas. Sensible planning could go a long way toward maintaining the delicate balance between development needs and environmental concerns.

Due to its prime location, the barrier beach - coastal lagoon system has been the focus of great development pressures. While these areas are extremely resilient to natural disasters, such as hurricanes and flooding, they are very susceptible to damage from human activities, which have the potential to destroy the delicate balance of natural forces in the barrier beach--coastal lagoon system.

Coastal ponds, and their associated salt marshes, have both intrinsic and ecological values that warrant their protection. The pond and marsh are important for flood control and erosion protection. These biologically productive areas play an important role in the food chain. Many economically important fishery stocks depend on the ponds and marshes for at least a portion of their life cycles.[3] Furthermore, salt marshes may help purify polluted waters.[4]

In addition to forming the seaward boundary of coastal ponds, barrier beaches serve several other important functions. Primarily, the barrier beach is a storm protection system. In response to storm action, the beach flattens out, causing waves to break earlier and expend much of their energy before encountering the land. The dunes trap aeolian particles, helping to build and strengthen the beach. In addition to storm protection, barrier beaches support important recreational activities.

The general trend of population movement toward the coast is clearly seen along the South Shore of Rhode Island. Easily accessible from the major population centers of Boston and New York, the South Shore has experienced tremendous growth since the 1950's. This rapid growth has placed some extreme pressures on the region.

The Town of Westerly is presently facing a dilemma resulting from overdevelopment in Misquamicut. This part of town is currently dependent upon septic systems for wastewater treatment. Failures of these systems, combined with the population density, pose a threat to the water quality in Winnapaug Pond. Degradation of the pond has public health, ecological, and economic ramifications.

Westerly can choose from several alternatives for dealing with this wastewater issue. First, the town could decide to do nothing at the present time. Recent surveys indicate that the water quality of Winnapaug Pond is relatively good; however, continued growth in this watershed could have significant negative impacts on water quality. Therefore, Westerly cannot afford to postpone resolution of the wastewater issue.

As a second alternative, the town could decide to extend sewer lines to Misquamicut. Westerly is already served by a sewage treatment plant that could handle the additional load generated by present and projected development in Misquamicut. A local businessman has proposed to extend the sewer line, at his own expense, in order to provide the sewage treatment capacity necessary for development of a large motel on Atlantic Beach. Upon completion, the new line would be turned over to the town, and presumably used to connect other residents to the municipal sewage treatment plant (MSTP). While this alternative could eliminate septic system related problems, there are other costs associated with the proposal. Primarily, the extension of the sewer line could spark a new wave of development along Atlantic Beach, which is poorly suited for the current level of development, let alone any increase.

A third alternative would be the increased regulation of septic systems. Although the design, siting, and construction of these systems are well regulated, there is only limited control over operation and maintenance. Legislation has been introduced in the Rhode Island General Assembly that would allow local governments to form wastewater management districts (WWMD). Through the WWMD, a local community could regulate the operation and maintenance of septic systems, which would be an important step in assuring the continued health of existing groundwater supplies and wetlands. Similar districts in other parts of the country have had a significant impact on the correction of septic system related problems. In order for this system to be effective in Misquamicut, it would have to be accompanied by actions designed to reduce the ultimate density of development.

Superficially, the choice between sewers and septic systems can be seen as a decision on wastewater disposal; however, this decision also has far reaching implications in terms of future development. In order to make a responsible decision on this issue, the decision makers should be aware of the potential long term ramifications of their decision, and not just the short term benefits.

In order to establish the groundwork for the discussion of wastewater treatment alternatives for Misquamicut and the Winnapaug Pond watershed, this paper will begin with a discussion of the general characteristics of the barrier beach - coastal lagoon system. Special attention will be paid to the values of this system, and the potential impacts of human activity.

The next chapter focuses on the Westerly Salt Pond Region. After establishing the physical characteristics, this section examines the factors which are placing increasing pressure on the natural system.

Chapter four details the alternative of the extension of sewer lines to Misquamicut. The current status of this proposal is reviewed, as well as the various costs and benefits associated with this alternative. Attention focuses on the potential for increased development resulting from the availability of sewer connections, and the suitability of the Atlantic Beach area for greater development.

Chapter five begins with a look at septic systems and their related problems. The utilization of wastewater management districts as a means to mitigate septic related pollution is examined, along with the potential application of this system to the Westerly Salt Pond Region. Furthermore, this section deals with the necessity of controlling the ultimate density of development. In order for any septic management scheme to be effective, there must be an effort to reduce the future density of the area through special zoning districts.

Finally, the conclusion will discuss several recommendations for Westerly. Whatever decision is made, it is important for those involved to base their decision upon careful consideration of the short and long term effects of each alternative.

II. The Barrier Beach - Coastal Lagoon System:

A. Introduction:

Barrier beaches, coastal ponds, and associated salt marshes, all play a vital role in the coastal ecosystem. Not only do these areas provide habitat for wildlife, they help provide benefits in terms of storm protection and flood mitigation. Figure 1 shows a generalized diagram of the barrier beach - coastal lagoon system. This is a delicately balanced natural system, and while it is well adapted to the forces of nature, it is severely threatened by certain human activities. In addition to the natural factors that define this system, this chapter will examine the effects of increasing human activities in these areas.

B. Barrier Beaches:

1. Physical Description and Processes

A barrier beach can be described as "... a narrow strip of land made of unconsolidated material that extends roughly

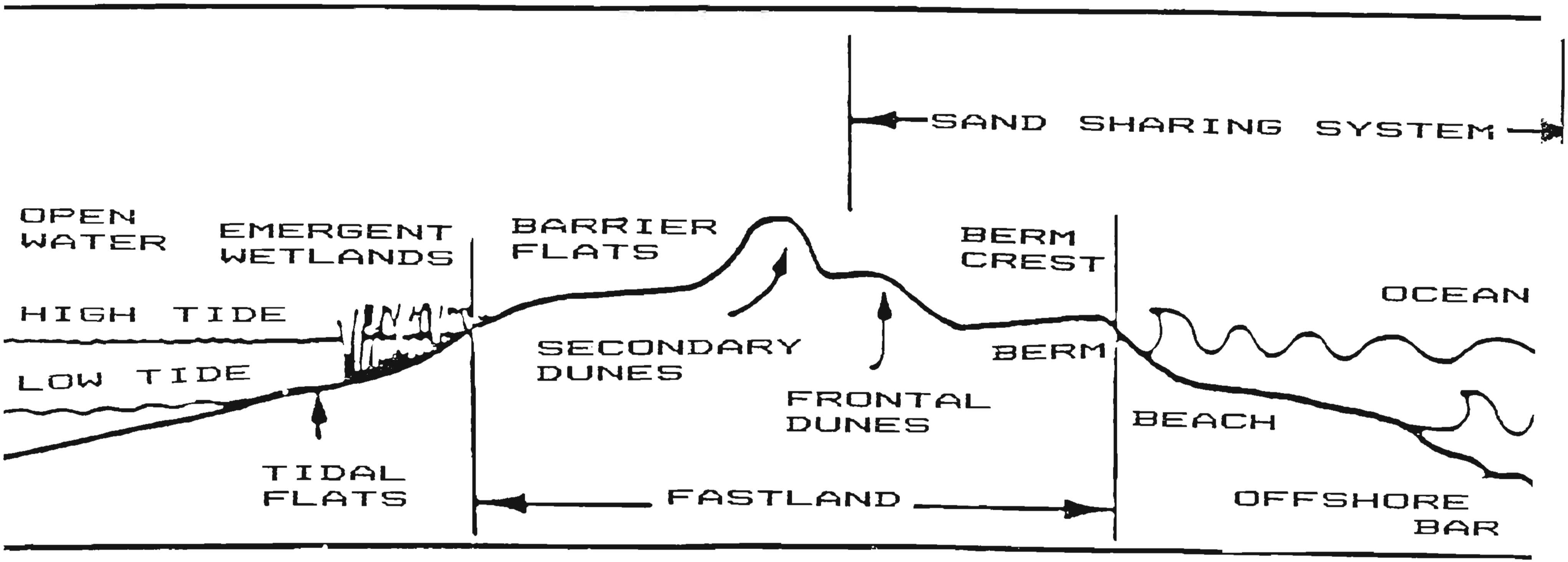

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Figure 1: The Barrier Beach System

parallel to the general coastal trend, and is separated from the mainland by a relatively narrow body of water.[5] A barrier island is merely a barrier beach with no land bridge to the mainland.

There are several theories concerning the formation of barrier beaches; however, the barrier beaches of Rhode Island's South Shore are thought to be the result of interactions between glacial deposits, and the action of wind and waves. As the last ice age ended, and the glaciers slowly retreated, they left behind debris scoured from the earth during their advance. What remained was an unconsolidated and poorly sorted till. The melting of the continental glaciers precipitated a general rise in sea level. As sea level rose, the increasing wave energy directed at the newly uncovered coasts, helped winnow the glacial deposits and transport the smaller sized particles. Longshore currents and wave action deposited this sediment load across the mouths of shallow embayments, creating barrier beaches.[6]

As seen in Figure 1, a barrier beach can be divided into several segments. The berm is the relatively low and flat portion of the beach that lies beyond the reach of ordinary high tides and waves.[7] Immmediately landward of the berm lies the dune area. Dunes are formed by wind borne particles that are trapped by vegetation and/or wave deposited debris. In the relatively protected area behind the dunes, more substanial vegetation may develop. This sheltered area is formed and influenced by storm surges which may occasionally wash sand from the beachfront over the dune crest.

Dunes play an important role in the growth and stabilization of barrier beaches. Plants, such as American beachgrass, play a vital role in maintaining the dunes. Roots form underground networks that help stabilize the dune. The leaves play an important role in trapping sand. When wind borne particles encounter the lower wind velocity area around the leaves, the particles settle out and are trapped by the beachgrass.[8]

While these are very hardy plants that are well adapted to adverse natural conditions, most do not tolerate trampling. Foot or vehicular traffic can destroy significant areas of beach-grass, and thus undermine the system that stabilizes the dunes. This can lead to erosion of dunes, and the transport of materials away from the beach and into the coastal lagoon. This material is effectively lost from the beach's reserves.

Barrier beaches are not static, rather they are constantly moving and changing shape in reaction to the amount of available material, wind velocity, wave action, and sea level changes. This ability to adapt allows the barrier beach to survive the vagaries of the coastal environment.

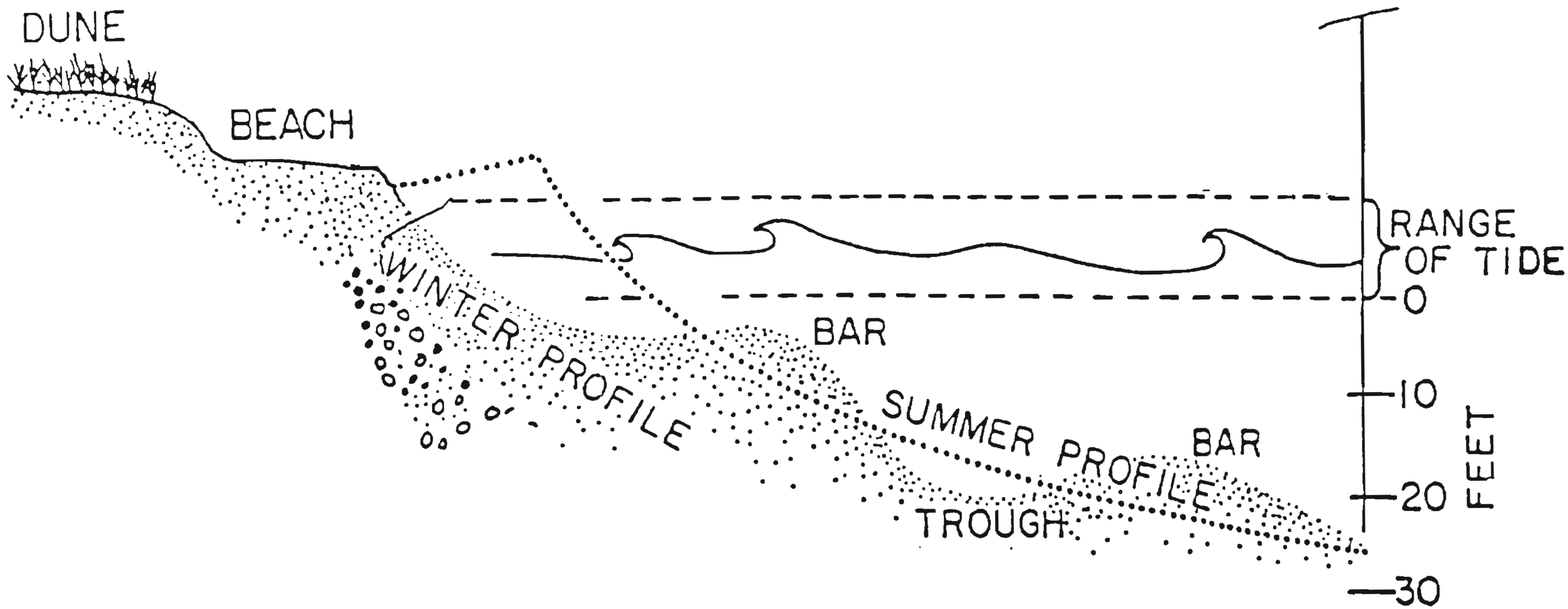
The barrier beach can be thought of in terms of a dynamic equilibrium between four factors:[9]

1. Materials - sand, silt, debris
2. Energy - wind, waves, tides
3. Shape of the Beach - steepness and width
4. Sea Level - rise or fall

The barrier beach survives through the balancing of these factors.

In order to understand the dynamics of the barrier beach, it is useful to think in terms of a materials budget that reacts to changes in energy or sea level through changes in the beach profile. Figure 2 shows the seasonal changes for an idealized barrier beach. During the stormy winter months, sand is washed from the beachfront, steepening the profile of the beach. This sand is transported offshore, where it forms an offshore bar. As the offshore bar grows, incoming waves respond to the shallow water and break further offshore than usual. In this manner, much of the waves energy is expended before it reaches the beachfront, which helps reduce the amount of sand washed from the beach. During the calmer summer months, waves transport the sand from the offshore bars to the beachfront. Thus the beach is widened and the beach profile becomes flatter.[10]

In addition to seasonal changes, the barrier beach can change in reaction to individual storm events. As large, storm induced waves pound the beach, they remove sand from the berm and dunes. Continued storm wave action can remove substantial amounts of material that are then deposited offshore. If the storm is severe enough, waves may actually wash over the dunes, carrying beach materials into the marsh and pond. The offshore transport of material, coupled with wind action and overwash, tends to flatten the profile of the beach. Waves lose energy as they move across the shallow offshore bars and onto the dunes. In this manner, the barrier beach reacts to severe storm conditions,



<u>Figure 2</u>: Seasonal Barrier Beach Profiles

and helps protect landward areas from the full force of the storm.

Barrier beaches also react to sea level changes. In response to sea level rise, waves are able to wash over the dunes and into the marsh and pond areas. Accumulation of sand landward of the dunes eventually buries the marsh in places; however, overwash material also extends shallow water into the pond, which allows the marsh to expand in this direction. Thus, the barrier beach system moves shoreward with increasing sea level. Evidence of this movement can be found in the geologic record, which records salt marsh deposits beneath present day barrier beaches.[11]

Although it may not appear so to the casual observer, the barrier beach is also moving on a daily basis. In addition to onshore and offshore transport, beach materials are also transported parallel to the beach. This movement is a result of the longshore current developed from waves striking the beach at an angle. As the wave rushes up onto the beach, particles are lifted, suspended in the wave, and moved inland. As the wave retreats the suspended material is washed back toward the ocean. Since the waves are striking the beach at an angle, the suspended particles are also transported a small distance parallel to the shore. While these longshore currents move beach materials around, they generally do not alter the overall area of the beach, provided enough beach material is made available to the system.[12]

2. Values

Due to their location, barrier beaches provide several valuable functions. First, they serve as the seaward levee that creates and helps maintain coastal ponds and salt marshes. As will be discussed in the next section, these features have important wildlife, recreational, and ecological values. Second, coastal barriers, and associated ponds, provide unique habitats for many plants and animals, including twenty species listed as endangered or threatened.[13] Third, barrier beaches provide excellent recreational activities, such as swimming, camping, fishing, beachcombing, and many others. Of the approximately $1.1 billion spent anually on fish and wildlife related activities in the states bordering the Atlantic and Gulf of Mexico, the majority is associated with activities on coastal barriers.[14] Finally, barrier beaches and islands provide landward areas protection from the direct fury of the sea.

3. Man and Coastal Barriers

While the barrier beach is well adapted to the high energy oceanfront environment, problems arise as man attempts to develop these mobile features. The concepts of property lines and ownership do not mix well with the dynamic nature of the coastal barrier. As the beach reacts to the natural environment, property and structures may be swept away. In its natural state, a barrier island will migrate toward the mainland with rising sea level. Concurrent with this movement is the "loss" of property from the front of the beach, and the growth of the landward side of the beach.

As the amount and value of development along a barrier beach increases, the motivation to stabilize this area will likely increase. In other words, the greater the development, the easier it is to justify the establishment of expensive shoreline protection projects. Therefore, it is important to consider the effectiveness and expense of these projects, as decisions are made which will affect future development patterns along a barrier beach.

In an effort to "stabilize" coastal barriers for the protection of property, man has attempted to make the beach stationary, which severely curtails the natural ability of the barrier to adapt to the changing coastal environment. Human efforts to stabilize the beach may have severe impacts on the dynamic equilibrium that maintains the beach. By altering the flow of materials, shape of the beach, and longshore transport, man-made structures can destroy the delicate natural balance of the coastal barrier system.

Coastal barrier protection and stabilization projects can be divided into four basic categories: sand stabilization, seawalls or breakwaters, groins, and beach replenishment.[15] Each of these schemes addresses the dynamic nature of coastal barriers in a different way.

Sand stabilization involves the use of semi-permeable objects, such as snow fences or discarded Christmas trees, to trap wind borne particles to build and stabilize the dunes. While this may bolster the dune barrier over the short term, it does not address the issue of beach recession.[16] A continued rise in sea level will eventually undermine the present dune ridge.

Seawalls and breakwaters seek to control beach erosion through the reduction of wave energy in the beach area. However, seawalls may actually increase the rate of erosion through the reflection of wave energy.[17] As sea level rises, the beach in front of the seawall is eroded and washed offshore. Eventually, the waves will carry to the seawall. Because the seawall is roughly perpendicular to the wave path, a good deal of the wave's energy is reflected back offshore. This increase in reflected energy hastens erosion through the offshore transport of sand. If sea level continues to rise, the seawall may be undermined or otherwise destroyed. In this expensive battle to halt erosion the beach is often lost, eliminating many of the recreational activities that were once available.[18]

Groins are walls extending perpendicularly from the shore into the ocean, and are designed to trap the sand being transported by the longshore current. Although the beach on the upcurrent side of the wall benefits from the deposition of material carried by the longshore current, beaches down current of the wall are cut off from an important source of materials. Thus, building a beach in one location, may actually destroy beaches in down current locations.

Beach renourishment involves the artificial build up of beaches through the dumping of large quantities of sand. The sand may come from quarries or dredge projects. Beach renourishment has the advantage of being generally less costly than seawall or groin projects. In addition, a renourishment project can easily be halted if it is judged to be ineffective or cost prohibitive.[19] However, this alternative is often limited by the availability of suitable renourishment materials and is still expensive.[20] The average cost for a beach nourishment project is on the order of one million dollars per mile, and may be several times higher.[21]

Coastal barrier stabilization plans should be regarded as temporary measures at best. They are often costly, and the disruption of the natural system can have the net result of destroying the beach that the program was supposed to save.

Barrier beaches are also unsuitable for development due to the exposure of these areas to hurricanes and other devastating storms. Coastal areas may be whipped by hurricane winds up to 175 miles per hour, and inundated by storm surges up to 20 feet above normal tide levels.[22] Low lying coastal barriers often bear the brunt of these onslaughts. Man made structures are poor defenses against such force. Coastal barriers are thus high hazard zones suceptible to high loss of property and human life.[23] Inland areas may also suffer increased damage as a result of barrier beach development. The large quantities of debris swept from the coastal barrier can batter and destroy inland structures, thereby increasing storm related damage.[24]

The vulnerability of coastal barriers to storm damage is well documented; however, even after severe devastation by storms, they are often redeveloped. A clear example of this is Westhampton Beach on Long Island. The 1938 hurricane destroyed 156 out of 179 homes on Westhampton Beach: today there are over 900 homes on the same coastal barrier.[25]

Thus, it can be seen, that although coastal barriers are prime targets for development, these low-lying, dynamic formations are poorly suited to support development. Furthermore, in addition to being costly and ultimately doomed to failure by the rising sea level, attempts by man to "stabilize" the barrier may actually exacerbate erosional problems. Destabilization and destruction of coastal barriers means the loss of important wildlife, recreational, storm protection, and esthetic values.

C. Coastal Lagoons and Salt Marshes:

1. Physical Description

Coastal lagoons, or saltwater ponds, are the relatively narrow bodies of water that separate the barrier beach from the mainland. In the case of Rhode Island, these ponds are also relatively shallow and less saline than sea water, with an average depth around five feet, and average salinities around 29ppm.[26] Many of Rhode Island's coastal ponds also have become stabilized by the construction of permanent inlets. This facilitates exchange between the pond and ocean. Toward the coastal barrier side of the pond, the bottom sediments are chiefly sand removed from the barrier beach by wind or wave.[27] Moving away from the barrier, the pond bottom tends to consist of silty lagoonal sediments.[28]

Salt marshes are low lying wetlands periodically inundated by salt water. Relatively few plant species can adapt to the rapid changes brought about by the periodic encroachment of salt water, therefore salt marshes in the Northeast are typically dominated by only four specialized plant species: cordgrass (Spartina alterniflora), salt meadow grass (Spartina patens), black rush (Juncus gerardi), and saltworts (Salicornia spp.).[29] S. alterniflora is the dominant plant type in the zone lying between normal high tide and normal low tide. Inland of the normal high tide line, S. patens becomes the prevalent species. J. gerardi is found still further inland. Underlying the plant growth is a peaty layer composed mainly of dead plant material. Figure 3 diagrams a typical New England salt marsh.

2. Values

The coastal pond - salt marsh complex is a valuable natural system in terms of biological productivity, commercial fisheries, wildlife, recreation, flood mitigation, and water purification. These ecosystems also have intrinsic value as open space and scenic resources. Recent studies indicate that wetlands rank high in esthetic quality in comparison to other land types.[30]

In terms of primary productivity, salt marshes are one of the most productive areas on earth. The average salt marsh

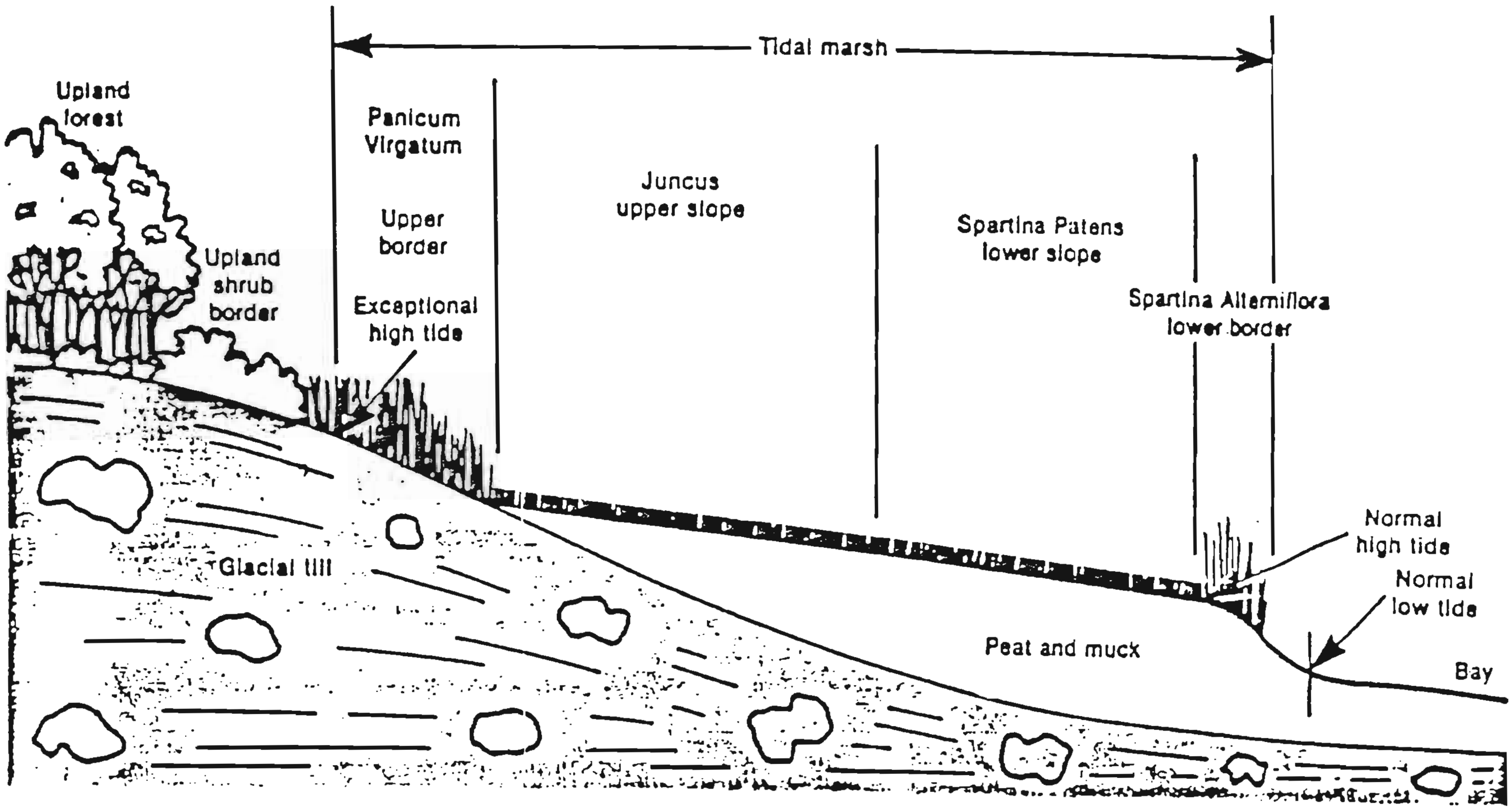


Figure 3: A Typical New England Salt Marsh

is two times more productive than the average agricultural land.[31] The high productivity of the salt marsh can be traced to several factors. First, nutrients are mechanically and chemically removed from the water.[32] Stands of marsh grasses provide low current velocity areas that promote the settling out of sediments and nutrients. The mixing of freshwater, laden with nutrients from the land, with the saline estuarine waters, induces flocculation and chemical precipitation of small particles. Second, the nutrients introduced to the system are rapidly recycled. Third, the periodic flushing of the marsh area helps deliver nutrients and remove waste products.

Although not as productive as the salt marsh, the remainder of the coastal pond is still very productive. Sunlight penetrates the shallow and relatively clear waters of coastal ponds, and promotes the growth of extensive beds of eelgrass and algae.33 Furthermore, the shallowness of the pond enhances the exchange of nutrients and organic material between the bottom, water column, and surface.[34]

The primary productivity of the coastal lagoon - salt marsh complex is an important factor in maintaining many important fishery stocks. Over 65% of the species contributing to commercial fishery landings on the east coast of the United States spend some portion of their life cycle in salt marshes and associated estuaries.[35] In addition to providing food, the protected marsh and pond areas provide habitat for these species.

Coastal ponds and marshes are also an important habitat for many other animals. Birds, in particular, use the ponds and marshes as breeding, nursery, and feeding areas. In addition to local bird species, coastal ponds provide important stopping points for flocks of migratory species.

The extensive fish and wildlife populations supported by the coastal pond complex also provide many recreational opportunities. It has been estimated that these areas are even more important to recreational fisheries than to commercial fisheries.[36] Rhode Island's coastal ponds also support commercial and recreational harvests of shellfish. The large waterfowl populations provide both hunting and bird watching opportunities.

Boating, swimming, and water skiing are some of the other recreational activities pursued in the coastal ponds. The scenic and recreational attractiveness of Rhode Island's coastal ponds provide significant economic benefits in terms of tourism and the attraction of businesses to the state.[37]

Salt marshes and coastal ponds are also important in mitigating storm and flood damage. Through the retention and absorbtion of flood waters, the pond - marsh complex helps reduce the impact of coastal flooding. The temporary retention of flood waters is primarily a function of the topography of the ponds.[38]

Wetlands may also help reduce storm and flood related damages through the control of erosion. Marsh vegetation reduces the flow velocity of moving water, which helps protect the shoreline.[39] Furthermore, the roots of marsh vegetation help to bind the sediments together.

Recently, coastal ponds and associated wetlands have been examined as a water purification system. Through chemical, biological, and mechanical activity, these areas may help reduce the levels of certain pollutants in coastal waters.

Because they are readily absorbed onto suspended particles, heavy metals, hydrocarbons, and other potentially toxic substances may be removed from the water and trapped in wetlands as the sediment load settles out.[40] Wetlands remove heavy metals with anywhere between 20 and 100 percent efficiency, and once removed heavy metals are effectively trapped within the sediment by the oxygenated zone at the sediment surface.[41] However, these substances may reenter the ecosystem through the food chain. For toxic substances which degrade in soils, entrapment in marsh sediments may be a permanent method of disposal.[42]

Salt marshes may also help control eutrophication through the damping of nutrient inputs into the coastal pond. Through the absorption of nitrogen and phosphorus entering the pond system, the marsh area may help prevent algal blooms and potentially resultant anoxic conditions in the pond.[43] Due to the lack of reliable data on nutrient input and output, the concept of salt marshes as nutrient buffers is incomplete.[44]

3. Man and Coastal Ponds and Salt Marshes

Coastal lagoons and associated salt marshes are very susceptible to damage from certain human activities. Stormwater runoff from developed areas can carry pollutants into the pond. Further, the prime coastal location of salt marshes makes them vulnerable to destruction through dredging and filling.

The runoff of surface waters and the flow of groundwater may carry harmful pollutants into the coastal pond system. Structures and development associated with an increased human presence can often exacerbate water contamination. Roads, bridges, buildings, and storm drains reduce the percolation of rainwater through the soil, which bypasses the purifying effects of percolation. Thus, stormwaters, carrying hydrocarbon residues and other contaminants, such as heavy metals, may flow directly into the pond. This stormwater discharge can have serious adverse effects on tidal wetlands.[45]

Factors associated with development may also increase nutrient loading of coastal ponds. Individual sewage disposal systems (ISDS), lawn and garden fertilizers, and animal wastes are some potential sources of excess nitrates.[46] As previously discussed, increased nutrient levels may eventually lead to anoxic conditions in an aquatic ecosystem.

In addition to increased contaminant loads, human activities may also affect coastal wetlands directly, through the dredging and filling of these areas. Drainage channels may be developed in order to control mosquitoes or to drain the wetlands to make them more suitable for agriculture or building. This alteration of the natural hydrologic system can destroy a salt marsh.

In an effort to establish a firm building surface, and to raise the land above the reach of periodic flooding, wetlands have been destroyed through filling. In addition to immediate burial and extinction of the fill area, filling also poses a serious threat to adjacent marshes and ponds. Leaching of nutrients and toxic substances from the fill material is a serious threat to the surrounding ecosystem.[47]

Thus, uncontrolled development of coastal areas has the potential to severely disrupt the coastal pond - salt marsh environment. The addition of nutrients and toxic substances, and dredge and fill activities, could easily destroy this environment and result in the loss of the many benefits derived from it. Careful control and mitigation of run off problems, and severe limitation of dredging and filling, can help reduce negative environmental impacts associated with increased development.

D. Summary:

The barrier beach - coastal lagoon complex is an area of esthetic, environmental, and economic values. Flood control, storm protection, fishery habitat, recreation, and wildlife support are but a few of the benefits derived from this natural system.

Although the barrier beach, coastal pond, and associated marshes are resilient to natural phenomena, such as storms or sea level rise, they are quite susceptible to factors associated with development of the coastal zone. Efforts to stabilize barrier beaches, fill marsh areas, or drain coastal wetlands severely disrupt the delicate natural balance. Indirect consequences of development, such as expanded road systems, and increased traffic, may also have detrimental effects upon these areas.

The important values of the barrier beach - coastal pond complex, coupled with its vulnerability to outside perturbation, require that any development affecting this system be well planned and executed. This should include the direction of development away from the more sensitive and vulnerable features, such as barrier beaches and marshes.

III. The Westerly Salt Pond Region:

A. Introduction:

Located in the extreme southwest corner of the state, the Westerly Salt Pond Region consists of the three salt ponds situated within the town boundaries, and their associated watersheds. These watersheds encompass approximately 4850 acres. From west to east these ponds are Maschaug Pond, Winnapaug Pond, and Quonochontaug Pond. Quonochontaug Pond is bisected by the boundary between Westerly and Charlestown. A diagram of the Westerly Salt Pond Region, together with a brief description of each pond can be found in Figure 4.

Rhode Island's South Shore is one of the fastest growing areas in the state (see Appendix A), and all three watersheds are experiencing problems associated with escalating development; however, the Winnapaug Pond watershed is currently facing the most immediate problems due its high level of development. For this reason, this chapter will focus mainly on the Winnapaug Pond watershed.

Pond	Area (acres)	Av. Depth (ft.)	Av. Salinity (ppt)	Surface/Watershed Ratio
Maschaug	42	3.8	14	1:10
Winnapaug	446	5	31	1:5
Quonochontaug	733	6	31	1:3

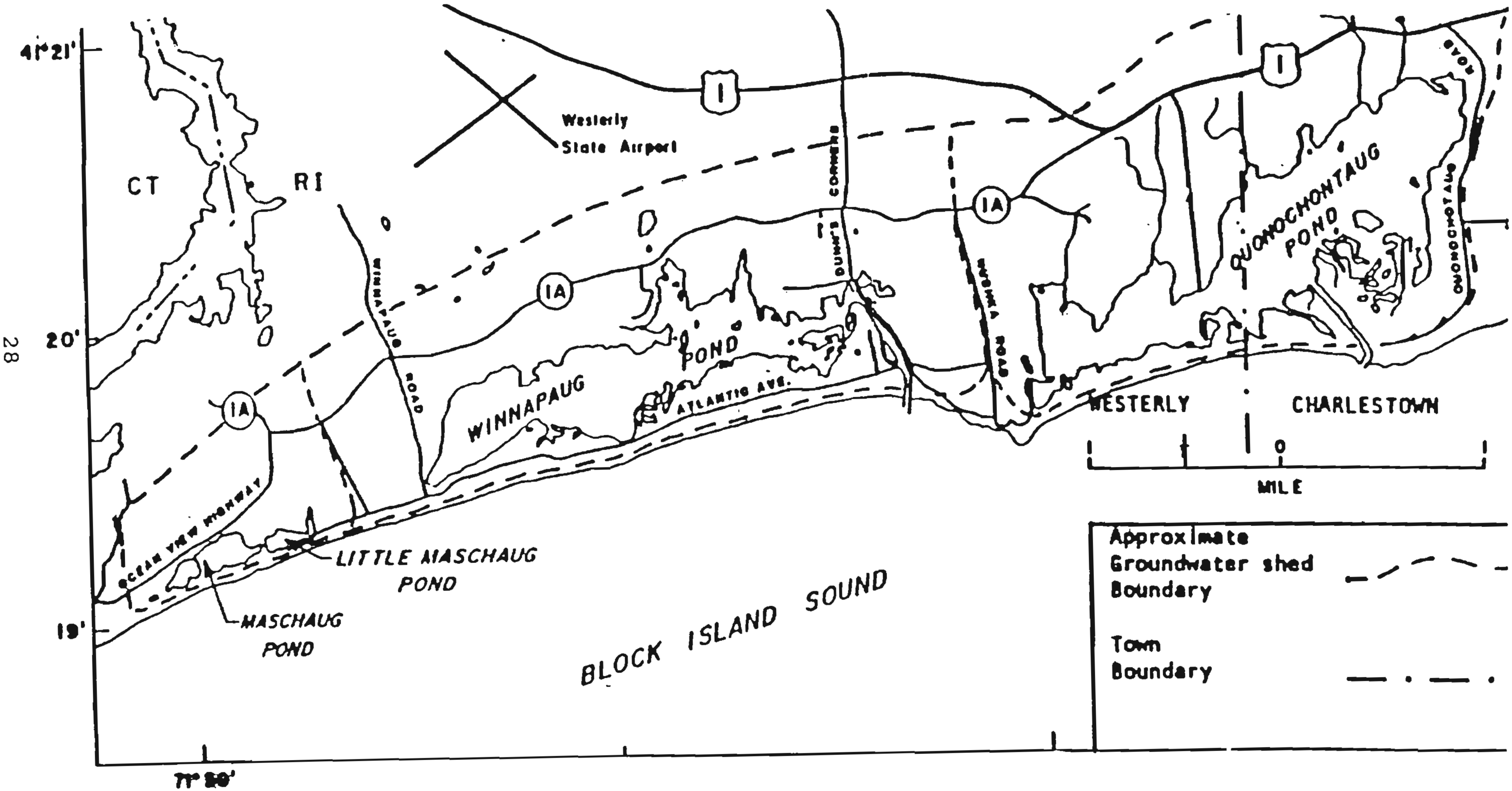


Figure 4: The Westerly Salt Pond Region

B. Physical Parameters:

1. Maschaug Pond Watershed:

Maschaug Pond is the westernmost pond in the Westerly Salt Pond Region. The pond is small, encompassing only 42 acres, and brackish, with an average salinity around 14 ppt. There is no permanent connection with Block Island Sound, which helps explain the low salinity. Saltwater input to the pond is accomplished mainly through overwash during storms.[48] A causeway divides the pond into two smaller ponds, sometimes referred to as Maschaug and Little Maschaug ponds. Culverts in the causeway maintain water exchange between the two sections. The pond drains a watershed of approximately 420 acres.

Maschaug Pond is fronted by the Maschaug Ponds barrier beach, which has been designated as an undeveloped barrier beach under the Coastal Barriers Resources Act (P.L. 97-348), as well as the Rhode Island Coastal Resources Management Plan (CRMP).[49] A low, poorly developed dune runs along the barrier, with dune crest elevations on the order of 8 feet above mean sea level.

Water quality in Maschaug Pond is rated SA by the Rhode Island Department of Environmental Management (DEM). The SA rating indicates that these waters are safe for shellfishing, fishing, and swimming. The pond is also designated as a conservation area under the Rhode Island CRMP.[50]

Due to its small size and shallow waters, Maschaug Pond does not support recreational boating. However, the pond does support large flocks of waterfowl, and is one of the few areas in Rhode Island that supports successful oyster beds.[51]

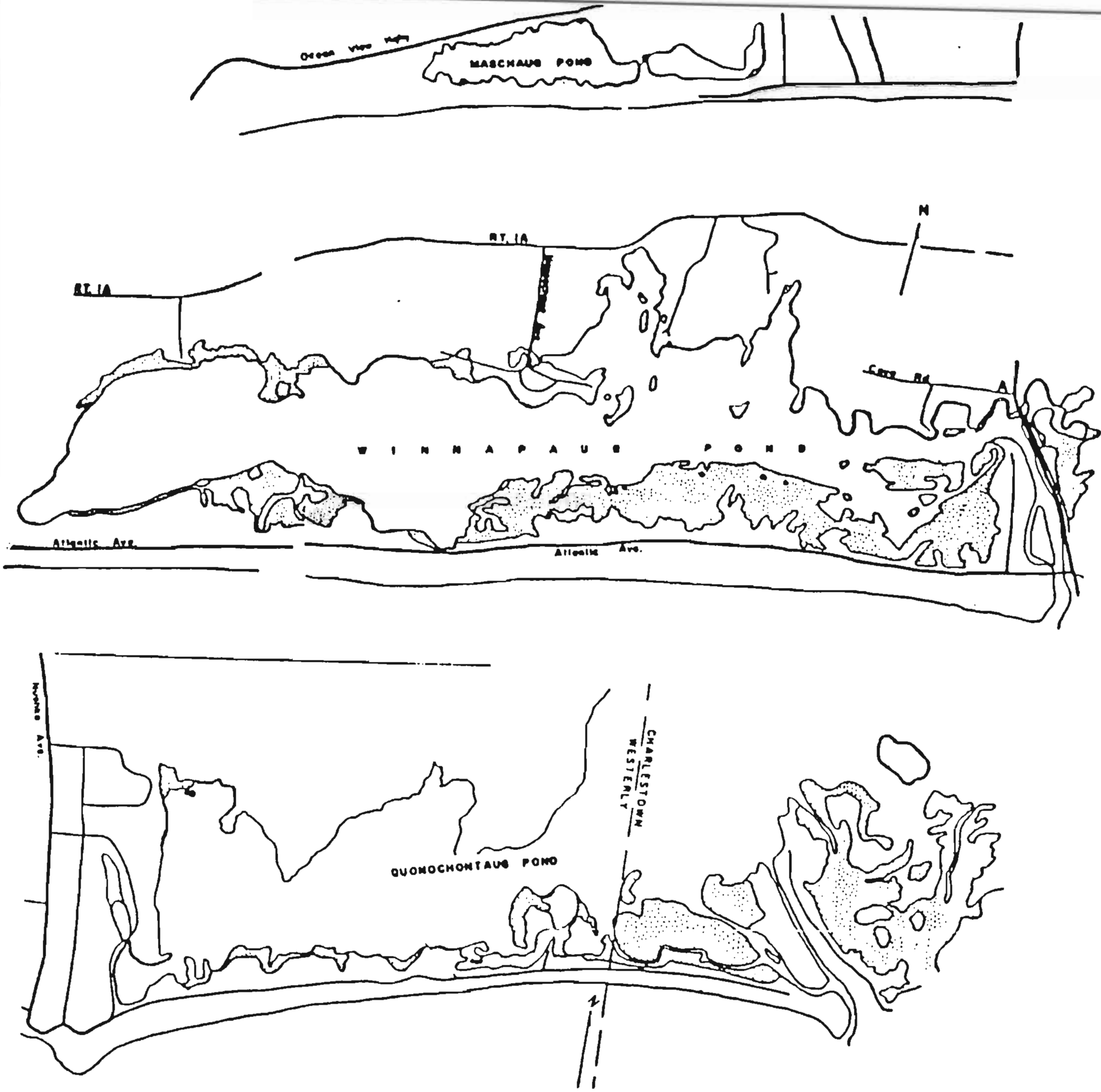
2. Winnapaug Pond Watershed:

Winnapaug Pond is a relatively shallow salt water pond, approximately 446 acres in size. Although several depressions in the pond extend to a depth of 25 feet52, the average depth of the pond is only five feet. As seen from the table in Figure 4, the average salinity of Winnapaug Pond is relatively high at 31 ppt. The pond supports several significant salt marshes, especially along the southern and eastern shores (Figure 5). The Weekapaug Breachway at the east end of the pond provides a stable connection with Block Island Sound.

Winnapaug Pond drains a watershed of approximately 2230 acres. The small watershed area limits the amount of fresh water run off, which helps maintain the high salinity of the pond. The waters of Winnapaug Pond are rated SA by the DEM.

Atlantic Beach separates Winnapaug Pond from the Atlantic Ocean. Dune crest elevations along Atlantic Beach range from 10.5 feet above mean sea level at Misquamicut State Beach, to over 30 feet above mean sea level at the extreme eastern end of the barrier.[53] The high dunes at the eastern end of the beach represent the remnants of substantial dunes which once ran the entire length of the barrier.[54]

Although the widespread shoals and shallows in the pond are not conducive to extensive recreational boating, the pond supports many other activities. Recreational fishing is a major



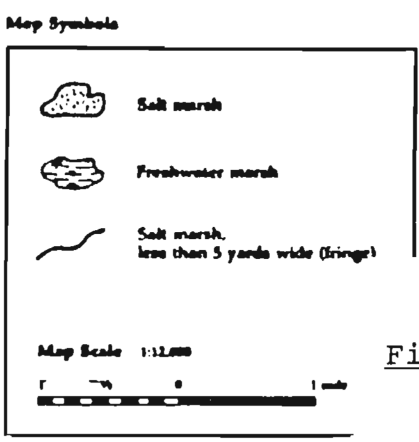


Figure 5: Salt Marshes in Maschaug, Winnapaug, and Quonochontaug Ponds

activity in the area, with a lot of effort concentrated along the Weekapaug Breachway. The pond's tidal flats also support recreational shellfishing for quahogs and scallops. At one time, portions of the pond were leased to provide a habitat for depurating oysters transferred from the Pawcatuck River.[55]

The pond's salt marshes and extensive beds of eelgrass provide food and habitat for many animal species. Waterfowl such as swans and cormorants are frequent inhabitants of the pond. The marshes also support several species of uncommon flowering plants.[56]

3. Quonochontaug Pond Watershed:

Encompassing 733 acres, Quonochontaug Pond is the largest pond in the Westerly Salt Pond Region. The pond is divided by the boundary between Westerly and Charlestown, with Westerly encompassing 35 percent of the pond's surface area, and 60 percent of the watershed area.[57] Quonochontaug is one of Rhode Island's deeper salt ponds, with an average depth around 6 feet. The pond is connected to Block Island Sound by a stabilized breachway near the eastern end of the pond.

Quonochontaug Pond drains approximately 2220 acres. As with Winnapaug Pond, the relatively small watershed area helps maintain the high salinity in the pond. The DEM classifies the waters of Quonochontaug Pond as SA. Extensive salt marshes flourish along the southern and eastern boundaries of the pond.

Quonochontaug Pond is fronted by the Quonochontaug Barrier.

Approximately two-thirds of the barrier, or 1.1 miles, falls within the boundaries of Westerly. This barrier has been designated as an undeveloped barrier beach under the CBRA of 1984. Dune crest elevations range from 13 feet above mean sea level near the western end of the beach, to 18.5 feet above mean sea level near the border with Charlestown.[58]

Quonochontaug Pond supports significant recreational boating activities. Several small yacht clubs and mooring areas provide convenient access to the pond's waters. The pond's extensive tidal flats are popular shellfishing areas. The pond and beach area also sustains recreational fishing for bluefish, flounder, striped bass, and other species. Several small scale commercial fishery operations for lobster, flounder, and scallops also take place in the pond.[59]

The pond's productive marshes and eelgrass beds attract large numbers of waterfowl and other wildlife. The marshes also provide habitat for several unusual types of invertebrate species such as Gould's trumpet worm, moon snails, and sand dollars.[60]

C. Storm History:

Rhode Island has experienced approximately thirty hurricanes since 1635, with fourteen so far in this century.[61]

The hurricane of September 21, 1938 devastated the state, with 262 deaths and damage estimates of over $100 million.[62] Along Atlantic Beach, the stillwater height reached 11.8 feet above mean sea level.[63] Practically every structure on Atlantic Beach was destroyed, and clean up crews worked for days just to reopen Atlantic Avenue.[64]

Following the 1938 hurricane the Winnapaug Pond - Atlantic Beach area was quickly redeveloped, only to be devastated by Hurricane Carol in 1954. Statewide, 19 deaths and over $200 million in property damage were attributed to Hurricane Carol.[65] The stillwater flood levels reached 11.5 feet above mean sea level in the vicinity of Atlantic Beach.[66] The storm surge reduced over 200 structures on Atlantic Beach to rubble in less than thirty minutes.[67] Debris washed off the barrier beach caused extensive property damage along the north shore of Winnapaug Pond.

Comparative damage estimates for the last two major hurricanes, the 1938 and 1954 storms, indicate that the Misquamicut - Winnapaug area sustained the heaviest damage of any South Shore community.[68] Due to the current high level of development, and the generally low dune crests, this area remains vulnerable to extensive hurricane damage.

D. Development:

All three ponds, and their associated barrier beaches and watersheds, are facing pressures from development. The Winnapaug Pond complex, however, is currently facing the most serious problems due to already dense development of the watershed. The current land use classifications for the Westerly Salt Pond

Region can be found in Figure 6.

1. Maschaug Pond Watershed:

A majority of the Maschaug Pond watershed is classified as currently undeveloped but zoned high density. Local zoning ordinances place almost the entire watershed in the residential, one acre, Watch Hill category (R-43 WH).[69] Minimum residential lot size for this zone is 43,000 square feet. Some of the area around the pond is presently maintained as a private golf course. The extreme eastern portion of the watershed has been designated as developed beyond carrying capacity. Many of the lots in this sector are less than 10,000 square feet.[70]

There are currently no homes located on the Maschaug Pond Barrier; however, the remnants of several homes destroyed by hurricanes are still visible. The relatively low dune crest along the barrier would provide little protection for any future development. The inclusion of this barrier beach into the national inventory of so-called undeveloped barrier beaches, under provisions of the CBRA of 1984, should help check redevelopment.

2. Winnapaug Pond Watershed:

The Winnapaug Pond watershed contains several large areas designated as developed beyond carrying capacity. Much of the remaining watershed is classified as areas of critical concern. The watershed is zoned predominately Residential-30 (R-30), or Waterfront-I (W-I).[71] Minimum lot sizes in these zones are

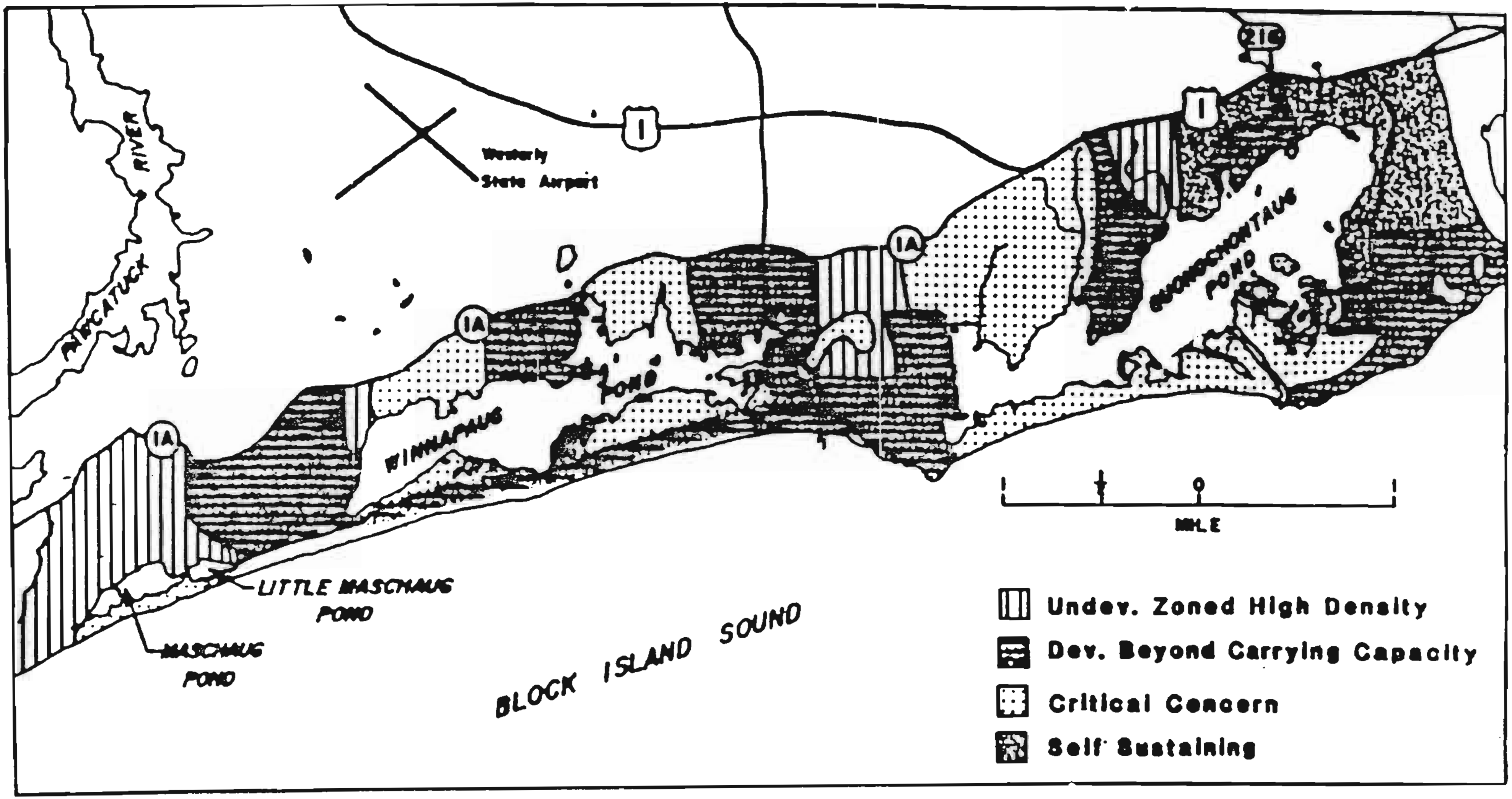


Figure 6: Land Use Classification for the Westerly Salt Pond Region

30,000 and 20,000 square feet respectively. However, many of the lots in the areas of critical concern were developed prior to these zoning regulations, and are on the order of 10,000 square feet.[72] There are also a few small sections zoned Business-1 (B-1), which has a minimum lot size of 6,000 square feet for residential usage.

Despite being decimated by the hurricanes of 1938 and 1954, Atlantic Beach has been extensively redeveloped. Many of the residential lots along the barrier are only 12,500 square feet,[73] which promotes fairly dense development. The Westerly Town Beach and the Misquamicut State Beach encompass approximately 25 percent of the barrier's land area, the remainder is largely in private hands.[74]

Misquamicut State Beach attracts large numbers of vacationers during the summer months. In reaction to these large crowds, the barrier beach and western end of Winnapaug Pond have been heavily developed with vacation homes, small motels, restaurants, bars, stores, and other related enterprises. Part of the problem in addressing development related problems in Misquamicut is the vast seasonal fluctuations in population.

3. Quonochontaug Pond Watershed:

The Westerly section of the Quonochontaug watershed is similar to the Winnapaug watershed, in that it has large areas classified as either developed beyond carrying capacity or of critical concern. The watershed also encompasses a significantly large area that is currently undeveloped but zoned high density. The vast majority of the watershed is currently zoned either R-30 or W-I, with minimum lot sizes of 30,000 and 20,000 square feet respectively.[75]

The Quonochontaug barrier beach has not been redeveloped since it was swept clean by the 1954 hurricane. Much of this barrier is currently controlled by the Weekapaug Fire District, and a private conservation group, both dedicated to maintaining the barrier in its undeveloped state. Inclusion of the Quonochontaug barrier under the provisions of the CBRA of 1984 should also inhibit development.

IV. The Proposal to Extend Sewer Lines to Atlantic Beach:

A. Introduction:

As population density and development in the Misquamicut area increase, the management of escalating wastewater loads becomes an issue. One alternative for addressing wastewater management is the extension of town sewer lines into the area. The wastwater could then be directed to the central treatment facility for purification.

The Town of Westerly currently has no plans to extend sewers to Misquamicut.[76] However, in order to provide wastewater disposal for a planned sixty room motel on Atlantic Beach, a local business-man, Mr. Udo Schwarz, has proposed to construct a sewer line from the motel site to the town's sewer system. As owner of the future motel, Mr. Schwarz believes that this is the most cost effective means of providing adequate wastewater handling capacity.[77] Mr. Schwarz has also offered to donate the completed line to the Town of Westerly. If this offer were accepted, Westerly could then use the extension as a means for connecting other area homes and businesses to the central treatment facility.

In order to establish a solid basis for reviewing the proposed extension, this chapter will begin with an examination of the general relationships between sewer projects and community development. This will be followed by a description of the Schwarz proposal and the current status of this project. Finally, there will be a discussion and analysis of the potential advantages and disadvantages of selecting this wastewater management option for Misquamicut and Atlantic Beach.

B. Sewers and Development:

1. Background Information

In the late sixties and into the seventies, in an effort to mitigate water pollution problems, the federal government began pushing the development of regional sewage treatment plants and sewer networks. As this program matured, researchers began to realize that this policy had significant secondary impacts, and several published works on the effects of sewers and treatment facilities on community development.[78] Models were also developed to predict the level of development resultant from a particular public works project.[79]

As the linkage between sewers and development became clearer, attention focused on the use of sewer decisions as a planning tool. Researchers examined the legal and economic aspects of using sewer and water connection policies for guiding the pace and location of development.[80] Several investigators have provided case studies on the relationship between sewer policy and growth.[81]

2. Discussion

The presence of public utilities, such as roads and sewers, can have a profound effect upon community development patterns. Although roads and highways are important antecedents to development, a 1975 Council on Environmental Quality report stated that "...(s)ewers and sewage treatment plants are replacing highways as prime determinants of the location of development."[82] Thus, it is important to realize that wastewater management decisions have ramifications well beyond the collection and treatment of wastes.

There are three major reasons for the importance of sewer development in determining land use patterns:

1.) Sewers have high fixed costs which lead to long design periods, typically around fifty years. This leads to substantial initial excess capacity, which makes the sewered area attractive for development.

2.) Highways, water supply, and sewerage are the three basic prerequisites for suburban development. Much of the federal highway system is in place, and water is generally supplied by semiautonomous agencies that are continually expanding their service. This leaves sewerage facilities as the major player in determining land use patterns.

3.) Stricter environmental regulations have reduced the wastewater disposal options available to developers.[83]

Thus, sewerage projects have several built in components that tend to facilitate and attract development.

Economies of scale and long design periods promote large systems with initial excess capacity. This excess capacity may vary from twenty percent of the used capacity up to several hundred percent, and is a strong inducement for development.[84] Once the facilities are in place, it is difficult to regulate the allocation of any excess capacity. Thus, population forecasts used in designing sewerage systems have the tendency to become self-fulfilling prophecies.[85]

Substantial construction, operation, and maintenance costs may also promote growth in recently sewered areas. The more customers that can be connected to the system, the larger the revenue base to support these costs. A community may feel compelled to expand wastewater treatment systems in order to meet rising costs. Community growth and development plans may become highly vulnerable to the search for increased revenues.

From a legal standpoint, communities may have a hard time defending the restriction of access to excess sewerage capacity. Courts have viewed sewers as a public health facility that should not be denied to those who want it.[86] However, in several recent cases, courts have also upheld the denial of sewer connections for growth management purposes, even where excess capacity was available.[87] Since judicial decisions have come down on both sides of this issue, it is impossible to predict the success of a community's plan to allocate excess capacity and control growth.

As sewer systems have a substantial impact on development and growth patterns, it follows that sewer planning can be a very useful tool in achieving overall community planning goals. Through the proper timing and location of sewage system expansions, a community can provide strong direction for future growth. The close linkage of sewage treatment decisions to local planning concerns can be a positive step toward minimizing the haphazard growth that can accompany sewer system expansion.

Without proper coordination of sewer decisions and community development planning, the provision of sewerage facilities is likely to "... set in motion a pathway of development difficult avert and virtually impossible to guide.[88]

Helter-skelter growth and development can be detrimental to a community. According to the Council on Environmental Quality:

> The pace and pattern of development greatly affect a community's ability to accomodate growth without strain. Rapid, unplanned growth is often economically inefficient and environmentally destructive. Development may occur at densities and in locations which defeat long term community goals.[89]

In order to avoid this situation, it is mandatory that community infrastructure (i.e. sewers, roads, etc...) decisions be made within the context of an overall development plan.

3. Fairfax County, Virginia - A Case Study

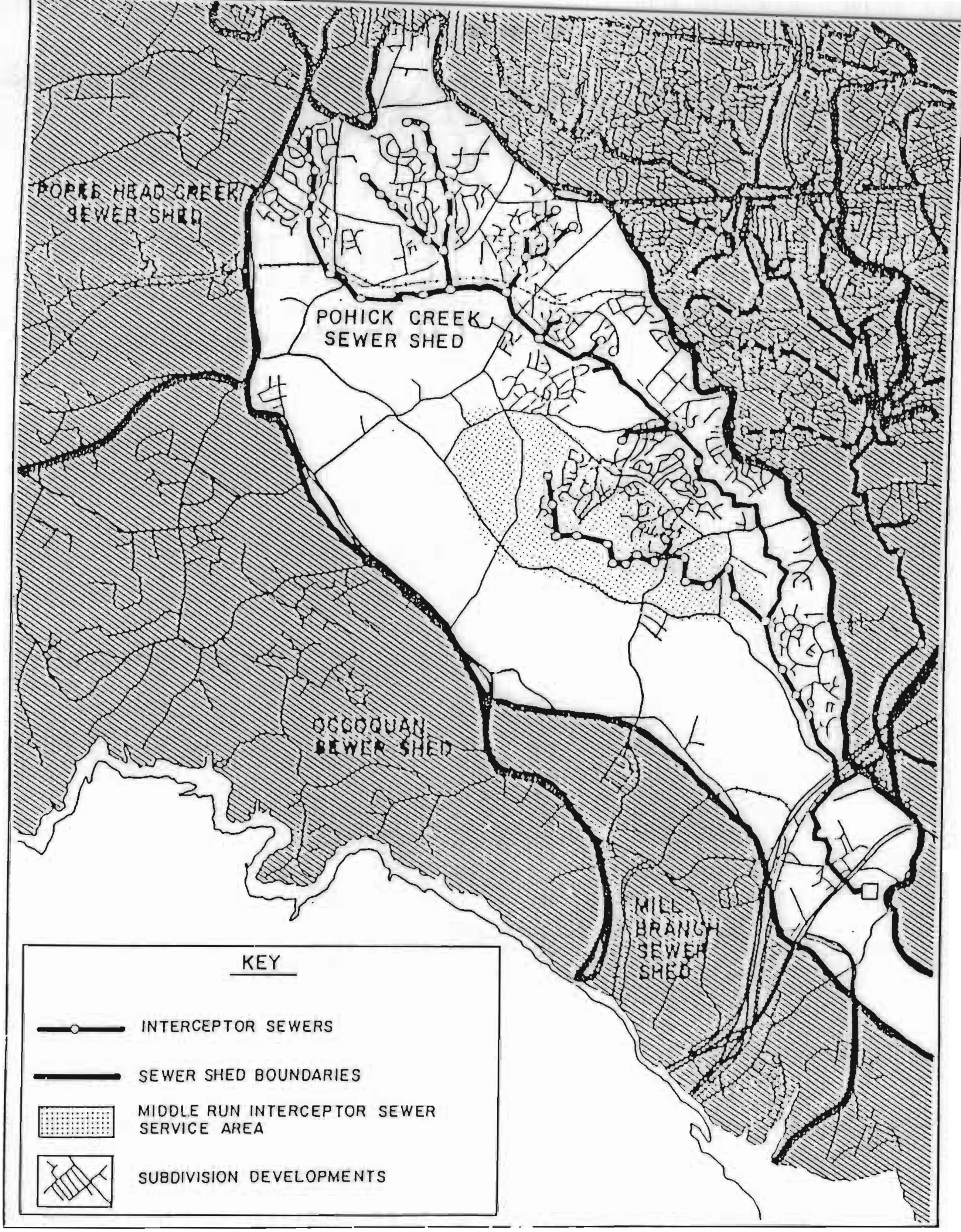
One of the most studied cases of the impact of sewers on community development, is the case of Fairfax County, Virginia, a suburb of Washington, D.C.. This is a well documented example of sewer system decisions undermining community growth planning.

In the late sixties, Fairfax was attempting to deal with rapid expansion and the effects of twenty years of suburban sprawl and leap frog development.[90] In 1969, in an effort to gain control of this growth, Fairfax County planners developed the concept of "holding zones". Development in these zones was to be delayed until a specific future date.

One of these so called "holding zones" was a 2500 acre tract in the Middle Run drainage area of the Pohick Creek watershed (Figure 7). In a plan adopted by the Fairfax County Board of Supervisors on September 10, 1969, this tract was designated as a holding zone, and development was to be withheld until 1975.[91]

Paradoxically, at the same meeting on September 10, 1969, the Board also awarded $155,000 to two developers to complete a Middle Run sewer spur, that had originally been proposed in 1966. In approving both the holding zone designation and sewer construction, the Board appears to have attempted to placate two major interest groups: residents concerned with unchecked growth, and developers concerned with recent restrictions on development.

On October 10, 1969, the Board approved the rezoning of two parcels of land within the Middle Run holding zone to high density. The Board reasoned that since the sewer was already there, these parcels could immediately accept denser development. Thus, the planned six year delay in development was reduced



<u>Figure 7</u>: Middle Run Service Area - Fairfax County (as of late 1975)

to only one month. In this case, the presence of a sewer line quickly undermined efforts to provide for planned and orderly growth. This goes to show that "...the master (community growth) plan may be pretty but the utility plan is powerful.[92]

C. Project Description:

Figure 8 diagrams the route for the proposed 7,000 foot sewer line extension. A forced main would originate at the owner's property on Atlantic Avenue. From there the line would run west along Atlantic Avenue, then turn north along Montauk Avenue. In order to maintain adequate pressure, the line would feed into an auxillary pumping station at the north end of Montauk Avenue. Leaving the pumping station, the line would run north along Winnapaug Road. Approximately 2600 feet north of the intersection of Winnapaug Road and Shore Road, the six inch forced main would feed into an eight inch gravity line. This line would then connect with the town sewer line located along Airport Road. The total cost of the project is estimated to be approximately $450,000, and would be paid for by the Schwarzes.[93]

In proposing this project at the Town Council meeting of September 22, 1986, representatives of Mr. and Mrs. Schwarz petitioned the Town Council for permission to connect into the Town of Westerly sewer system. Public hearings on the proposal brought strong reaction from both proponents and opponents of the plan. Those in favor saw the extension of sewer lines as an effective means of addressing ISDS related problems in the

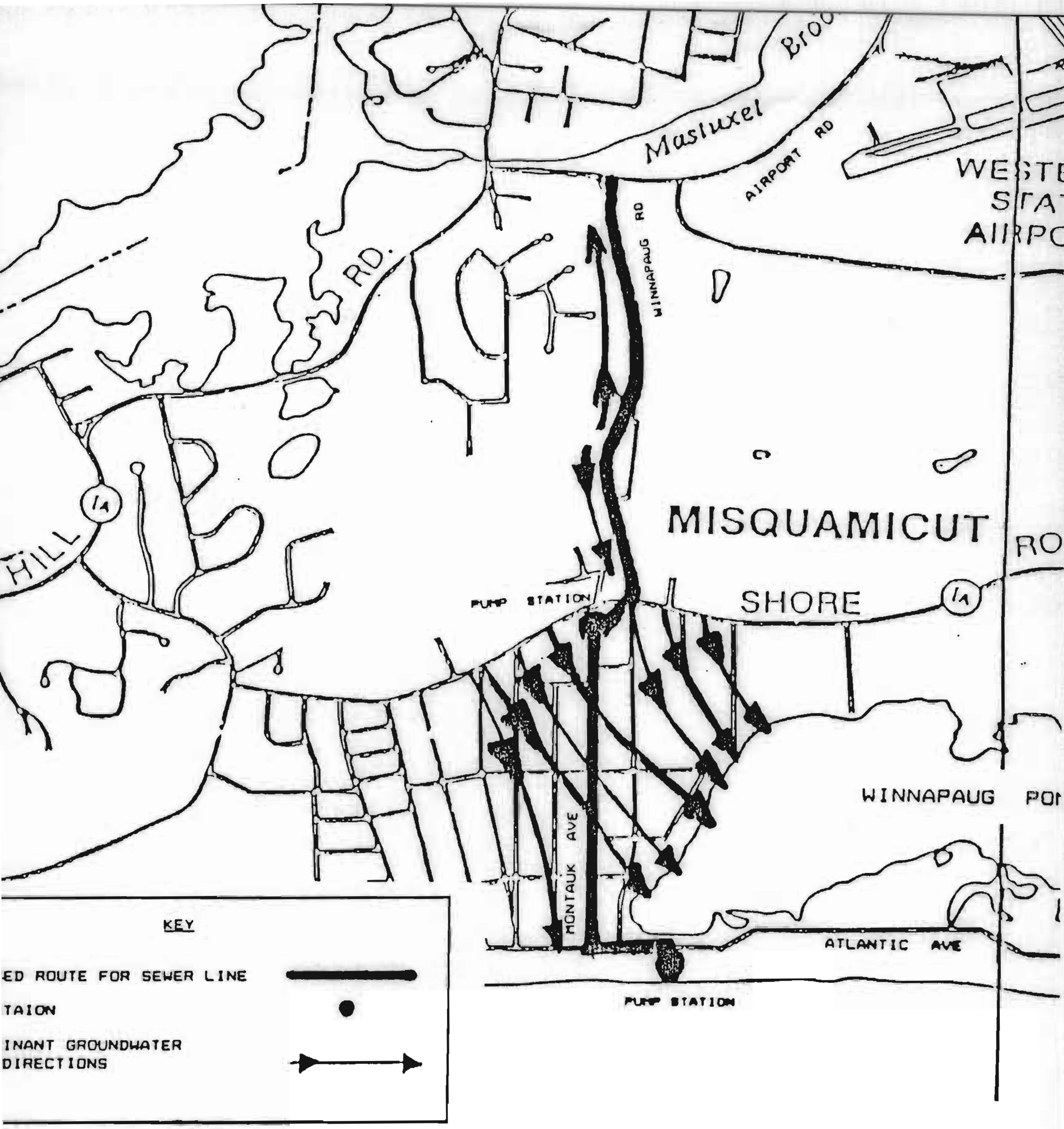


Figure 8: Proposed Route of Sewer Line Extension with Groundwater Flow Directions

Misquamicut area. Furthermore, they felt that access to the municipal sewage treatment plant (MSTP) would enhance the general quality of the area. Those opposed to the plan pointed to the potential for increased development spurred by the availability of town sewers, and the increased potential for pollution associated with this development.

At the next regular Town Council meeting on October 27, 1986, the Town Solicitor recommended that the Council take no action on the proposal because of the coordinated permit procedures required by the CRMC.[94] At this time the Council voted to refer the matter to the Town Engineer for report at the next meeting.

The matter was discussed again at the Town Council meeting on November 11, 1986. The Town Solicitor again objected to deciding the issue outside of the coordinated permit review procedure. Furthermore, he also expressed concern over making the decision with only four of seven Council members involved, due to the absence of one member and disqualification of two other members for potential conflicts of interest.[95] Despite these objections, the Council voted 3 to 1 in favor of the following motion:

> THAT:"The Council approve the extension of sewers into the Misquamicut area subject to the approvals of all proper authorities - Town and State - who will ensure that the project proceeeds correctly.[96]

Thus, the Council approved the petition of Mr. and Mrs. Schwarz to tie into the Westerly sewer system.

In addition to Town Council approval, the project must also obtain several state permits. In order to rationalize the permitting process for projects affecting Special Area Management Plan Regions, such as coastal pond areas, the Rhode Island Coastal Resources Management Council has instituted a coordinated review procedure (Section 320.0 of the CRMP). The general idea behind this procedure is to establish communications between the applicant and the state agencies that may be involved in the permitting process. This helps establish a systematic method for defining the permitting framework at an early stage of the project. This gives the agencies and the applicant a chance to iron out any potential problems in the project before it is too far advanced to be easily altered. Furthermore, it can alert an applicant that the proposed project is unacceptable prior to the expenditure of large amounts of time and money.

A preapplication conference for the proposed sewer line extension was held on December 19, 1986. Mr. Arthur Leiper, the Westerly Town Engineer, was the permit coordinator for the project, and served as chairman of the conference. The conference was attended by representatives of the CRMC, Statewide Planning Program, Westerly Conservation Commission, Historical Preservation Commission, and the U.S. Soil Conservation Service. The Department of Environmental Management did not send a representative, but did forward a written statement concerning the project. The applicants, Mr. and Mrs. Udo Schwarz were represented by Attorney Joseph Turo. Although very informative, this conference was just a preliminary step, and the project is still in the process of obtaining the necessary permits.

It is interesting to note that every agency involved in this conference expressed some reservations about the Schwarzes' proposal. For example, the Statewide Planning Program representative voiced concern over the growth effects of sewer development. He further stated that sewers were not needed to cure pollution problems in Misquamicut, rather they were merely a tool for the expansion of development, which would create growing evironmental problems.[97]

Mr. Victor Bell, in a letter representing the views of the Department of Environmental Management (DEM), expressed concerns over the location of the project in an environmentally sensitive area that was prone to flooding. Furthermore, the DEM was concerned with potential degradation of Winnapaug Pond, brought about by increased bacteria and nutrient loads in runoff waters resultant from increased development.[98]

From a procedural standpoint, Mr. Bell had reservations about the Westerly Town Council's approval of connection of the project into the town sewerage system, outside of the coordinated review procedure.[99] I believe that the Town Council also made a serious tactical error in passing the motion to permit the tie in of the proposed sewer line. The Council has significantly curtailed its options through premature approval. The Council drastically reduced its opportunity to oppose the system pending any information uncovered during the coordinated permitting procedure. Westerly would be in a much stronger position if a decision had been withheld until later in the permitting process. Thus, Town approval has been granted prior to the full investigation of this proposal.

In taking this action, it appears that the Town Council was acting on political, rather than planning, considerations. Town approval forces other agencies, such as the DEM or CRMC, to make a tough decision with political ramifications. If the project is not approved, these other agencies will become the "bad guys" in the eyes of project supporters. If on the other hand, the proposal gains approval, the state agencies involved, having had the final say on the project, will bear the brunt of complaints from project opponents. The time lag between Council approval and final approval would also help blur the connection between Council actions and the final result.

Although this may have been a good decision from a political standpoint, it has considerably weakened Westerly's position in determining the final disposition of the project. In discussing the management and planning role of municipal governments, the CRMC states that:

> (Municipal governments)... have the primary responsibility for how the (salt pond) 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.[100]

In my opinion, Westerly has not fulfilled its responsibilities. Premature approval, outside of the coordinated review procedure, means that a critical decision was made without all the facts, and that Westerly's future options in dealing with this project have been curtailed.

D. Discussion:

The proposal to extend sewer lines to the Atlantic Beach section of town has raised some important questions concerning the level of need for the system, as well as the potential benefits and costs of the proposed extension. Much of the debate centers on the effect that this project would have on development, and whether or not increased development is a desirable result.

In order to examine the merits of the proposed sewer extension, this section will discuss the list of potential benefits of the project, as put forth by representatives of the Schwarzes. These potential benefits include the following:

1. Westerly would recieve a capital improvement at no cost;
2. Increased sewage flow would make the treatment facility more efficient;
3. The system could be easily cleaned and maintained through closings during the winter;
4. The system would relieve ISDS problems, and alleviate the leaching of septic effluent into the pond;
5. The project would enhance building in the area.[101]

The Town would indeed receive a capital improvement at no initial cost. As previously mentioned the cost of building the proposed line is estimated to be approximately $450,000. In these days of local budgetary concerns this is a substantial amount; however, one should be aware that there are also long term operating costs associated with Town acceptance of the completed line.

Should the Town accept the line, Westerly would become responsible for the costs associated with the operation and maintenance of the extension. In order to take full advantage of the new sewer line, the Town would have to bear the cost of extending the line to the sections of Misquamicut lying beyond the path of the original line.

Homeowners in the area could also be expected to bear some of the costs associated with access to the sewage treatment system. The cost per home to install a grinder pump and connect into the sewer line would be around $5,000.[102] This represents a substantial sum, especially when one considers that many of these homes are only occupied for a few months out of the year.

In addition, there are some hidden monetary costs that may be associated with the project. For example, increased development spurred by the extension of sewer lines could increase demands for fire and police protection, and other community services.

The point of this section is not to provide a rigorous economic analysis of the project, rather it is to highlight the necessity of examining all the costs associated with the system before accepting a $450,000 capital improvement at face value. According to the Council on Environmental Quality, the local benefits associated with infrastructure investments, such as sewers, may be seriously outweighed by indirect negative impacts related to changes in local land use.[103]

Increased efficiency of the central wastewater treatment facility was cited as a second potential advantage of the extension. The Town of Westerly water treatment facility has the capacity to handle 3.5 million gallons of sewage per day, with a current flow rate of approximately 2 million gallons per day (gpd).[104] According to DEM estimates for wastewater generation, the expected flow from a motel is 40 gallons per person per day.[105] Assuming that the proposed 60 room motel is occupied by 240 guests, the motel would generate approximately 9,600 gallons of wastewater per day. In itself, this additional flow is insignificant in comparison to the total treatment load, and would thus have little impact on system efficiency.

If the sewer extension was also utilized to connect the rest of Misquamicut to the treatment facility, the daily flow would increase by approximately 500,000 gallons per day.[106] This significant boost would improve the efficiency of the treatment facility; however, it seems doubtful at this point that Westerly would move to connect the entire Misquamicut area to the system, due to the cost of extending the lines, and the cost to individual homeowners.

The proposed extension would have an advantage over the rest of the sewer system, in that the line could be easily shut down for cleaning and maintenance while the motel is closed over the winter months. However, any advantage gained through the ability to shut the line off for extended periods, would quickly disappear if the line were extended to other homes and businesses. Once connected to the MSTP, year round residents would be severely inconvenienced by any interruption of sewer service. Thus, this advantage would apply only as long as the line was used exclusively for the motel.

Although the seasonal use pattern of this line could afford maintenance and repair advantages, it also points to a potential drawback of the project. By committing the MSTP to the seasonal loads from Misquamicut, the sewer extension would effectively reduce the capacity of the system to serve other areas of Westerly as the town expands. In this manner, the potential needs of year round businesses and residents may not be met due to the necessity of reserving capacity for the summer months. Furthermore, any efficiency gains from the added flow from Misquamicut would be lost during the winter months, as the treatment plant's capacity for this waste was idled.

Thus, one of the decisions that must be faced is the allocation of remaining treatment capacity among potential users. Should a significant portion of the current excess capacity be allocated to an area where it would be minimally utilized for the majority of the year?

Representatives of the Schwarzes also stated that the proposed project would have the beneficial effect of mitigating ISDS related problems in Misquamicut and Atlantic Beach. As will be seen in Chapter Five, there are some contamination problems related to substandard and failing septic systems in this region. The extension of sewers would be one means of alleviating this situation. Whether or not this is the best alternative will be more fully discussed in following chapters.

While the proposed system does have the potential to virtually eliminate ISDS related pollution problems, it is also the potential source for other forms of contamination. As the surface and groundwater flow directions in Figure 8 indicate, any accidental break in the line would lead to the flow of raw sewage into Winnapaug Pond. While the line will be underground, the force of a storm surge or other disaster could fracture it. In order to deal with this possibility, a requirement has been attached to the project that the line be flooded with fresh water when a hurricane is imminent.[107]

Furthermore, through the stimulation of local development, the extension of sewer lines could increase the flow of contaminants to the pond, such as surface runoff from roads and parking lots, automobile emissions, and litter. Thus, the system could clearly reduce ISDS problems; however, other pollution problems may be exacerbated by the sewer line and any associated development. It seems ironic that "...by tending to attract development, sewers may create several environmental problems in solving one.[108]

As a last potential benefit of the project, representatives of the Schwarzes point to the enhancement of building in the area. While some people may view increased development as a benefit, there are many who would see this as a drawback. Indeed, this has become a major point of contention.

The enhancement of building could be advantageous to some interests through increases in property values and the growth of commerce. However, over the long run, additional development could have severe impacts associated with pollution, storm related damages to property and endangerment of the local population, not to mention degradation of the barrier beach/coastal pond complex.

Referring to Figure 6, much of the area potentially served by the sewer system extension, is already classified as developed beyond carrying capacity. The stimulation of building is clearly not the means to alleviate this condition.

Due to its shorefront location, much of the development pressure would be focused on the Atlantic Beach barrier. As previously discussed, barrier beaches survive through the maintenance of a dynamic equilibrium. The beach is constantly moving and shifting, which works contrary to the notion of building permanent structures on the beach. Attempts at stabilization to support development are often very costly, and may actually exacerbate erosional problems.

Atlantic Beach, as other barriers, is migrating toward the coast as sea level rises. Since 1940, erosion rates along the west end of Atlantic Beach have averaged two feet per year.[109] Many scientists predict that sea level will continue to rise as glaciers are melted by rising atmospheric temperatures.[110] Therefore, Atlantic Beach can expect to experience continued erosion from the inundation of low lying areas, and the increased reach of wave energy associated with rising sea level.

In addition to the gradual encroachment of the ocean due to sea level rise, the Atlantic Beach area must also face the sudden destruction that accompanies hurricanes and other major storms. While the dune crest is only 10.5 feet above mean sea level in the area of the proposed motel, the storm surge for the 50, 100, and 500 year storms will meet or exceed this elevation (Table 1).[111]

Table 1: Stillwater Flood Elevations

Area	Stillwater Flood Elevation (feet)			
	10 yr	50 yr	100 yr	500 yr
West end of Maschaug Pond to west end of Winnapaug Pond	7.7	10.3	11.7	16.4
West end of Winnapaug Pond to western corporate limits	7.8	10.5	11.9	16.8

The storm surge resulting from the 50 year storm would reach the level of the dune crest near the western end of Atlantic Beach. The storm surge associated with the 100 and 500 year storms can be compared to the elevations of the storm surges that accompanied the 1938 and 1954 hurricanes: 11.8 and 11.5 feet respectively. As both of these hurricanes caused near total destruction along Atlantic Beach, the 100 year storm can be expected to deliver similar results. The magnitude of destruction associated with the 500 year storm surge level would far exceed the catastrophic dimensions of either the 1938 or 1954 hurricanes.

These storm surge heights gain further significance when the effects of storm waves are added. Storm driven waves may easily exceed the stillwater flood elevations, resulting in increased damage and destruction. The Federal Emergency Management Agency classifies coastal flood hazard zones into two major categories: V zones and A zones. V zones represent the area of the 100 year flood plain that would be subject to velocity wave action. This generally indicates the inland extent of a three foot breaking wave above the flood.[112] The A zone represents the portion of the 100 year flood plain not subject to velocity wave action.

Figure 9 shows the areal extent of both these zones in the Westerly Salt Pond Region. Much of Atlantic Beach, including the site of the proposed motel, falls within the V zone. Furthermore, almost the entire Winnapaug Pond watershed is either in an A zone or a V zone. Development in these areas, especially V zones, is by definition highly vulnerable to storm damage and may also pose storm related hazards further inland.

As previously discussed, development on barrier beaches may

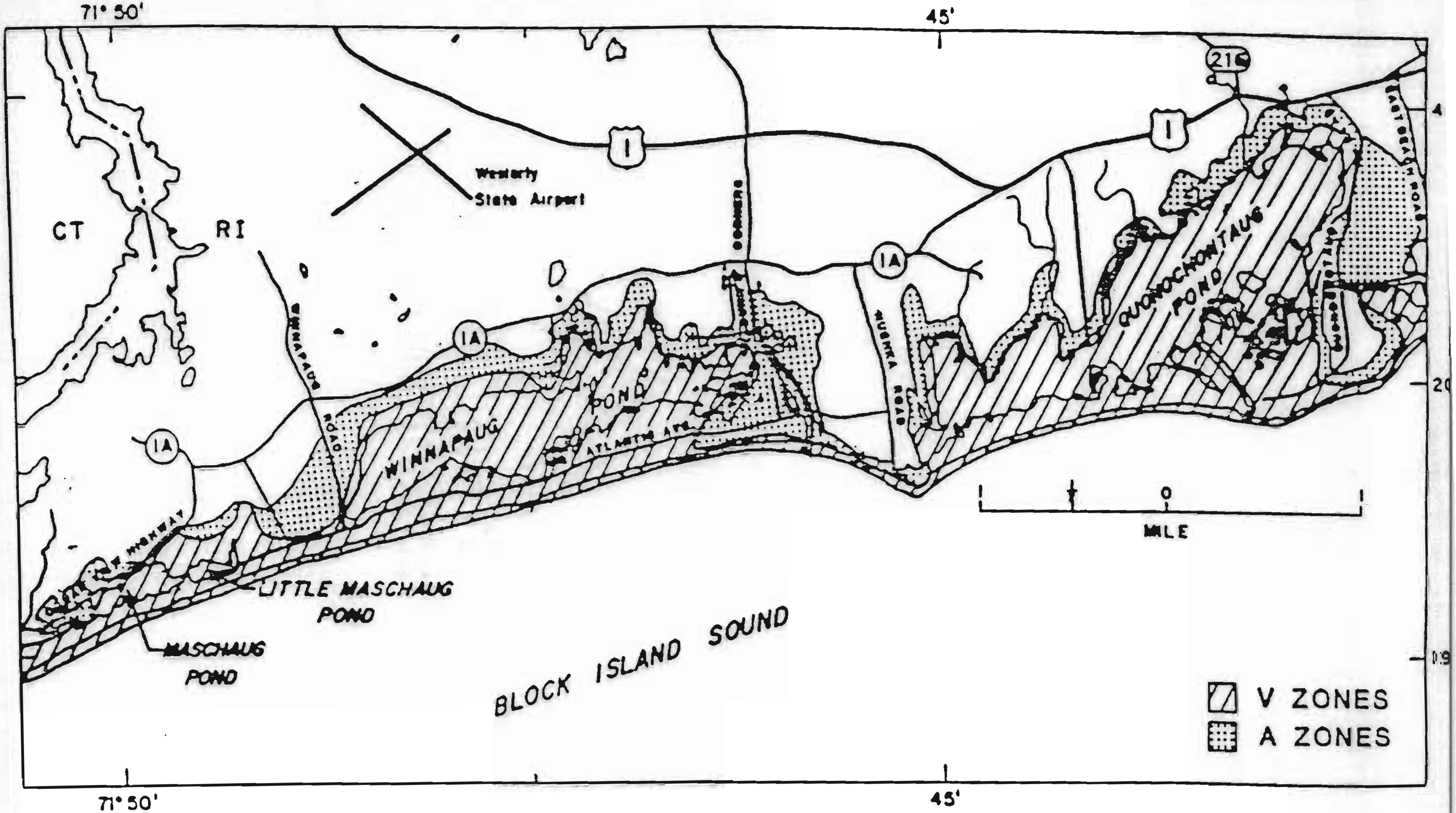


Figure 9: Coastal High Hazard Zones

destroy the system's natural storm protection qualities. Additionally, debris washed from the barrier can act as battering rams and greatly intensify destruction inland of the beach.

According to the CRMC, the current high development of Atlantic Beach, and the increase in public utilities in high flood danger zones, will greatly increase the cleanup costs following the next severe storm.[113] Restoration of roads, water mains, and power lines will be time consuming and expensive. Clearly, the costs of rebounding from a serious storm increase as the level of development and extent of public utilities within the region increase.

E. Summary:

At first glance, the extension of sewer lines to Misquamicut has many potential benefits: the acquisition of a significant project for no initial cost, increased treatment plant efficiency, and alleviation of ISDS related problems. However, upon closer examinination, it becomes evident that there are also certain detrimental impacts associated with the project: costs connected with the operation, maintenance, and extension of the system, seasonally fluctuating flow rates that could reduce treatment facility capability to handle year round residents, and the potential for pollution associated with system damage or increased development.

Potentially, the system could also serve as an impetus for growth. While some parties may benefit in the short run from increasing property values and commerce, increased development may have serious repercussions. As many of the lots in the Atlantic Beach section of Misquamicut are already developed, the presence of sewer connections will not open up extensive new areas to development. However, the presence of sewer lines will encourage the expansion of existing construction. This can be seen in the Schwarzes' proposal, which envisions the sewer extension as a means to develop a 60 room motel on a site currently occupied by a small restaurant (Figure 10).

Furthermore, the sewer extension could also impact development patterns in the northern part of the Winnapaug Pond watershed, which is relatively undeveloped. As the extension would pass through the northern shore and upper watershed, it has the potential to encourage further growth in this sector. According to the CRMC, "...(f)urther development anywhere in the (salt pond) region poses problems of increased nutrient loadings to the ponds and major issues concerning the region's capability to provide potable water and absorb domestic wastes.[114] Therefore, additional development of the upper watershed is an issue that requires careful consideration in any sewer decisions for Misquamicut.

Large portions of Misquamicut have already been designated as areas of critical concern or areas developed beyond carrying capacity, and would be vulnerable to the environmental consequences of expansion. This growth could have serious effects upon the coastal pond - barrier beach ecosystem.

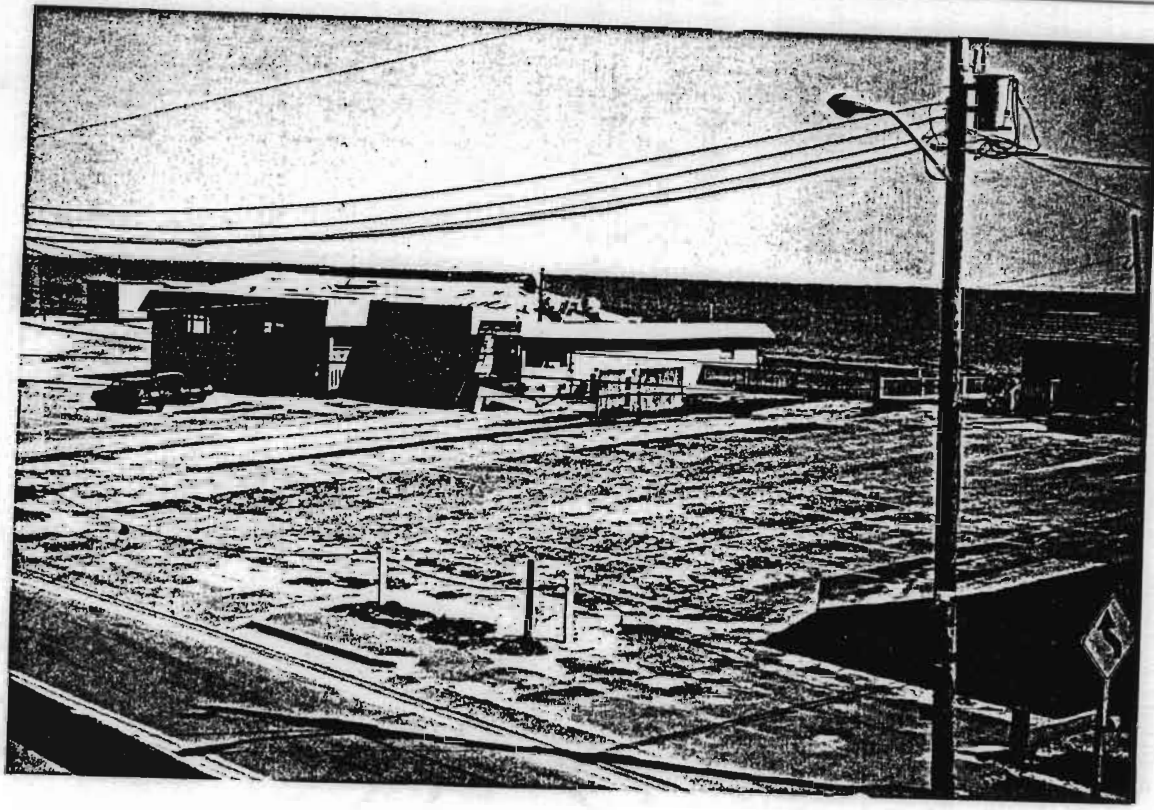


Figure 10a: Current Development on Proposed Motel Site

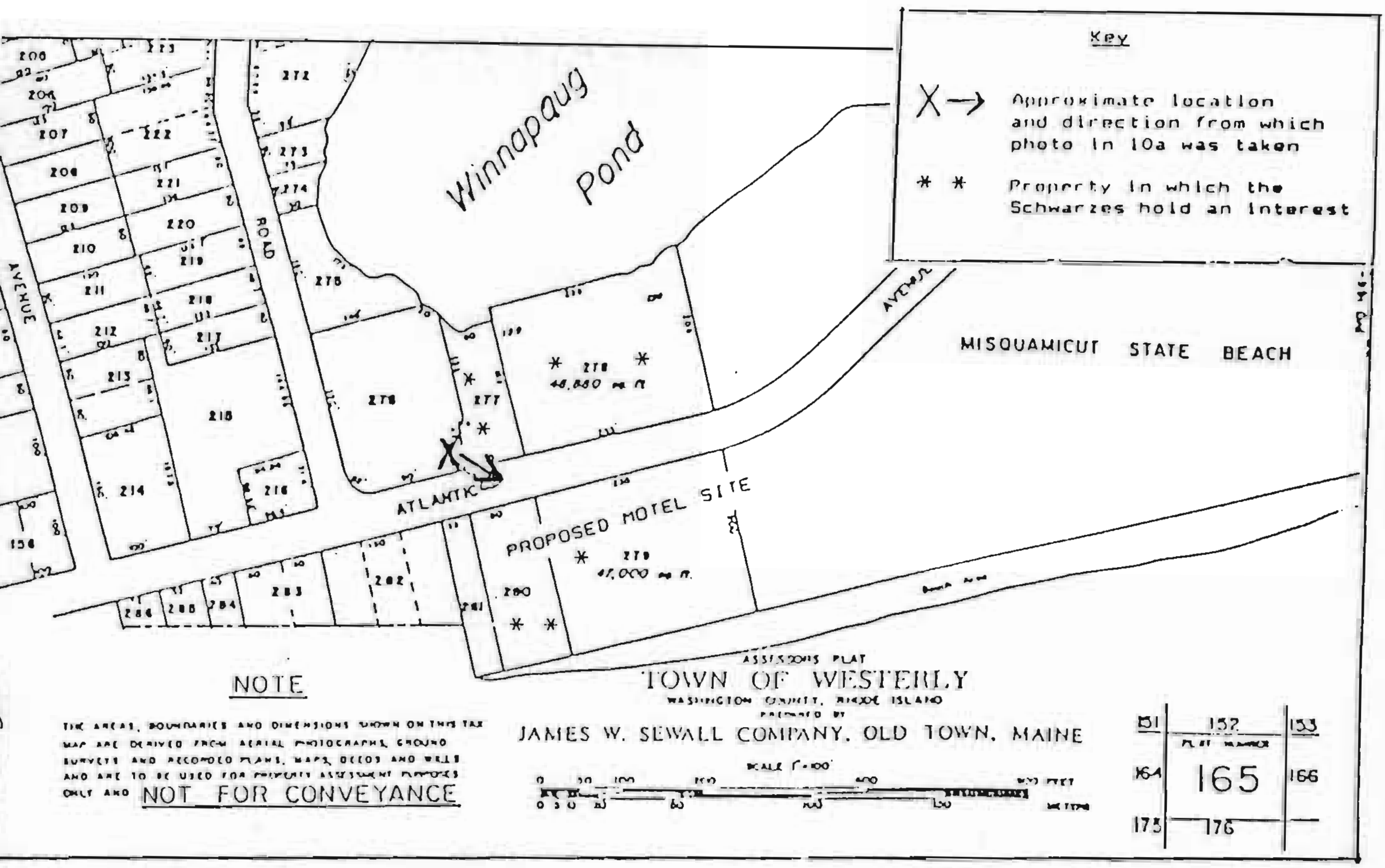


Figure 10b: Location of Proposed Motel Site

Atlantic Beach and Misquamicut are subject to severe erosion, flooding, and storm damage. Continued development would exacerbate future storm related damages, both along the barrier beach and inland. As previously discussed, the dynamic nature of the barrier beach makes it ill suited for development.

Thus, it is imperative to examine all aspects of this project before it gains final approval. As previously stated, the secondary impacts of such a project, can seriously outweigh the potential benefits.

V. The Wastewater Management District Alternative:

A. Introduction:

The establishment of a wastewater management district (WWMD) is a second alternative for insuring the proper treatment of wastewater in the Westerly Salt Pond Region. Within the district format, the Town of Westerly could help reduce ISDS related problems while avoiding the problem of intensified development that may accompany the expansion of sewer service.

Properly designed, installed, operated, and maintained, individual sewage disposal systems (ISDS) can be an effective method of wastewater management. Septic systems can provide a cost effective method of wastewater treatment in areas not served by sewer lines and a central wastewater treatment plant. However, severe problems can occur if these systems are not operating correctly. An insufficient septic system can be a source of groundwater and surface water contamination.

Rhode Island has many regulations dealing with the design and installation of septic systems; however, there are not sufficient regulations concerning the operation and maintenance of these systems. In order to address the problems associated with poor operation or maintenance practices, a bill providing local communities the power to establish ISDS maintenance districts is currently being considered in the Rhode Island General Assembly (See Appendix B for text).

The formation of a WWMD would permit the Town of Westerly to regulate the operation and maintenance of ISD systems, and more importantly, address the problem of failing systems. Application of this concept to the Salt Pond Region could be an important step forward in mitigating ISDS related problems and protecting water quality.

In order to establish the necessary background, this chapter provides a general overview of septic systems and septic system problems, followed by an analysis of the current state of ISDS regulation in Rhode Island. After establishing this framework, the focus will turn to the potential benefits of augmenting current regulations with WWMD provisions. This will include a case history of one community that already utilizes the WWMD concept. Finally, the possible establishment of a WWMD for the Westerly Salt Pond Region will be discussed.

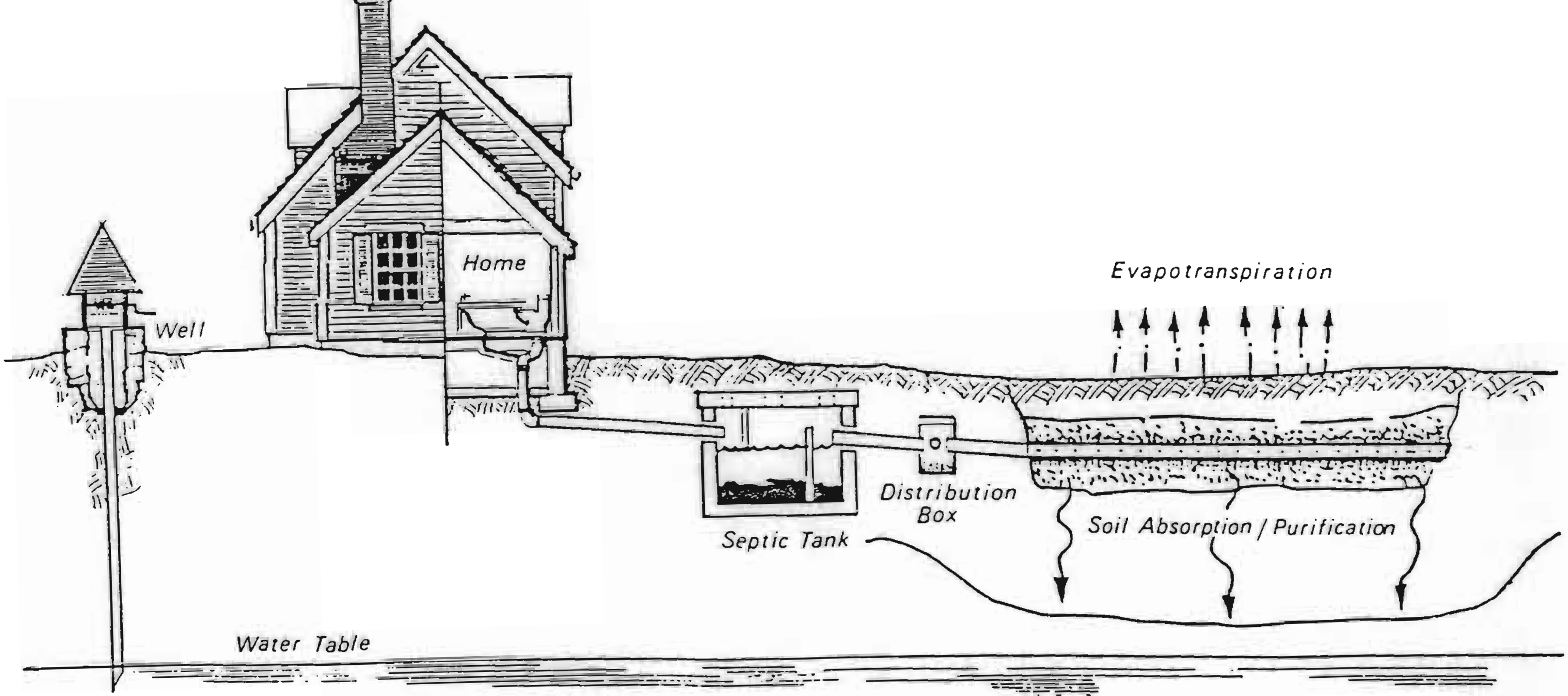
B. ISDS Background Information:

1. Basic System Design

A generalized ISDS can be broken down into two basic parts: a septic or holding tank, and a leach field. A diagram of a generalized ISDS can be seen in Figure 11. Household wastewater enters the septic tank through a drain near the top of the tank. The septic tank holds the effluent and allows the heavier solids to sink to the bottom, where anaerobic bacteria digest the effluent to form a sludge. The septic tank must be pumped periodically in order to remove the accumulated sludge. After pumping, the sludge is then transported to a sewage treatment plant for ultimate disposal. Baffles in the top of the tank control the horizontal movement of foam and lighter particles that float on the surface.

As the water level in the septic tank rises above the discharge fitting, clarified wastewater moves out of the tank and into the leaching field. A distribution box at the head of the leach field directs the effluent to a number of perforated pipes in the field. At this point, the wastewater begins to percolate through the gravel drain field and underlying soil where it is further purified and diluted.

This two part ISDS can be thought of as a localized secondary treatment plant or two stage purification system: removal of solids in the septic tank, and purification of liquids in the drain field. As a wastewater treatment strategy septic systems provide several advantages.[115] First, these systems require minimum maintenance, with tank pumping every two to five years. Second, an ISDS is low in cost when compared to the per unit cost of a central wastewater treatment facility. Third, a basic ISDS is a low technology system, and therefore relatively easy to operate and maintain. Finally, these systems have very low



<u>Figure 11</u>: A Typical Septic System

energy requirements.

2. ISDS Disadvantages

Although ISD systems can provide low cost wastewater treatment, there are several disadvantages associated with these systems.[116] Since the system depends on filtration through the soil for purification, there is the potential for groundwater and surface water contamination. This can occur if the leach field is not of sufficient size, the soil is unsuitable, the system has outlived its usefulness, or the water table is too close to the base of the leach field. In these situations, the wastewater does not pass through a sufficient amount of soil, or percolates too quickly, to become purified before entering the groundwater. Further, the system will overflow if not properly maintained. Overflows can result from clogged pipes or leach fields, or an overaccumulation of sludge in the bottom of the septic tank. Finally, household chemicals, or septic system cleaning agents may enter the groundwater through an ISDS.

Poorly performing ISD systems can lead to groundwater contamination. Contaminants can be divided into three basic classes: microorganisms, nutrients, and chemicals. In order to develop an effective ISDS management program it will be necessary to examine the effects and fates of these contaminants.

Bacteria and other microorganisms in excreta pass easily through the septic tank and into the absorption field.[117] From the drain field they can enter the groundwater and migrate with the water flow. Problems can occur if these organisms are transported to drinking water source areas. Bacteria may also enter the ground or surface waters through an ISDS and be flushed into nearby water bodies. This can contaminate aquatic organisms and cause serious health problems if the tainted organisms are ingested. Viruses are other potentially harmful organisms that may be introduced into the groundwater through septic systems. Viruses are able to survive up to six months in soil or groundwater, and thus may be transported significant distances.[118] These organisms are generally removed through absorption onto soil particles; however, absorption does not deactivate the virus, and it may be washed free by heavy water flows.[119]

ISD systems may also introduce excess nutrients into the groundwater and surrounding ecosystems. Nitrogen and phosphorus are generally the limiting nutrients in aquatic ecosystems; increased availability of these nutrients can initiate plant blooms and increased primary productivity in the receiving waters. A rapid increase in primary production can lead to excessive plant material and bacterial decomposition, resulting in low levels of dissolved oxygen. The resultant oxygen poor environment can have a very disruptive effect on the ecosystem. Therefore, it is important to understand how these nutrients move through an ISDS and into the ground and surface waters.

Nitrogen enters the septic system in the form of ammonia. From there it enters the absorption field where it is oxidized and converted into nitrate. As the nitrate percolates through the soil, away from the oxygenated surface area, it is removed by bacterial reduction under anaerobic conditions.[120] If the percolation time is not sufficient, nitrate may enter the groundwater. Excess nitrate may be transported to surface water bodies and initiate eutrophication. In the salt pond ecosystem, increased nitrate loading often produces algal blooms, which may lead to low oxygen conditions.[121] Of a more direct threat to humans, high nitrate concentrations in drinking water may cause infantile methemoglobinemia ("blue baby" syndrome).[122]

Phosphorus, in the form of phosphate, is the other major nutrient that may enter the ecosystem through an ISDS. As phosphorus is also a limiting nutrient in many aquatic ecosystems, additional phosphate loading could potentially initiate eutrophication. Phosphates pass easily through the septic tank and into the drain field. Once in the drain field, phosphates are readily absorbed by clay particles and are not easily transported. Under most circumstances, phosphate is not transported in quantities large enough to significantly contribute to aquatic plant growth.[123] Since clay particles absorb most of the phosphates, soils with low clay content may allow increased transport of phosphates.[124] Thus, areas composed of sandy soils, such as coastal zones, may be more susceptible to problems associated with phosphate loading.

ISD systems may also introduce contaminants in the form of household and septic cleaning agents. These chemicals are not readily removed by either the septic tank or absorption field, and thus pose a significant threat to ground and surface waters. Septic system cleaners can be divided into three categories: biological, inorganic chemical, and organic chemical. The biological based cleaners include yeast or other organisms which are introduced into the septic tank to help in the decomposition of waste materials. Inorganic cleaners include acids and bases used to help dissolve the waste material, unclog pipes, and reduce the scum layer. The organic solvents are particularly insidious, and may pose health risks in concentrations as low as a few parts per billion.[125] These solvents are typically composed of chlorinated hydrocarbons, and may persist indefinitely in groundwater.[126] According to many studies, these additives are generally ineffective as ISDS cleaners, but they may have severe side effects in terms of reduced system performance and water contamination.[127] Since chemical cleaners are not removed by even the best septic system, prevention of water contamination by these solvents must occur before they enter the wastewater flow. Toward this end, many areas prohibit the sale or use of organic solvent septic system cleaners.

Many of the contamination problems associated with ISD systems can be traced to inadequate design, siting, operation, or maintenance. A properly operating system can reduce the level of many contaminants to acceptable levels before they enter the groundwater. Problems associated with chemical additives must be addressed before the contaminants enter the septic system.

C. ISDS Management Districts:

According to one expert, the major causes of septic system failure are: inadequately sized septic tanks, unsuitable soil characteristics, high groundwater levels, and failure to properly maintain the system.[128] The first three problems are based on design and siting factors, and are subject to extensive regulation in Rhode Island. According to the ISDS taskforce, Rhode Island's ISDS minimum standards compare favorably with other states in the Northeast region.[129] Although the ISDS taskforce has recommended several changes for these regulations, the framework for regulating the design and siting of septic systems is well established.

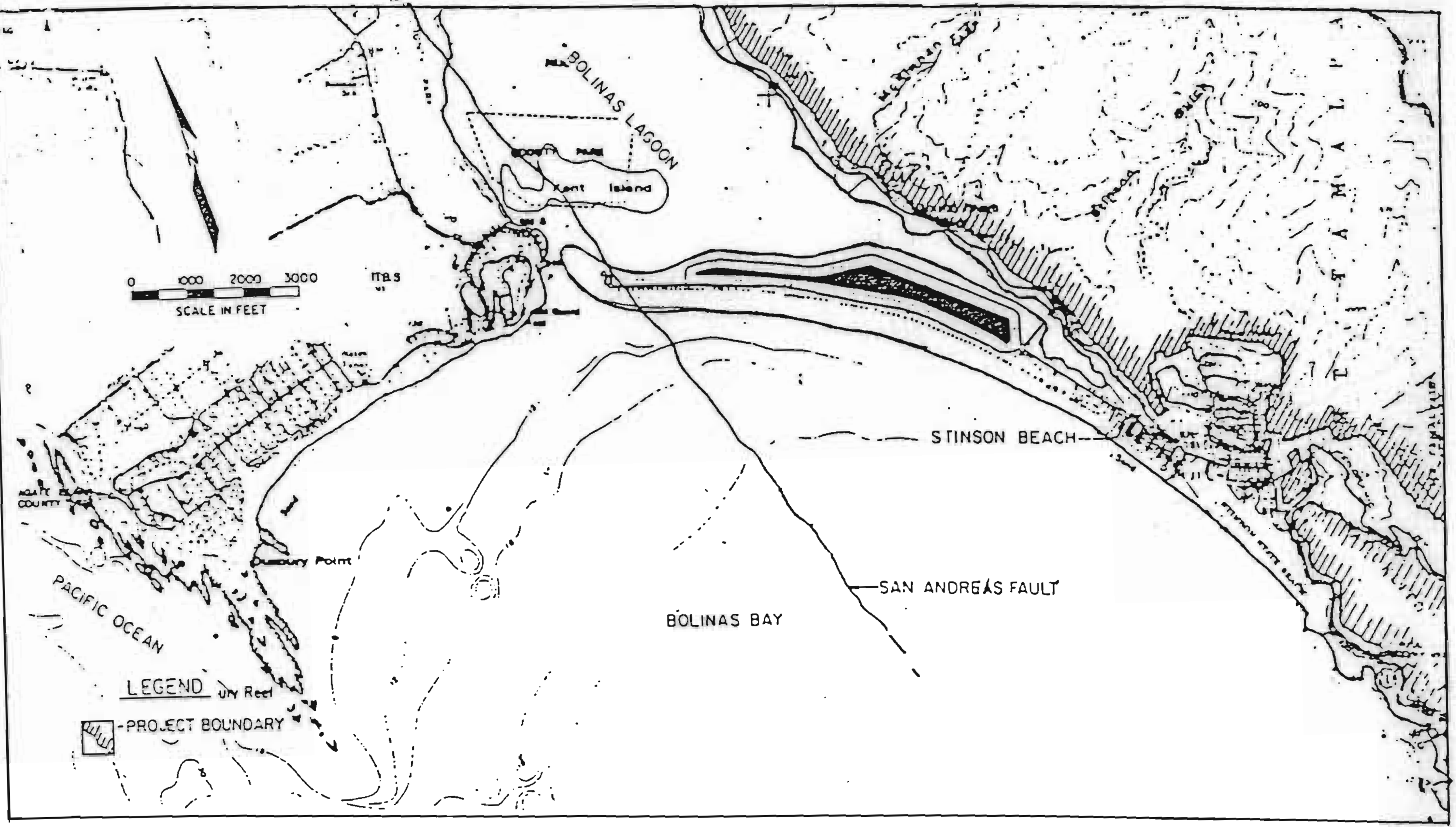
Operation and maintenance procedures are not well regulated in Rhode Island under the current system. In Rules and Regulations Establishing the Minimum Standards Relating to Location, Design, Construction, and Maintenance of ISD Systems, only one paragraph out of thirty eight pages deals directly with ISDS maintenance.[130] This appears to be insufficient means to address problems associated with operation and maintenance deficiencies.

In an effort to deal with some of these problems, the Rhode Island General Assembly has been considering adoption of an ISDS management program. In order to judge the potential benefits of instituting an ISDS management district scheme, it is worthwhile to see how these programs have worked elsewhere. The following section presents a case study of one community where a management program has been established to deal with ISDS problems.

1. Stinson Beach

Stinson Beach, California provides a well documented case study on the effectiveness of ISDS management in abating problems associated with failing septic systems. Stinson Beach is a coastal resort near San Francisco (Figure 12). Evidence that failing ISD systems were causing water quality problems in nearby Bolinas Lagoon, resulted in an order by the San Francisco Regional Water Quality Control Board (SFRWQCB) to prevent any new ISDS construction. In addition, the SFRWQCB also disallowed the general use of existing systems after October 1977, within the Stinson Beach County Water District (SBCWD).[131] In effect, this order mandated the development of a new wastewater treatment program for the area by October 1977. Faced with this problem, the SBCWD initiated a comprehensive study into the current status of the community's ISD systems. The initial survey of all households in the SBCWD indicated that approximately 10 percent of all systems were failing.[132] However, over 50 percent of the failures were correctable through minor mitigation procedures, such as system cleaning or pumping.[133] Only 4 percent of the failing systems, or 0.4 percent of the total systems, required major repairs or replacements.[134]

Although the SBCWD had some authority over the design and installation of septic systems, there was no method for dealing with operation or maintenance problems. Enabling legislation was passed to eliminate this deficiency, and the SBCWD began an active ISDS management program. Through the aggressive management



<u>Figure 12</u>: The Stinson Beach Project Area

of ISD systems, the SBCWD demonstrated that a well managed ISDS district can provide a cost effective and satisfactory method of wastewater treatment. Stinson Beach, an area seen as geologically and hydrologically unsuitable for ISD systems, has been able to overcome many deficiencies through comprehensive management.[135] Thus, the SBCWD has improved the reliability of ISDS wastewater disposal and avoided the huge costs of developing a central wastewater treatment facility.

Although the Stinson Beach example is one of the most extensively studied, other areas have also had favorable results with ISDS management. Communities in Wisconsin, Ohio, and Maine, to name a few, employ some sort of ISDS management regime.[136] The documented benefits of these programs, coupled with decreased federal emphasis on new central treatment facilities, should foster the continued proliferation of ISDS management districts.

D. ISDS Management for the Westerly Salt Pond Region:

1. Background

The Westerly Salt Pond Region could benefit significantly from the implementation of an ISDS management program. A 1975 Rhode Island Statewide Planning Program map shows that the Westerly Salt Pond Region has been an area of concentrated septic system failures and system alterations (Figure 13).[137] Many of these problems still exist today. Although the extension of sewer lines could alleviate ISDS problems, formation of a WWMD could address the same issue without promoting additional development.

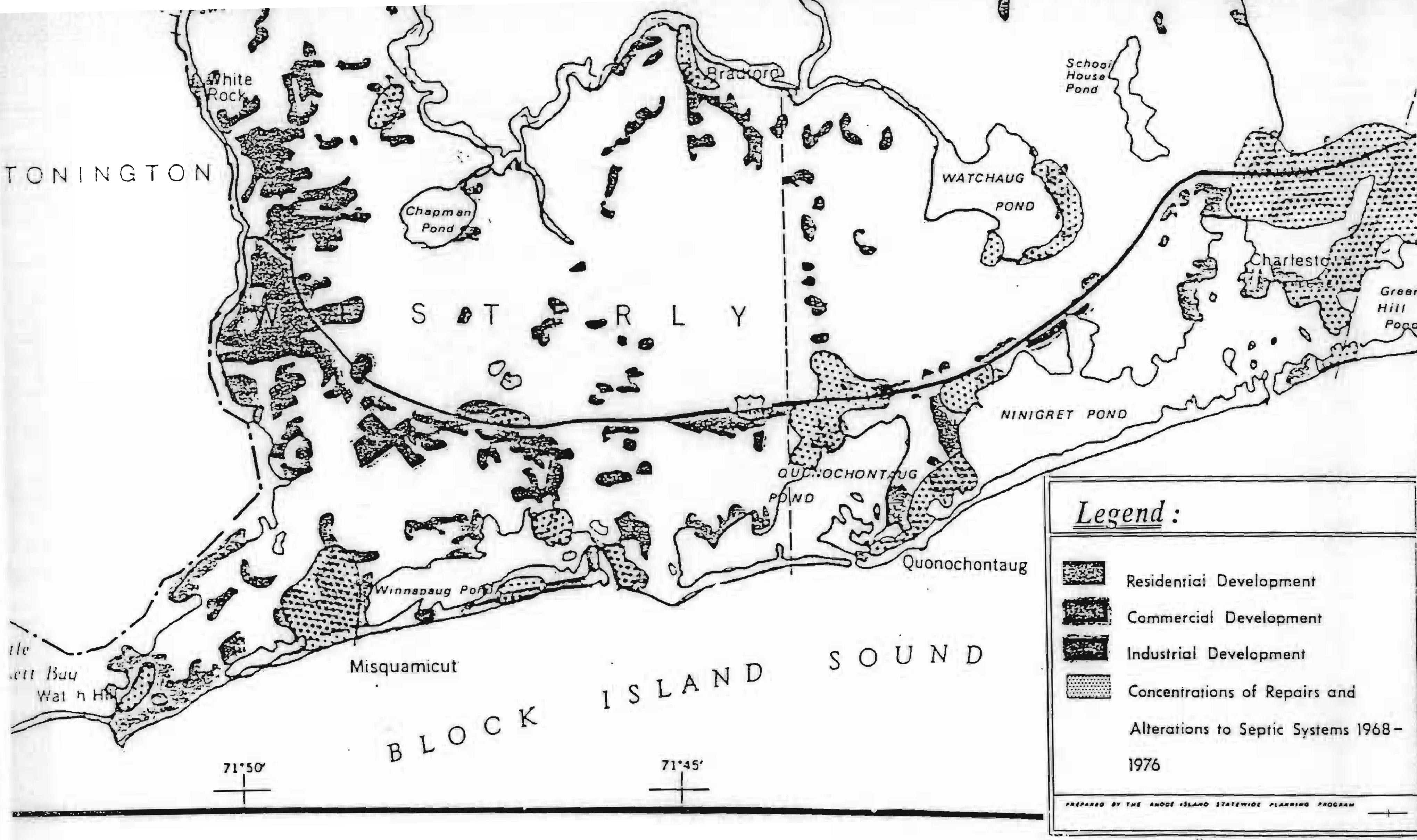


Figure 13: Septic System Failures and Alterations

In order to discuss the application of a WWMD to the Westerly Salt Pond Region, it is important to understand some of the factors leading to current ISDS problems, as well as the pressures that the region will be facing in the future.

Figures for 1980 indicate that there were almost 2400 ISD systems in the watershed areas of the Westerly Salt Pond Region.[138] More importantly, over two-thirds of the houses in the Winnapaug and Maschaug watersheds, and one-half of the houses in the Quonochontaug watershed were constructed prior to the adoption of state ISDS regulations in 1969.[139] This represents a point of considerable concern since these systems have been built to unknown standards. Many of these systems are also approaching the design life expectancy of 30 years for septic tanks, and 20 to 25 years for absorption fields, for systems built to current standards.

The ultimate number of houses in this area is estimated to be over 6,000: representing approximately 2.6 times the present number of septic systems.[140] In addition, 45% of all land in the Rhode Island Salt Pond Region is privately held, and currently undeveloped.[141] This illustrates the significantly increased pressures that the Westerly Salt Pond Region will be facing in the future. In order to sufficiently handle ISD systems it is imperative that a management program be developed.

The composition of soils in the salt pond watersheds also contributes to ISDS problems. USDA soil surveys indicate that the beach areas consist of sandy, highly permeable soils with high water tables.[142] Soils in the marsh areas are characterized by high organic content and high water tables.[143] Both soils are conducive to rapid entry of ISDS effluent into the groundwater.

Thus, the present and potential density of septic systems, age of existing systems, soil types, and groundwater levels indicate the potential for severe ISDS related problems in the Westerly Salt Pond Region. ISDS failures could result in unacceptably high levels of groundwater contamination. Groundwater flowing into the region's three salt ponds transports contaminants, which could result in degradation of the ponds, and seriously restrict the use of these waters.

Although the waters of all three ponds are currently rated SA, an increased inflow of contaminants could easily lower this classification. In order to monitor the pollution levels in coastal ponds, the Coastal Resources Center (CRC) supports a volunteer force of pond watchers who continually sample salt pond waters and monitor the levels of certain contaminants.

Figures 14 and 15 show some of the results of the water sampling program for Winnapaug Pond. The two factors monitored in this example are fecal coliform bacteria and dissolved oxygen. Fecal coliform levels are used as an indicator to estimate the levels of other harmful bacteria in the pond. Sources for bacterial contamination include ISDS effluent, farm runoff, and pet wastes. As the graph in Figure 14 indicates, fecal coliform levels in Winnapaug Pond have generally remained within the safe shellfishing limits established by the state.

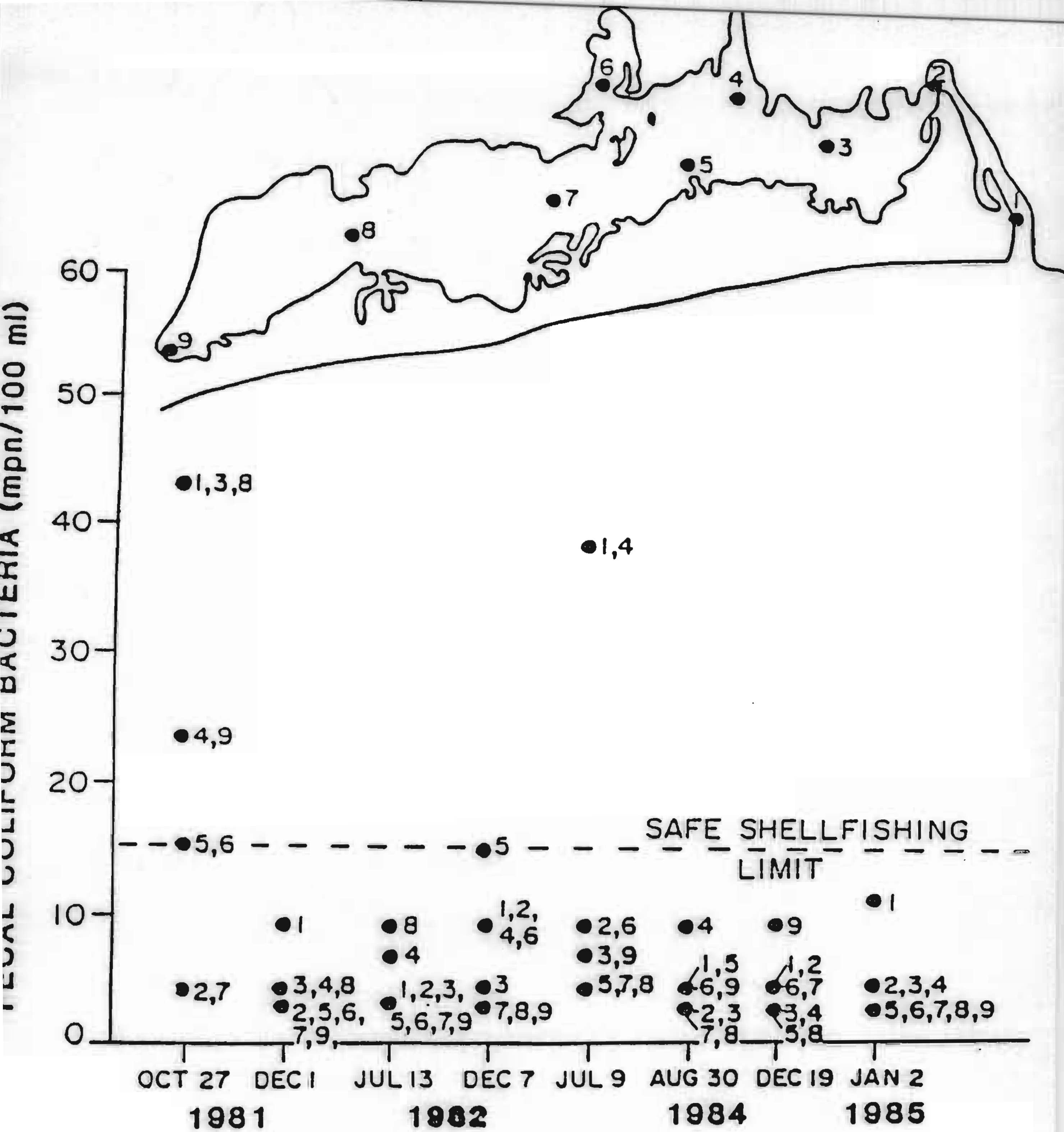


Figure 14: A Water Quality Indicator for Winnapaug Pond Bacterial Levels

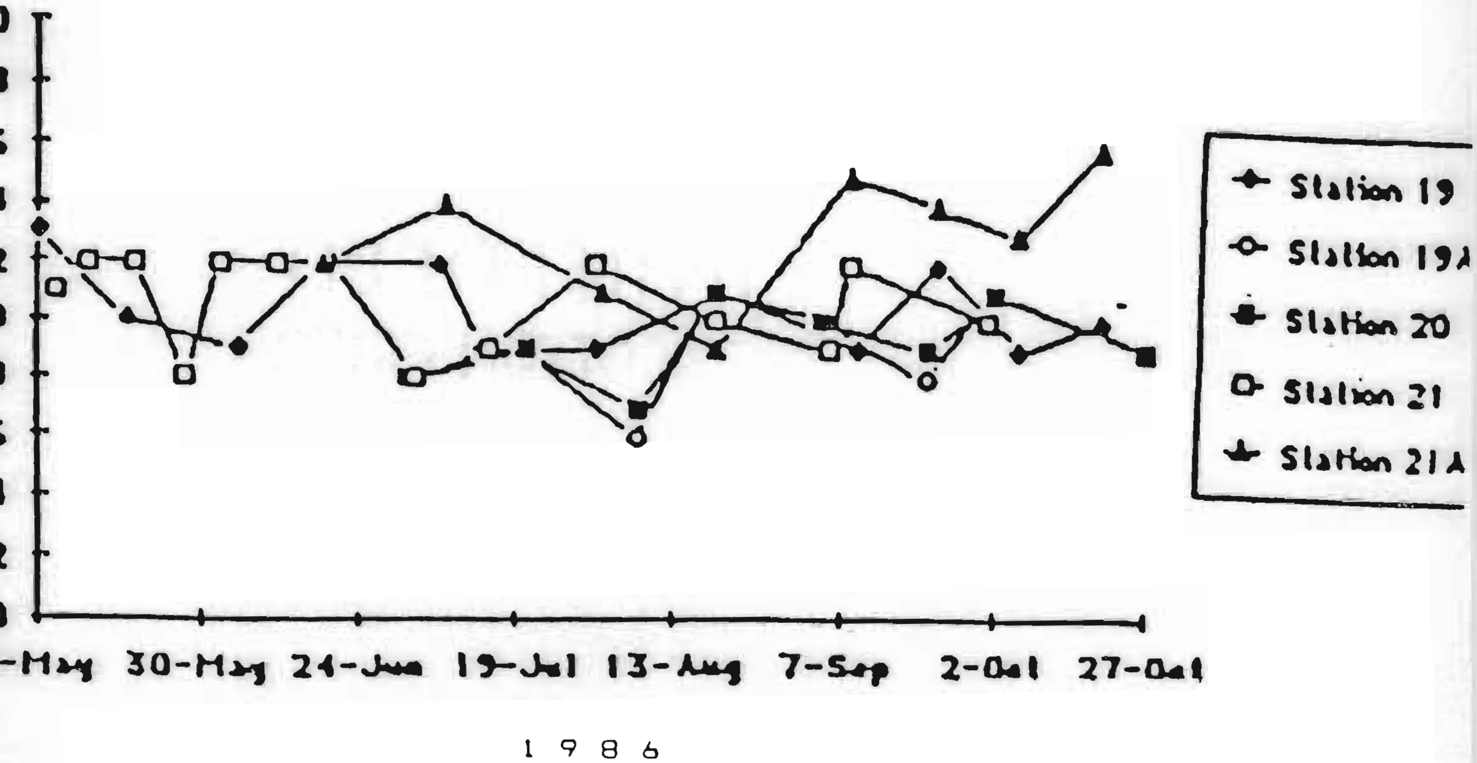


Figure 15: A Water Quality Indicator for Winnapaug Pond Dissolved Oxygen (DO)

Higher bacterial levels may result from periods of heavy rains, which rapidly inundate the ponds with runoff waters. In effect, heavy rains increase ground and surface water flows, decreasing the residence time of bacteria or other materials in the soil. This leads to reduced filtration of waters entering the pond, and periods of increased contaminant levels.

Dissolved oxygen content (DO) is used as another indicator of water quality. Figure 15 shows DO levels for Winnapaug Pond. Although oxygen concentrations of 4 mg/L will support some fish, concentrations of 5 mg/L are considered the minimum level necessary to maintain healthy and diverse fish and shellfish populations.[144]

Low oxygen levels may indicate problems with nutrient loading and eutrophication. Eutrophication, the excessive growth of aquatic plants and algae, may result from nutrient enrichment. Nitrogen is the limiting nutrient for plant growth in coastal marine waters.[145] Therefore, increased nitrogen loads can trigger eutrophication, which may result in environmental problems. Bacterial decomposition of overabundant plant material pulls oxygen from the water, reducing DO concentrations. Eventually, some waters may experience anoxic conditions.

The above indicators reveal that Winnapaug Pond is currently in fairly good condition. However, expanding development of watersheds will increasingly threaten the water quality of the salt ponds.[146]

Nitrogen is the primary limiting factor for plant growth in the more saline coastal ponds, such as Winnapaug and Quonnochontaug, whereas, both nitrogen and phosphorus limit growth in the less saline ponds, such as Maschaug.[147] Thus it is important to understand the relationships between nitrogen loads, development, and water quality.

Residential use, including lawn fertilizers and septic systems, is the major source for inorganic nitrogen loading in all three of Westerly's salt ponds.[148] ISDS related loads are estimated to be 53 percent of the total residential load.[149] Table 2 shows the current inputs of inorganic nitrogen into Maschaug, Winnapaug, and Quonochontaug ponds.[150]

Table 2: Sources of Inorganic Nitrogen to Groundwater (Lbs/Yr)

Watershed	Residential Use		Agricultural Use	Precip.
	ISDS	Other		
Maschaug	4,657	4,130	241	433
Winnapaug	22,973	20,373	2,516	4,312
Quonochontaug	8,214	7,285	1,000	5,213

The above table clearly shows that ISD systems are the most important single source of inorganic nitrogen to groundwater, and thus the coastal ponds. While nutrient levels in the three ponds are currently acceptable, the projected increase in development and the related increase in septic systems, has the potential to push nutrient loads to unacceptable levels. Table 3 shows the projected increase in nitrogen loadings at saturation development.[151]

Table 3: Projected Nitrogen Loads at Saturation Development (Lbs/Yr)

Watershed	Current Load	Load at Saturation	% Increase
Maschaug	9,461	18,352	194%
Winnapaug	50,174	108,381	216%
Quonochontaug	21,662	58,718	271%

All three ponds show a dramatic increase in nitrogen loadings, with the annual loading projected to exceed 100,000 pounds for Winnapaug Pond. As previously discussed, increased nitrogen loads can have serious negative impacts on water quality. While nitrogen is only one threat to water quality, expanding development of these watersheds will also result in increased loadings of other contaminants, such as hydrocarbons, phosphorus, and bacteria and viruses.

Thus, all three ponds can be seen to be severly threatened by increasing population densities. One method of reducing the flow of contaminants into the ponds would be through the mitigation of ISDS related problems. ISD systems are a major contributor of nutrients and other pollutants to the salt ponds, and close supervision of these systems could dramatically improve the future quality of the ponds. An ISDS is an easily identifiable source that can be inspected and monitored. This would be an easier task than trying to control some of the other sources of pollutants such as agricultural runoff, lawn fertilizers, or precipitation.

2. Program Implementation:

Assuming future adoption of the WWMD enabling legislation, effective implementation of these provisions will require action at both the state and local level. This section will focus on the process of implementation.

Before local communities can develop WWMD programs, the state should develop a set of model regulations. This is already underway at the DEM, and will help provide statewide consistency of WWMD regulations. The state model should reflect minimum standards, so that stricter regulations could be developed in order to address special local circumstances. In addition to this general model, the state should develop appropriate models for areas of special concern, such as salt ponds, groundwater recharge zones, and drinking water supply sources. According to the ISDS taskforce, Rhode Island lags behind the rest of the region in terms of special area management programs.[152] Development of model regulations for special areas would be an important step in rectifying this situation.

The WWMD enabling legislation should also be amended to include alternative penalties. Under the current proposal, violators face a fine of up to $500 per violation per day. This is a substantial penalty and should be retained. The penalty provisions should also include the option of halting water service to properties that are in violation of WWMD regulations.

In communities with public water systems, such as Westerly, the cessation of water service would accomplish two desired effects: the flow of effluent to the failed system would be halted, and the violator would have an immediate incentive to rectify the problem. This penalty response would also avoid some of the potential delays and difficulties of collecting monetary penalties.

Outside of the WWMD concept, but also important in alleviating ISDS contamination problems, the state should move to ban the sale and use of organic solvent septic system cleaners. As previously discussed, these solvents can pose a significant health risk, and do little to mitigate ISDS problems. Action at the local level would be ineffective, as the solvents may still be available in neighboring communities. Thus, it is necessary to address this problem on a statewide basis.

Concurrent with state efforts, Westerly could begin developing the basis for a WWMD for the Salt Pond Region. Although the Salt Pond Region is not the only section of Westerly that relies on ISDS wastewater treatment, it is an area of special concern due its geological, biological, and hydrological characteristics, and mounting development pressures. Since the Quonochontaug watershed is shared with Charlestown, and requires a regional program to effectively manage ISDS problems, this section of the paper will focus primarily on the implementation of a WWMD for the Winnapaug and Maschaug watersheds.

In order to develop an effective WWMD program, it is necessary to begin with a detailed understanding of the management area. Toward this end, Westerly should conduct a door to door survey to establish the state of wastewater treatment in the salt pond watersheds. The survey should cover ISDS type, age, and maintenance practices. In addition to the survey information, each system should undergo an initial inspection to determine whether or not the system is functioning correctly. Survey and inspection results would provide a good assessment of the state of affairs in the management district. This process could begin immediately, providing a head start in dealing with ISDS problems. Regardless of the formation of a WWMD, this information would be a valuable planning tool for the Town of Westerly.

Concurrent with the identification phase, Westerly should implement an aggressive public education program. As homeowners become more aware of ISDS operation and maintenance procedures, as well as the environmental consequences of failing systems, they will be more willing to detect and correct ISDS deficiencies. Information could be made available to the public through seminars conducted by district officials. Westerly's fire districts, a sub unit of local government, may provide a useful conduit for directing necessary information to homeowners.

In addition to identification and education, Westerly would need to develop an administrative framework for the district. The WWMD should have close ties with, and perhaps fall under the Public Works Department. This would give the WWMD access to the civil engineering and wastewater treatment expertise found in the Public Works Department. This would help limit the number of new personnel needed to handle WWMD business, and reduce unnecessary duplication of expertise.

This new operational system must also develop a source of funding. Some of the district's operating expenses could be covered by a fee system. ISDS operators would be charged a yearly fee for the services of the WWMD. Residents tied into the central wastewater treatment facility would not be subject to this fee. In this manner, those who most directly benefit from the program would bear the costs.

Additional sources of funding may be available from the state or federal government. Federal funding for the restoration of private on-site disposal systems may be available under section 201 of the Federal Water Pollution Control Act (FWPCA). These grants can be made available provided the following conditions are met: public ownership of the system is not feasible, there is public control over the operation and maintenance of the system, and the cost and environmental impact of the system is less than that for the application of a central wastewater treatment scheme.[153] Formation of a WWMD would provide public control over ISD systems, and thus would be a major step in satisfying the eligibility requirements for federal funds under the FWPCA.

As soon as the WWMD becomes operational, the district should adopt a system of periodic ISDS inspections. Homeowners would be obligated to have their ISDS inspected every two years, and pumped as required. This system could be designed to work along the same basic principle as automobile inspections. Licensed septic service companies would inspect and certify the system, and forward a copy of the certification to the WWMD. Under the proposed legislation, the WWMD would have the ability to set standard inspection and pumping rates. This system would provide the district with a relatively inexpensive means of monitoring ISD systems, and identifying potential problems.

Since the WWMD will require repair or replacement of failed systems, the district should develop guidelines for this eventuality. As previously discussed, many ISDS problems can be relieved through simple maintenance procedures, such as line cleaning or tank pumping. Strict water rationing can also help reduce ISDS problems.[154] The installation of devices such as air assisted toilets and water saving shower heads could be a viable means of mitigating some septic problems.

Construction of a second absorption field is another method for dealing with ISDS failures. As the first drain field becomes clogged and saturated, effluent could be diverted to the second field. While in disuse, the first field could be rehabilitated. Periods of disuse allow the leach field to fully drain, exposing clogged infiltrative surfaces to air. The resulting aerobic conditions facilitate the decomposition of the clogging materials, restoring much of the porosity of the soil, and thus rejuvenating the leach field.[155] In this manner, the two drain fields could be alternately rested, resulting in better system performance.

In the event that minor mitigation procedures are insufficient to relieve the problem, guidelines should be developed for system replacement. In cases where installation of a new standard system would not produce satisfactory results, the application of alternative systems should be investigated. A mound system is one possible alternative to the standard system. Mound systems employ the elevation of absorption beds above the natural ground level by building a mound of suitable fill material. In this manner percolation time can be increased and effluent treatment improved. This type system may be of particular interest in regions with excessive soil permeabilities and high groundwater levels, such as the South Shore. Correctly designed, installed, and operated mound type systems have been proven to be an effective wastewater treatment alternative in some areas where conventional systems are inadequate.[156]

In the event that an ISDS should require significant repairs or replacement, the WWMD should assist affected homeowners in obtaining special grants or low interest loans to help defray the expense of system rehabilitation. Low interest loans for the repair or replacement of subsurface holding tanks, including septic systems, will soon be available from the state. These loans are financed by a bond issue that was passed in a 1985 referendum, and the guidelines for their availability are nearing completion.

After implementing a WWMD for the Winnapaug and Maschaug watersheds, Westerly should work on the development of regional arrangements with Charlestown and Hopkinton. Westerly and Charlestown share the Quonochontaug watershed, and all three towns share the Pawcatuck River watershed. Therefore, in order to provide effective, comprehensive management, it is imperative to develop regional arrangements.

E. Summary:

ISD systems are low cost and effective wastewater treatment systems. Proper functioning of these systems depends on proper design, siting, installation, operation, and maintenance. The first three factors are covered by existing state regulations; however, operation and maintenance are not adequately regulated. This situation could be rectified through the passage of WWMD enabling legislation, and the subsequent adoption of WWMDs by local governments.

The salt pond watersheds of Westerly have been the site of significant ISDS related problems. ISDS problems based on the region's geological and hydrological characteristics, are further exacerbated by the age of the systems and strong development pressures. Although ISDS contamination is not an immediate threat to Westerly's drinking water supply, groundwater contamination could lead to other serious environmental problems. The three salt ponds are also vulnerable to contamination from tainted groundwater. Increased nutrient, microbial, or chemical loading of these ponds could significantly degrade their water quality, and restrict their use.

At current levels of development, the Salt Pond Region is experiencing ISDS problems: continued development will intensify this condition unless prompt corrective actions are taken. The ISDS management district concept has proven to be an effective means of addressing ISDS problems. Adoption of this type program could be a viable alternative for wastewater management in the Westerly Salt Pond Region.

Although the WWMD concept is a desireable program for the Westerly Salt Pond Region, it cannot successfully address ISDS problems without some limit on final development densities. No matter how well ISD systems are designed, installed, operated, and maintained, they can not provide adequate wastewater treatment when they are packed together and heavily utilized. In coastal zones characterized by high water tables and soil porosity, lot sizes need to be large in order to provide adequate percolation and treatment of wastewater.

The Westerly Salt Pond Region is already densely developed; furthermore, as previously discussed, current zoning statutes could permit a 2.6 fold increase in the number of houses. For an area already experiencing some ISDS related problems, the addition of this many new systems could have serious negative impacts. In order to deal with the problem of growing development, several attempts have been made to increase the minimum residential lot size to 80,000 square feet. These measures would control the ultimate density within the salt pond watersheds. To date these proposals have met with stiff resistance from local developers, and the future adoption of such a measure by the Westerly Town Council is currently unclear.

Efforts should be made to increase minimum lot size for the salt pond watersheds, regardless of the outcome of the wastewater management debate. The importance of special zoning to help insure adequate ISDS treatment has already been discussed; however, if the sewer line proposal gains acceptance, special zoning would still be in order. The increased developement brought about by the availability of sewer lines would intensify other pollution problems, such as run off from roofs, parking lots and roads, litter, auto emissions, and lawn fertilizers. Adoption of an increased minimum lot size would help lessen some of these side effects of development.

VI. Conclusion:

As this nation's coastal population continues to expand, the pressures placed upon the coastal zone will increase. Although there is clearly a need to provide housing and other facilities for the growing population, there is also a need to provide for sound planning and development of these facilities.

In developing coastal areas, sensitive features such as barrier beaches, salt ponds, and wetlands demand special care and attention. These areas provide important ecological, recreational, storm protection, flood mitigation, economic, and esthetic qualities that deserve to be protected and preserved. In making any decision concerning the future development of the coast, all factors should be carefully weighed and considered. This includes the environmental, as well as the economic impacts.

In making decisions based on the face value of a proposed project, the long term consequences may be totally overlooked in favor of short term benefits. This is clearly an undesireable, and potentially disasterous strategy to undertake.

Rhode Island's South Shore is currently experiencing rapid growth. This rapid expansion has highlighted the conflict between developmental and environmental concerns, as well as the need for sound planning in addressing this conflict.

The Westerly Salt Pond Region is one of the areas along the South Shore under strong development pressure, and is already experiencing significant problems associated with the present density of development. One of the major problems has been the environmentally safe disposal of wastewater. There are several choices for solving this problem; however, the extension of sewer lines, or institution of a WWMD appear to be the most practical solutions.

On the surface this debate seems to be over the best wastewater disposal alternative; however, the future of development in Misquamicut and Atlantic Beach is the underlying point of contention. The desirability of greater development along Atlantic Beach and within the Winnapaug Pond watershed has become a heated local issue. Many residents see the choice of a wastewater management program as a vote for or against greater development.

While the barrier beach - coastal lagoon system is well adapted to the onslaughts of storms and rising sea level, it is not as resilient to overexploitation by man. Due to scenic, recreational, wildlife, and other values, pond and oceanfront real estate is highly prized and sought after. However, over-development often destroys many of the original natural values.

As previously discussed, Atlantic Beach is poorly suited to handle greater levels of building and development. Atlantic Beach, as does any barrier beach, survives through the maintenance of a dynamic equilibrium. Attempts by man to stabilize the beach are often expensive and ineffective, and may intensify erosional problems. Any development along Atlantic Beach is susceptible to beach recession, as the beach is currently retreating at a rate of approximately two feet per year.

Local storm history points to another factor that works contrary to greater development. The 1938 and 1954 hurricanes effectively swept Atlantic Beach clean, and propelled the debris into homes located further inland. The standard project hurricane for this section of the South Shore would be accompanied by a storm surge several feet higher than either the 1938 or 1954 hurricanes. The level of destruction resulting from a storm of this magnitude is almost unimaginable.

Given all of these factors, I believe that it is fairly obvious that Atlantic Beach is not suitable for the construction of large structures. CRMC land use maps have designated this as an area developed beyond carrying capacity: it cannot support further development.

The effects of sewers on community development have been well documented. Fairfax County provides a solid example of the uncontrollable growth that can accompany sewer construction. Once sewerage facilities are in place, "...it is difficult, if not impossible to control the rate and nature of land development within the service area.[157] It is also clear that unplanned, undirected development is often "...economically inefficient and environmentally destructive.[158] Thus, sewer decisions made outside of an overall planning framework may undermine long range community development goals.

Sewer construction accompanied by strict zoning regulations designed to control growth, would seem to be one method of overcoming the development problem. However, zoning ordinances are only as strong as the political and administrative structures that support them.[159] Thus, a community's ability to control growth would vary with the local political climate.

The extension of sewer lines to Atlantic Beach and Misquamicut would clearly eliminate any ISDS related problems. However, this option has the significant side effect of potentially encouraging haphazard growth. While increased development may seem a desirable alternative in terms of tax revenues, commerce, and tourism, it could also disrupt the natural barrier beach--coastal lagoon ecosystem, degrading the values that make it attractive to residents and vacationers in the first place.

Furthermore, the dedication of a significant portion of the central wastewater treatment facility's remaining capacity to a seasonally occupied section of town, may not be the best allocation of this resource. Through reserving approximately 500,000 gallons per day of treatment capacity for Misquamicut during the summer months, the ability to provide future service to year round businesses and residences is significantly diminished.

In addressing the issue of sewer construction within the

Salt Pond Region, the CRMC states that:

> The experience of many communities nationwide demonstrates that sewer systems encourage high density development and increase runoff contamination of adjacent water bodies. 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 desireable alternative.[160]

Other wastewater management alternatives are available for Misquamicut and and should be fully investigated before any decisions are made.

The establishment of a WWMD has the benefit of addressing the ISDS issue, without intensifying development pressures. Many ISDS related pollution problems stem from poor operation and maintenance practices. In the Atlantic Beach/Misquamicut section of Westerly, pollution problems could also be attributed to the age of existing systems, as well as local geological and hydrological characteristics. A well developed WWMD could address all of these issues, and significantly mitigate ISDS related pollution. Experience in other parts of the country, such as Stinson Beach, has shown that strong management of septic systems can produce excellent results, even in locations poorly suited to this form of wastewater disposal.

In order for the WWMD concept to be effective, the ultimate density of development in the Westerly Salt Pond Region must be controlled. I believe that a strong WWMD could deal with many ISDS problems at current levels of development. However, if, as predicted, the number of homes in the region is almost tripled, then the WWMD may not be able to overcome the negative impacts associated with overcrowding of ISD systems. Rhode Island's 208 Water Quality Program calls for minimum lot sizes of 60,000 square feet in unsewered areas.[161] Thus, the Town of Westerly should strive to institute current proposals for special two acre residential zoning in the salt pond watersheds.

The combination of a WWMD with two acre salt pond watershed zoning would provide for adequate wastewater disposal, without encouraging continued development of these environmentally sensitive areas. Summarizing the findings of this paper, I believe that Westerly should pursue the following goals in order to help preserve and protect the Westerly Salt Pond Region:

1. Commit to working within the coordinated review procedure, in order to maintain an informed and strong decision making position;

2. Include all future sewer decisions within an overall community development framework;

3. Adopt special large lot zoning for the salt pond watersheds;

4. Define the current status of wastewater disposal in the area through the results of a door to door survey;

5. Institute a Waste Water Management District as soon as possible; and

6. Make every effort to direct development toward less sensitive areas.

Appendix A:

Rhode Island Population and Housing Figures

1970 - 1980

Source: Rhode Island Statewide Planning Commission

Population by City and Town 1970 - 1980

Town	1970 population	1980 population	% change
Charlestown	2,863	4,800	67.66
Narragansett	7,138	12,088	69.35
S. Kingstown	16,913	20,414	20.70
Westerly	17,248	18,580	7.72
South Shore Sub-Total	(44,162)	(55,882)	(26.54)
Barrington	17,554	16,174	- 7.86
Bristol	17,860	20,128	12.70
Burrillville	10,087	13,164	30.50
Central Falls	18,716	16,995	- 9.20
Coventry	22,947	27,065	17.95
Cranston	73,037	71,992	- 1.43
Cumberland	26,605	27,069	1.74
E. Greenwich	9,577	10,211	6.62
E. Providence	48,151	50,980	5.88
Exeter	3,245	4,453	37.23
Foster	2,626	3,370	28.33
Glocester	5,160	7,550	46.32
Hopkinton	5,392	6,406	18.81
Jamestown	2,911	4,040	38.78
Johnston	22,037	24,907	13.02
Lincoln	16,182	16,949	4.74
Little Compton	2,385	3,085	29.35
Middletown	29,621	17,216	- 41.88
Newport	34,562	29,259	- 15.34
New Shoreham	489	620	26.79
N. Kingstown	27,673	21,938	- 20.72
N. Providence	24,337	29,188	19.93
N. Smithfield	9,349	9,972	6.66
Pawtucket	76,984	71,204	- 7.51
Portsmouth	12,521	14,257	13.86
Providence	179,213	156,804	- 12.50
Richmond	2,625	4,018	53.07
Scituate	7,489	8,405	12.23
Smithfield	13,468	16,886	25.38
Tiverton	12,559	13,526	7.70
Warren	10,523	10,640	1.11
Warwick	83,703	87,123	4.09
W. Greenwich	1,841	2,738	48.72
W. Warwick	24,323	27,026	11.11
Woonsocket	46,820	45,914	- 1.94
Sub-Total	(902,572)	(891,272)	- 1.25
State Totals	946,734	947,154	0.04

Housing Units by City and Town 1970 - 1980

Town	1970 housing units	1980 housing units	% change
Charlestown	1,971	3,064	55.45
Narragansett	4,778	6,587	37.86
S. Kingstown	6,020	8,138	35.18
Westerly	6,776	8,250	21.75
South Shore Sub-Total	(19,525)	(26,039)	(33.36)
Barrington	5,044	5,399	7.04
Bristol	5,519	6,823	23.63
Burrillville	3,168	4,602	45.27
Central Falls	6,847	7,446	8.75
Coventry	6,970	9,492	36.18
Cranston	23,039	27,280	18.41
Cumberland	7,851	9,152	16.57
E. Greenwich	3,046	3,615	18.68
E. Providence	15,494	19,402	25.22
Exeter	795	1,390	74.84
Foster	874	1,132	29.52
Glocester	1,685	2,829	67.89
Hopkinton	1,693	2,264	33.73
Jamestown	1,554	2,052	32.05
Johnston	6,561	8,758	33.49
Lincoln	5,215	6,348	21.73
Little Compton	1,329	1,694	27.46
Middletown	4,901	6,483	32.28
Newport	11,158	11,886	6.52
New Shoreham	752	1,009	34.18
N. Kingstown	7,336	8,813	20.13
N. Providence	7,701	11,343	47.29
N. Smithfield	2,806	3,526	25.66
Pawtucket	27,864	29,768	6.83
Portsmouth	4,528	5,773	27.50
Providence	68,133	67,535	- 0.88
Richmond	830	1,384	66.75
Scituate	2,302	2,897	25.85
Smithfield	3,835	5,117	33.43
Tiverton	4,219	5,010	18.75
Warren	3,543	4,151	17.16
Warwick	26,221	32,450	23.76
W. Greenwich	762	1,008	32.28
W. Warwick	8,119	10,448	28.69
Woonsocket	16,489	18,354	11.31
Sub-Total	298,203	346,633	16.24
State Totals	317,728	372,672	17.29

Appendix B:

Proposed WWMD Enabling Legislation

STATE OF RHODE ISLAND

IN GENERAL ASSEMBLY

JANUARY SESSION, A.D. 1987

AN ACT

RELATING TO SEPTIC SYSTEM MAINTENANCE

Introduced By:

Date Introduced:

Referred To:

It is enacted by the General Assembly as follows:

SECTION 1. Title 45 of the General Laws entitled "Towns and Cities" is hereby amended by adding thereto the following chapter:

CHAPTER 24.5

WASTE WATER MANAGEMENT DISTRICTS

45.24.5-1. Short title. -- This chapter shall be known and may be cited as the "Rhode Island Septic System Maintenance Act of 1987."

45-24.5-2. Legislative findings. -- The general assembly hereby recognizes and declares that:

Septic systems or individual subsurface disposal systems (ISDS) are prone to failure without proper maintenance. ISDS failure poses a risk to public health through the contamination of the state's surface and underground waters. Improperly treated wastewater from malfunctioning ISDS can impair or prevent the use of the state's waters for drinking and domestic purposes, as well as swimming, wildlife habitat, boating, fishing and other-water based recreation. In many suburban and rural areas of the state, the use of ISDS is the only practical or available means to treat wastewater. Most community and individual drinking water supplies and some of the state's prime recreational waters are located in areas that rely on ISDS. Recreational and drinking supply waters are the least tolerant of wastewater contamination and, therefore, require rigorous protection. ISDS will continue, for the near term, to be the primary means of wastewater treatment in many areas of the state where public and private water supplies and recreational waters exist. Therefore, to help avoid both contamination of state waters and the associated risks to the public health and to help preserve the natural ecosystems, wastewater disposal systems must be properly maintained to prevent their malfunction and/or failure.

45-24.5-3. Declaration of Purpose. -- The purpose of this chapter is to authorize the cities and towns of the state to adopt ordinances creating Wastewater Management Districts (WWMD), the boundaries of which may include all or a part of a city or town, as specified by such ordinance. Such ordinances shall be designed to eliminate and prevent the contamination of state waters, caused by malfunctioning individual subsurface disposal systems (ISDS), through the implementation of ISDS inspection and maintenance programs. The wastewater management district ordinance programs shall be designed to operate as both an alternative to municipal sewer system and as a method to protect surface and ground waters from contamination.

45-24.5-4. Powers of councils. -- The city or town council of any city or town in the state, by itself or pursuant to chapter 45-43, and in accordance with the purposes of this chapter, are hereby authorized to adopt ordinances creating Wastewater Management Districts (WWMD), which may be empowered, pursuant to such ordinance, to:

a) Provide for the passage of District officials and septage haulers onto private property when necessary for the periodic inspection, maintenance, and correction of ISDS systems.

b) Raise funds for the administration, operations, contractual obligations and services of the Wastewater Management District by:

1. Assessing property owners for taxes or annual fees;
2. Borrowing, and for that purpose, by issuing bonds or notes of the city or town;
3. Setting rates for pumping.

c) Establish the necessary administrative, financial, technical, enforcement, maintenance, and legal structures to effectively implement and conduct wastewater management district programs, as well as hire the personnel necessary to support these structures.

d) Establish a public education program, which would precede the implementation of a WWMD, to make property owners aware of the proper maintenance and care of ISDS systems and the need for periodic pumping. After a WWMD has been created, an education program could remain in place to educate new residents and update members of the district on new information or procedures.

e) Receive grants and establish a revolving fund to make available grants and low interest loans to individual property owners for the improvement, correction, or replacement of failed septic systems.

f) Authorize and contract with independent septage haulers.

g) Contract with other cities or towns for septage disposal through sewage treatment plants.

h) Designate proper collection and disposal sites for septage collected by authorized pumping and hauling agents.

i) Levy fines for non compliance. Such fines shall be no greater that $500 per violation. Each day of a continuing violation shall constitute a separate and distinct violation.

45-24.5-5. Powers of state agencies retained. -- The Departments of Enivronmental Management and of Health shall retain all of their existing authority regarding individual sewage disposal systems.

SECTION 2. This act shall take effect upon passage.

EXPLANATION

OF

AN ACT

RELATING TO SEPTIC SYSTEM MAINTENANCE

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This act enables municipal governments to establish septic system districts to oversee the maintenance of existing septic systems.

This act shall take effect upon passage.

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Figure 10a: Photograph by John R. King

Figure 10b: Assesor's Plat, Town of Westerly, R.I.

Figure 11: Rhode Island Statewide Planning Program, 208 Water Quality Management Plan for Rhode Island. Draft Plan and Environmental Impact Statement, (Providence, R.I.: R.I. Statewide Planning Program, 1979), p.85.

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