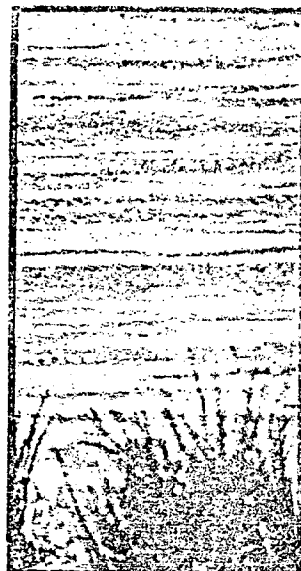


BEACH EROSION CONTROL AND
SHORELINE ACCESS PLANNING

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BEACH EROSION CONTROL AND SHORELINE ACCESS PLANNING

September 1978

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OFFICE OF MANAGEMENT, BUDGET, AND PLANNING

Dover, Delaware 19901

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BEACH EROSION CONTROL AND
SHORELINE ACCESS PLANNING

September 1978

prepared by
the Delaware Coastal Management Program

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PREFACE

This is the eighth in a series of working papers which are issued to interested citizens and governmental officials so that they may actively and effectively participate in the development of Delaware's Coastal Management Program. Working papers have also been issued on the following subjects:

1. Program Overview and Public Review Guidelines
2. Coastal Zone Boundaries
3. Geographic Areas of Particular Concern
4. Program Goals and Objectives
5. Federal-State Interaction and the National Interest
6. Authorities and Organization
7. The National Interest in Resources and Facilities of the Delaware Coastal Zone.

This paper is divided into two parts: Part One, Beach Erosion Control; and Part Two, Shoreline Access Planning. Part One is designed to satisfy the Shoreline erosion/mitigation planning requirements of Section 305(b)(9) of the Federal Coastal Zone Management Act Amendments of 1976. Part Two is designed to satisfy the shoreline access and protection planning requirements of Section 305(b)(7) of that Act.

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SHORELINE EROSION AND MITIGATION PLANNING

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SHORELINE EROSION AND MITIGATION PLANNING

As long time residents of Delaware's coastal areas are aware, the shoreline has undergone and is continuing to undergo substantial change, primarily beach erosion. In order to properly plan for continued use of coastal areas, it is necessary to answer certain basic questions with regard to coastal processes. Such questions include: 1) What causes beach erosion; 2) What, if anything, can be done about it and at what cost; 3) Why are some beaches eroding faster than others; 4) Why are Cape Henlopen and portions of Lewes Beach growing; 5) Why is Lewes Harbor filling with sediment; 6) Can coastal change be predicted; 7) What are the economic implications of beach erosion; 8) What is the relationship between erosion and the severity of damage caused by storms?

I. Causes of Coastal Change

a) Marine Transgression

The coastal zone of Delaware, including both the coasts of Delaware Bay and the Atlantic shoreline, is categorized as a lagoon-barrier-marsh shoreline. This coastal zone is presently undergoing a relatively rapid transgression by the Atlantic Ocean and the Delaware Bay. A transgression is basically the advance of the sea over land areas caused by a relative change of sea level with respect to the land surface. There are two geologic processes causing this change. The first is the actual rise in the level of the world's oceans caused by a gradual melting of the polar ice caps. The second is the compaction of the sediments in the earth's crust which causes the nearshore land surface and the ocean floor to sink. The combination of these two factors leads to coastal erosion and a gradual rise of the ocean and bay relative to Delaware's land area. Accordingly, over the long term, a landward and upward movement of the barrier beaches has occurred. Figure 1 describes this process. As the relative sea level rises, waves begin to attack the beach at a higher elevation causing increased erosion of the shoreline. At the same time, the process of dune formation continues caused by blowing beach sands. The processes occur slowly enough that the dune's position relative to the shoreline is maintained, but the net result is a gradual landward and upward movement of the barrier beach and dune line. To give some scale to this ongoing effect, it can be noted that during the past 12,000 to 14,000 years, the sea level has risen approximately 440 feet. Centuries ago, the shoreline of coastal Delaware lay seaward on the outer Atlantic Continental Shelf approximately 80-100 miles east of Rehoboth Beach. Since then, the Atlantic Ocean level relative to the land has risen to its present position. These coastal erosion and relative sea level rise processes are continuing today.

The rate of sea level rise during the past 2,000 years has averaged about 5 inches per century, however, the rate of rise in the past 45 years has accelerated dramatically. Tide gauge records at several east coast locations have shown that during this period of time the sea level has risen 6 to 7 inches. This may sound insignificant, but its effects on coastal development can be catastrophic, particularly during intense storms.

To put the effect of sea level rise into perspective, refer to Photo 1. This is the remnants of an ancient pine forest exposed in the surf zone at Dewey Beach after storm erosion. It is obvious that these trees must have grown behind a barrier, and the ongoing transgression has overridden the forest to the extent that the covered trees are now exposed in front of the beach and are below mean sea level. It has been determined that these trees are approximately 300-400 years old which indicates the extremely rapid rate at which Delaware beaches move, a minimum of a quarter of a mile since the forest was alive.

b) Littoral Transport

1) Longshore

In addition to the transgression described above, there is another geologic process that affects coastal change. Geologists call this process littoral transport. Littoral transport is a term for the movement of beach and offshore sand caused by waves and currents and involves two components. One component of littoral transport is longshore transport, in which sand moves parallel to the shore. Most longshore currents are generated by waves striking the shoreline at an angle, (Figure 2). When the wave breaks at a slight angle, water from the breaking wave surges up on the beach face at an angle to the shore and returns by rolling back down the beach face in response to gravity. The net effect is a slight longshore movement of sand-laden water. The cumulative effect of many breaking waves is to move sand steadily along the shore.

2) Onshore/Offshore

The second component of littoral transport is onshore--offshore transport, in which sediment moves perpendicular to the shore. Transport of sand perpendicular to the shore is responsible for a constant exchange of sand between berm and bar. Berms are the flat, above-water features of the beach, whereas bars are underwater ridges of sand parallel to the shoreline that are seldom exposed except at unusually low tides. Onshore-offshore transport is determined primarily by wave steepness, sediment size and beach slope. In general, low waves of long wave period (low steepness waves) move material onshore, whereas high, steep waves move material offshore.

Figure 3 illustrates generalized "summer" (also called "normal" or "berm-type") and "winter" (also called "storm" or "bar-type") profiles associated with the onshore-offshore transport processes. Fair weather conditions prevalent in the summer months favor accretion of the berm, producing a prominent convex-upward beach face and a smooth, usually barless, offshore profile. Since storms tend to be more frequent and severe in the winter, the beach shows a "winter" profile of erosion. The berm is typically narrow and concave-upward, with one or more offshore bars present. It is important to note that the concept of "summer" and "winter" profiles is generalized, and either profile may occur during any particular season.

The onshore-offshore processes of sediment transport associated with storm waves are illustrated in Figure 4. Profile A shows the beach under normal wave action. Note the wide berm and smooth offshore profile. Profile B shows the change during initial attack of storm waves. Sand is eroded from the berm and deposited seaward of the high-water line. This type of wave attack often produces one or more erosional scarps on the beach. Often the storm waves remove enough sand from the beach face to expose underlying marsh muds.

Profile C of Figure 4 shows continued erosion of the berm and storm wave attack on the foredune.

In addition to the greater height, shorter period and greater steepness of storm waves, their destructive nature is augmented by increased tidal level during a storm. This rise above normal water level is called the storm surge and is due primarily to the action of strong winds creating a surface current on the water. When such a current reaches the coastline, water tends to pile up against the land, raising the water level.

Profile D of Figure 4 shows the final beach configuration after the storm wave attack and the resumption of normal wave action. Much material has been removed from the foredune and berm, resulting in a landward displacement of both the dune crest and the high tide line. As waves return to normal, the process of berm build-up begins. As described above, long, low waves move sand landward. This sand moves in the form of a wedge which migrates up the beach face and eventually welds itself onto the berm. This envelope is commonly known as a "repair bar". The result of this process is seaward accretion of the berm and restoration of its pre-storm configuration. Thus, onshore-offshore transport is a continuous, cyclical process, depending primarily on wave conditions impinging on the beach. Human interruption or alteration of long-shore or onshore-offshore sand transport processes has resulted and continues to result in coastal change in Delaware. The specific causes and effects of such change vary from place to place, and therefore, they will be described, in detail, later during a discussion of specific coastal segments.

c) Storm Effects

1) Washover

Another major coastal process is that of washover. Washover is a process whereby storm waves, heavily laden with sand eroded from the beach and nearshore marine area, breach the dunes and deposit large quantities of sand on top of the barrier island and in the back-barrier marshes. This process results in a landward migration of the shoreline and an upward build-up of the barrier island. The result of a series of these washovers over a long period of time is also shown in Photo 1.

Washover is a periodic, natural process associated with all barrier islands and is accompanied by violence and destruction. Although some barriers were washed over during the December 1974 storm, most particularly along the Delaware Bay, the last major washover occurred during the northeaster of March 1962. Photos 2 and 6 show the results of this process. It is inevitable that washover will occur again; the only questions are when and with what associated destruction.

In times of elevated water levels when waves wash over the berm, coastal sand dunes form an effective barrier to storm waves. A well developed beach/dune system contains a considerable quantity of sand which must be removed before water can rush inland. The time required for the ocean to remove this material is usually several tidal cycles and most coastal storms do not last that long. When dune systems are removed or otherwise unstabilized, the time required to remove what little sand remains is considerably shortened and washover can occur even during relatively mild storms.

In addition to dunes providing a protective barrier to wave washover, the offshore transport of sand during storm conditions tends to reduce the slope of the nearshore marine surface. This transport process serves to extend the shallow water area seaward and waves progressively break further from the barrier, dissipating much of their energy before they come ashore. Where a barrier beach or dune has been developed and structurally stabilized the natural self-sacrificing process of beaches and dunes cannot take place and the force of the waves remains concentrated upon the barrier, causing greater erosion and more storm damage than would occur naturally.

The areas subject to the washover process include the barriers from Pickering Beach to Lewes Beach along the Bay and, with the exception of the highlands at Rehoboth Beach, from the Great Dune at Lewes to the Maryland border along the Atlantic coast.

2. Depth of Closure

Another important concept in the long-term beach erosion process is that of the so-called "depth of closure". According to Dean, the depth of closure is "the depth over which the equilibrium beach adjustments occur. This must depend on the capability of the more extreme waves to remold the sediment bottom to these depths. Although no precise estimate of this value is available, it is recognized that for small bodies of water (bays, for example) where wave energy is not great, the depths may be on the order of 3 to 6 feet. On the open ocean coasts, this depth is generally taken to be approximately 20 to 40 feet.(T)he rapid response of a beach profile to incremental rises in sea level would require the occurrence of large, frequently occurring waves. Therefore although the rise in sea level is fairly gradual, the shoreline response to this rise may be rather dramatic. This can be demonstrated by considering a location that has usually calm weather for a period of (say) 15 years followed by a very extreme storm of long duration (say, a return period on the order of 100 years). During the period of relatively calm weather, sea level rise would cause only minor beach erosion because the wave energy is insufficient to remold the sand bottom out to depths greater than perhaps 6 feet. Relative to the increased sea level, the profile for depths from 6 feet to the depth of closure have a "deficit of sand". The extreme storm, therefore, will cause beach erosion, transport and deposition to at least partially satisfy the deficit of sand associated with the undernourished profile. This erosion and associated beach recession to satisfy the latent deficit of sand in the profile can be considered permanent. (Figure 4(a)).*

In other words, the predominant transport of sand during storms is offshore and the increased turbulence sweeps large quantities of sand out to sea where it is deposited in relatively calm (i.e. deeper) water. After the storm passes, the waves return to normal and beach rebuilding begins, however those calmer waves do not have sufficient energy to remold the sediment deposited this deep water. The net result is a dramatic retreat of the shoreline and permanent loss of sediment offshore.

* Dean, R.G., "Beach Erosion: Causes, Processes, and Remedial Measures", CRC Critical Reviews in Environmental Control, Vol. 6, Issue 3, 1976

d) Summary

The evidence offered above indicates that beaches are constantly changing natural systems. Even a stable beach is one which undergoes constant change with periods of erosion balanced by periods of deposition. "Stable" does not mean permanent, nor does it imply that the beach is fixed, but rather that the natural processes are balanced over a long period of time.

This balance is delicate and can easily be upset. Beach stability is determined by: (1) the amount and type of materials making up the beach; (2) the intensity of the natural forces responsible for change; and (3) the stability of sea level.

Beaches recede when the capacity of the wave forces to transport sand exceeds the amount of sediment supplied to the system. The greater the deficiency of sand, or the greater the capacity of the wave forces, the more rapid the rate of sediment transport and erosion. A variation in any three factors, energy, sediment or sea level, can alter the balance of erosion and deposition. Beach erosion is a natural process and becomes a serious problem only when man's structures are placed in the path of shore recession.

The "natural condition" for beaches and barrier islands is simply a wide range of sand-deposit responses to various wave conditions. Like river systems in which streams adjust in cross section to accommodate the water flow, beaches adjust in cross section to accommodate wave runup. During winter storms, when the wave runup can be high, the active beach expands, landward and seaward; during the summer, when runup is generally low, the active beach zone contracts.

Most of the time this process of beach-profile expansion and contraction is of minor significance, geologically or economically, because it is confined to the central part of the active zone where little change in the sand deposit is involved. Under these conditions, the cross section required to accommodate the wave runup is similar to the stream cross section at low-river stage. In the river system, the flow is confined within the stream banks most of the time, so the stream bed can easily accommodate the discharge. In the beach system, the berm serves as the topographic constraint for wave runup most of the time.

During such extreme storm conditions as hurricanes or severe winter northeasters, the beach cross section makes major adjustments to lengthen the distance of the runup and thus dissipate the increased energy. In the offshore region, this results in an extension of the zone of shoaling and breaking waves beyond the outer bar. At the landward end of the profile, if the increased energy level is high enough, the wave runup extends into the zones normally associated with sand dunes and adjacent sand flats.

II. Coastal Process Related to Specific Coastal Segments

The coastal processes described above affect certain segments of the State's coastline in differing ways. In order to describe coastal change in a coherent manner, it will be helpful to divide the coastal area into six zones; each of which is affected differently (and some, not all) by littoral transport, wave attack and engineering works. The zones are shown in Figure 5.

a) Marsh Against Piedmont

This zone extends from the Delaware-Pennsylvania border to Wilmington. The shoreline here consists of a narrow tidal marsh forming along the Delaware River against Piedmont crystalline rocks. Typical features of this narrow, upper coastal plain are shown in Photo 3. Geologic evidence indicates that a marsh formed the natural shoreline from 2,670 years ago until recently, when fill material was dumped on the marsh. A narrow sand body is located along the marsh edge of the Delaware River in limited areas. Coastal flooding is controlled by local streams more than by marine processes. Marine influence is minimal in this area and for this reason Zone 1 will not be considered further in this section.

b) Marsh Against High Coastal Plain

This zone extends from Wilmington to the Chesapeake and Delaware Canal. The marshes here are restricted to a narrow zone between the lower Delaware River and coastal plain. Lack of sufficient sand supply and wave energy precludes the development of sandy barriers and, therefore, the shoreline consists of highlands with isolated pockets of marsh. Here again the effect of coastal processes is limited, primarily due to the narrow width of the tidal Delaware River. The short fetch does not permit large waves to form, thereby limiting the extent of wave damage to the shoreline.

c) Broad Marsh with Minor, Isolated Sandy Barriers

This segment extends from the C & D Canal to Bowers. The coastal plain is wide and broad marshes form in the coastal zone. The northern portion of the zone to the Smyrna River is characterized by deeply incised valleys and a high, rolling coastal plain topography. The southern portion is characterized by a low coastal plain with less than 30 feet of relief. Sand and gravel sediments of pre-Holocene age, deposited during times of higher sea level, are eroded at points along the Bay and provide a local source of coarse sediment to the shoreline system. These sediments form minor, isolated sandy barriers and beaches along the northern portion of the Bay. The topography of the pre-Holocene sediments acts as a control on the configuration of the present shoreline. Drowned river valleys of Pleistocene age, now covered by marshes, appear as slight indentations along the coast. Highlands of pre-holocene sediments cause bulges along the shoreline and are areas of concentrated erosion. The outcroppings of these sediments along the River and Bay shore are rather infrequent. Most of the exposed Pleistocene sediments are located inland along tributaries and are, therefore, not subject to extensive erosion. As a result of this limited sand supply, coupled with relatively low wave energy characteristic of this zone; extensive barrier beaches are unable to form. The lack of a beach/dune system makes structures located close to the shore very vulnerable to storm waves, particularly in the area from Port Mahon south to Bowers Beach.

Waves generated by local winds within the Bay are the primary causes of shoreline erosion. From Bombay Hook Point north to the Canal, the shoreline varies from a north-easterly to an easterly exposure. Since winds do not blow from this direction a significant portion of the time, the potential for wave generated erosion is reduced considerably. Waves emanating from the east and north-east, however, are usually associated with storms, but in this region the narrowness of the River and Bay does not permit the build-up of destructive waves. Long-term as well as storm-induced erosion is, therefore, minimized in this area.

In the region from Kent Island south to Bowers Beach the Bay widens rapidly and the fetch of storm waves is considerably increased. This, coupled with the lack of protective sandy barriers and the exposure of highly erodible marsh muds, account for the rapid erosion of this segment of the shore.

d) Continuous Sandy Barrier

This zone includes areas of broad coastal marsh separated from the waters of Delaware Bay by a continuous, relatively narrow, sandy coastal barrier. This zone, from Bowers Beach southward to the area of the Great Marsh at Lewes, is one in which the littoral drift stream sand is in fairly continuous motion. The sandy barriers are rarely thicker than 10 feet. The majority of the sandy barriers in this zone have thicknesses of less than 5 feet and are usually less than several hundred feet wide. A characteristic of this zone is the rapid erosion and landward migration of coastal barriers at rates of up to 10 feet per year averaged over the last century and a half. With a high tide and storm setting, sand is easily washed across the barrier into the marsh area. At the same time, waves attack the substrate underneath the very thin coastal barrier and erode exposed older marsh muds. Thus, this shoreline area is one that contributes massive quantities of mud to the waters of Delaware Bay during times of storm erosion. At the same time, the broad coastal marshes continue to grow upward as muddy tidal waters flood across them and deposit mud on the surface.

These rates of coastal erosion appear to be continuing and may be projected into the future. In view of the fact that the littoral drift stream plays an important role in this area, the construction of groins or jetties may have a major effect on the coast. It may be assumed that any jetty or groin protruding beyond the shoreline area of this zone will cause a rapid collection of sand on one side and acceleration of erosion on the other side.

With the development of the breakwaters at Lewes and the growth of Cape Henlopen spit northward around the inner breakwater, the flow of sand from that area moved into ever deeper waters in addition to being deposited in Lewes Harbor. Accordingly, the sand sediment supply was cut off and the beaches northwest of Lewes Beach were starved of the sand they had been receiving during much of the 19th century, triggering a new cycle of coastal erosion in the area from Primehook Beach southward to Lewes Beach.

Earlier in the 20th century, as a convenience to boatment, a new inlet was developed at Roosevelt Inlet just west of Lewes Beach. The Broadkill River was thus deflected southeastward along the channel of the older Lewes Creek and dredged deeper so that the river might emerge into Delaware Bay at Roosevelt Inlet. With the cut-off of sediment supply from the southeast; and a change in flow directions of tidal waters; the littoral transport stream, on an average, tended to reverse its flow to the south and east into the Lewes Harbor area. A considerable amount of sand has been trapped by the jetties at Roosevelt Inlet. Some sand bypasses the jetties on flood tide and is deposited within the inlet at Lewes Creek and Broadkill River. As a result, relatively rapid erosion has occurred on the sediment-starved southeastern side of Roosevelt Inlet along Lewes Beach.

The coast here is susceptible to greater wave attack due to its proximity to the mouth of the Bay where it can be affected by waves approaching from the northeast. Flooding and washover are common problems in this area. Washover lobes extending into the back-barrier marsh at Broadkill Beach are shown in Photo 6. Washovers are a major mechanism for the movement of sediment as coastal barriers migrate landward. In view of these geologic hazards, the houses in this area have to be built on stilts. This, however, is only a short-term solution and futile in the long run. Groins built along the town of Broadkill Beach trap sand leading to the impression that the beach is accreting. However, if the groin field is not maintained, natural erosion processes will take over. Also, this solution is only locally effective as it increases erosion both north and south of the groin field.

Erosion along the Delaware Bay shoreline is caused by a combination of relative sea level rise and waves generated within the Bay by local winds. The rates of erosion at various locations are highly variable as shown in Figures 6 and 7. The highest rates of erosion tend to occur in areas where marsh sediments form the shoreline such as at Port Mahon. In areas where the more resistant pre-Holocene highlands crop out along the coast, i.e., in areas of more compacted sediments such as Bowers Beach, the average rates of erosion are significantly lower.

The only area in this zone that has shown a net accretion over the past century is Broadkill Beach. Analysis of historic maps indicates net beach accretion here is an anomalous short-term situation caused by longshore movement of sand prior to the reversal of the littoral drift which in turn was caused by the breakwaters at Cape Henlopen. Since the supply of sand has been diverted, this area has subsequently been eroding at rates comparable to other stretches of sandy beach along Delaware Bay. The construction of a groin field at Broadkill Beach has been effective in controlling beach erosion under normal conditions, however, the area has been severely damaged by erosion during storm events. Moreover, the groin field has caused accelerated erosion both to the north and south.

e) Cape Henlopen Spit Complex

The Cape Henlopen Spit Complex extends from the Roosevelt Inlet area of Lewes Beach to the tip of Cape Henlopen and southward to the city of Rehoboth Beach. Massive wave attack along the Atlantic Coast is eroding sand and washing it across the low-lying barrier at Whiskey Beach and into the Gordons Pond marsh area. Some sand is being picked up by coastal winds and blown into broad dune fields developing from Whiskey Beach to the Great Dune at Lewes. A large portion of the sand being eroded away from this area is being carried northward by the littoral transport stream and deposited at the tip of Cape Henlopen in the relatively deep channel between the inner and outer breakwaters. Some of the sand flows around the Cape and is deposited on the sand flats in the lee of the Cape.

By the time Cape Henlopen protruded as a simple pointed spit northward beyond the line of the inner breakwater, much of the sediment began to be diverted into the outer harbor area.

At this point, massive silting began in Lewes Harbor itself. Accordingly, Lewes Harbor is one of very heavy deposition of sand in the eastern end and mud in the center. With the cut-off sand supply and the gradual dominance of flow of sand from the northwest to the southeast along Lewes Beach, an additional sand supply began to move into the Lewes Harbor area. Much of the sand eroded from northwestern Lewes Beach ends up in the shallow western area of Lewes Harbor. These two littoral transport streams converge in a "null area" (Figure 8) and the beach here is accreting. The sand bars developing on the western side of Cape Henlopen (Photo 7) and the sand buildup on the northeastern side of the Ferry Terminal groin provide visual evidence of this phenomenon.

This process results in shoaling and silting of Breakwater Harbor, which was once over 30 feet deep and is now only 8 to 10 feet deep. Any planning in this area should consider these rapid rates of change. It is estimated that in the next several decades, Cape Henlopen Spit will join the inner breakwater if natural processes continue in their present form. The resultant sheltering effect will decrease wave energy and accelerate shoaling. Eventually the present harbor will become a marsh unless the area is constantly dredged. The use of Lewes Harbor during the next half century is thus in question. Clearly the technology exists to maintain the Harbor. However, it will be at the expense of considerable dredging. Problems that will arise will include the costs of dredging, the location of sites on which to place the dredge spoil, and conflicts of interest between industrial development of the port and the development and increased use of the recreation facility in the State Park to the east.

The net effect on the Atlantic coast of Cape Henlopen Spit Complex is coastal erosion rates of up to 10 feet per year in the north and 3-5 feet per year in the south. Figure 9 shows the historic recession of the Atlantic shoreline and the growth of Cape Henlopen since 1765. It can be noted from this figure that between 1765 and 1843 the Cape grew at a rate approximating 37 feet per year. During the period between 1843 and 1910 the rate of growth declined to about 17 feet per year, however, since 1929 Cape growth has accelerated to about 55 feet per year on the average. This rapid migration continues today.

Figure 11 describes the annual rates of shoreline recession along the Atlantic coast.

f) Atlantic Coast Baymouth Barrier Complex

The shoreline from Rehoboth Beach to the Delaware border at Fenwick Island consists of a wide sandy baymouth barrier interrupted by uplands at Rehoboth and Bethany Beach. Components of this barrier include tidal deltas, back-barrier marshes, beaches and dunes. The shoreline is straight but there are minor bulges and indentations. For instance, bulges occur where resistant marsh muds crop out on the beach face. The barrier is continuous except for a break at Indian River Inlet. The location of the Inlet has varied widely in the past and its present position is maintained artificially. It must be recognized that it is abnormal for inlets to be stable, the normal process is migration. The barrier varies from less than 0.2 to more than 0.9 miles in width. Beach, dune and washover sands are fairly constant 0.25 mile in width, while the marsh covered tidal delta sequence shows widths ranging from 0. to 0.7 mile.

Coastal Lagoons with fringing marsh growth are located behind the sandy barrier. The three major lagoons include Rehoboth Bay, Indian River Bay and Little Assawoman Bay. These lagoons are very shallow, no more than 7 feet deep at low water. In general, the floor of the lagoon is covered by mud and sand. Highlands are eroding at the beach face in three major locations: Rehoboth Beach, Cedar Neck and Bethany Beach. There are also highlands at Thompsons Island (in north Rehoboth Bay), at Burtons Island (behind Indian River Inlet) and behind Fenwick Island. This highland material provides a major supply of sand to the barriers. Several surveys conducted in the past indicate general erosion along the entire Atlantic coast of Delaware with the exception of some areas where protective measures have been taken.

The area between Rehoboth Beach and Indian River Inlet is one of relatively rapid coastal change. Erosion rates along this stretch of Atlantic coastal Delaware have been measured at approximately 3 feet per year averaged over the past century and a half. Here again, coastal washover and erosion processes are dominant. The highlands at Rehoboth Beach have been undergoing continuing erosion as the coastline maintains its straight configuration. Northeasters and hurricanes that approach the area frequently have caused washovers of sand across the barriers and into the adjacent coastal lagoons or marshes. Thus, the barriers themselves are constantly changing or moving physiographic features. They tend to erode at the beach face and immediate nearshore area and build in a landward direction across the marshes and lagoons. The evidence of this change is clear from the historic map record. It is also discernable from coastal surface and sub-surface geological studies. The well-known destruction of the coastline during storms over the past several decades is part of the process of change.

Construction on highlands is safe, but subject to flooding of low fringe areas during extreme storm tides or, if adjacent to the beach, subject to coastal erosion. Construction on the washover barriers is a very different matter. As these barriers are normally subject to rapid changes, construction on them must be considered to be temporary and subject to violent destruction.

Rehoboth Beach is maintained in its present condition mainly by a system of groins (Photo 8). Due to net northerly littoral transport, these groins cause accretion of sand on the southern side and erosion on the northern side. The highlands, on which Rehoboth and similar towns along the Atlantic coast of Delaware are located, are also undergoing coastal erosion. Most of the sand and gravel carried northward by the process of longshore transport originate from these highlands. Some of the eroded sand is placed in littoral transport and on washovers, and some is permanently lost offshore to the shelf. The zone of erosion extends from the upper limit of storm tides to a depth of 30 feet below sea level. This zone of potential erosion migrates landward and upward during the transgression, eroding sediments from previous coastal environments of the past 100,000 years.

The baymouth barrier south of Dewey Beach, situated between the Atlantic Ocean and Rehoboth Bay, is shown in Photo 9. The elements of the linear barrier observed on this photograph consist of the beach face and berm, dunes and few washover fans seen as light patches extending across and behind the dune line. Dunes provide major protection during storms. Natural breaks in dunes on a wide, low dune washover barrier allow some water to flow through during storms and prevent major water build-up on the seaward side. Maintenance of a high, narrow dune can lead to catastrophic flooding during storms. Removal of dunes guarantees a washover.

The location of a former tidal delta and inlet is shown in Photo 10. These areas of broad back-barrier marshes were once part of the tidal channel-inlet system that existed in the southeastern corner of Rehoboth Bay during the past 100 years. The inlet was filled in by landward migration and littoral transport of sand and gravel. Later a new inlet broke through much closer to the present Indian River Inlet. Increased deposition of sand in the back-barrier portion of the old channel-inlet system caused it to become shallow. Marsh growth started at this time, resulting in more deposition of mud and sand until the whole area was covered by a back-barrier marsh. The channels between these back-barrier marshes now are slowly being filled by deposition of sand and mud.

Thompsons Island, on the northern shore of Rehoboth Bay, represents a highland surface eroded as a consequence of the ongoing transgression (Photo 11). The sea cliff, which is approximately 15 feet high, was cut by waves impinging on the highland. A large amount of sand and silt is supplied to the lagoons from areas such as this. In general, during the process of the transgression, features like Thompsons Island are first surrounded by marshes and tidal creeks. When sea level rises, such areas become surrounded by water, thereby forming islands which are finally submerged or destroyed as a consequence of sea level rise coupled with wave erosion. An example of this process is Big Piney Island, situated on the west-central side of Rehoboth Bay. This island is presently very small (about 85 feet long). According to historical records, it was once much larger and had an orchard and building on it. Big Piney Island is now covered by marsh grasses.

Indian River Inlet provides access by boat to the Atlantic Ocean from Indian River Bay and Rehoboth Bay. The present inlet has been stabilized by the U. S. Army Corps of Engineers to keep the inlet channel open. The original natural inlet was unstable and moved north and south over a 3 to 4 mile area in historic time. Jetties have been built to prevent closing of the inlet by littoral drift and wave action. This has resulted in a build-up of sand on the southern side of the inlet and erosion on the northern side. This is known as a "jetty effect" and should be anticipated when such structures are built. Erosion on the northern side of the jetty has endangered the foundation of the highway which runs parallel to the beach, and failure to constantly repair and maintain the beach would eventually result in the destruction of the highway and bridge over Indian River Inlet.

Near Bethany Beach, the direction of the littoral drift changes. North of this area, called a "nodal area", littoral transport is toward the north; south of the nodal area transport is to the south. As a result of this process, there is a net loss of 69,000 cubic yards of sand annually from the Bethany area and the beach recedes at an average annual rate of about 2 feet per year.

Average annual rates of coastal change along the Atlantic coast of Delaware from Rehoboth Beach to Fenwick Island Inlet are shown in Figures 12 and 13. Analysis of historic charts shows that over the past 130 years, net erosion has occurred along most of Delaware's Atlantic shoreline. With the exception of the rapidly advancing spit at Cape Henlopen, areas of accretion along the Delaware Coast are small and localized.

The greatest amount of erosion has occurred along the east side of Cape Henlopen and along the 2 mile stretch of beach north of Indian River Inlet.

Relatively little erosion has occurred along beaches just south of Dewey Beach, Cotton Patch Hills and in the vicinity of Little Bay and Fenwick Island. Extensive shoal areas in the form of offshore linear sand ridges refract incoming waves and thus cause wave energy to be distributed unevenly along the shore. Therefore, some places are exposed to greater amounts of wave energy than others; such stretches of shoreline will recede more rapidly.

III. The Prediction of Future Coastal Change

Rates of shoreline change for coastal Delaware have been shown in terms of geologic time, centuries and millennia, as well as in yearly rates based on historic analysis of events over the past 150+ years.

The long-term geologic trend is evident. Coastal erosion is proceeding landward at a very rapid rate, accompanied by a rise in relative sea level of approximately 1.0 foot per century. In terms of predicting short-term change, however, rates of change in the immediate past are used. It is known that short-term events (year or decade) vary sharply. Some of these are caused by man and include beach nourishment programs, construction of bulkheads, dikes, groins, jetties, breakwaters and inlets as well as destructive events such as building on or removing dunes.

It can be projected confidently that the average rate of coastal erosion over the next 50 years will resemble that of the past 125 years. Thus, annual long-term average rates of erosion in Atlantic coastal Delaware of 1 to 2 feet in the south gradually increasing to 3 to 10 feet per year north of Rehoboth Beach can be anticipated. However, the groins and jetties already affect this prediction. Therefore, some areas will be more stable; and erosion in other areas, such as those north of both the groin and jetty fields, will accelerate.

Predictions of rates of coastal erosion along coastal Delaware Bay are less precise, but here again erosion rates should parallel past history. Again, the exception will be those areas with groin fields, such as central Broadkill Beach, or areas that have and continue to receive beach nourishment. The partially sheltered nature of the Bay coast tends to reduce storm effects. On the other hand, the very low topography and lack of sand and gravel available for development of a large barrier system assures rapid erosion during the high-intensity storm event.

In conclusion, assuming that past and presently acting processes continue for the next 50 years, the past 125 year maps of erosion rate should be fairly precise indications of the potential future of coastal erosion. However, beach nourishment programs or lack of responsible actions by private constructors in the coastal zone could negate all predictions.

IV. EFFECTS OF COASTAL PROTECTION WORKS ON BEACHES

Over the long term, beach erosion is a natural process of building as well as taking away beaches. On an undeveloped shore, there is really no such thing as beach erosion, only the movement of sediment as the sea resculpts the shore line. During storm events, dune and beach sand is washed over the barrier and deposited inland. This results in a landward and upward movement of the barrier. Much of the sand that was transported offshore is gradually returned to the beach and the process of dune formation begins anew. Generally speaking, a beach that remains undisturbed is in a state of equilibrium, with the sediment carried away by storm waves roughly equal in magnitude to the sediment that is carried landward during calmer weather. So, all other things being equal, beaches are forever, but in different places at different times. All other things are not, however, always equal. The dynamic equilibrium that exists on an undisturbed beach is alien to man's static sense of equilibrium. Once a line has been established, whether it be a shoreline or a property line, man unreasonably expects it to stay put. Once structures are placed on or very near the beach the "instant geology" of the shoreline becomes apparent and, when buildings or other improvements are threatened, man intervenes with his structural defences in an attempt to "hold the line." By doing so, however, a situation is actually being created that is much more unstable and will lead to greater problems of erosion as well as increased governmental expenditures in the future.

Erosion is a serious national problem for barrier beachfronts as well as mainland beaches. About half of our U. S. shoreline is eroding and several coastal areas require continuous beach-restoration programs. Nevertheless, the shore zone remains one of the most desirable settings for recreational, residential, and commercial development, and competition for the remaining undeveloped land has increased in recent years. This trend has greatly accelerated the demand for barrier beach properties. Planners and decision-makers responsible for the management of shoreline resources must have a basic understanding of the nature of the inshore zone and ready access to reliable information.

In no other resource-management field, however, is there more misconception, mysticism and generally confused thinking than in beach erosion control. The problem is often approached on an emotional rather than a scientific basis. Amateurish schemes for erosion control abound. The reason for the uncertainties about how to deal with erosion is that erosion control is far from an exact science. The professionals in the field are quick to point out that, although there is a large pool of scientific information on beach erosion, techniques for restoring and protecting eroding beaches must be substantially improved.

Most erosion problems along the mid-Atlantic coast can be traced back to the early development of the beach-front property during the 1920's, 1930's and 1940's. As the coast and beaches were stabilized, the "line of development" soon became a "line of defense". Further private and public development contributed directly to increased pressure to protect this line.

For example, along the coast of North Carolina, the initial concept of management was to create a continuous line of high barrier dunes approximately 500 feet inland from the active shoreline. The WPA/CCC labor force of the 1930's was used to construct sand fences out of millions of locally cut shrubs and trees. These fences disrupted the winds blowing across the beaches and adjacent sand flats, causing fine sands to drop near the fences. As the sand accumulated forming dunes, more fences were constructed at higher and higher levels, trapping large masses of windblown sand. Soon roads and utility lines appeared, followed by subdivisions. Unfortunately, sea level has continued to rise since the 1930's and the shoreline has receded hundreds of feet. The dunes are now disappearing rapidly under the direct attack of waves so other, vastly more expensive

"solutions" including fixed structures and beach nourishments are being explored.

The ideal solution to the beach-erosion problem would be (1) to plan all developments well inland from the high-water line and (2) to design all structures so that periodic severe-storm surges can occur without major damage. The life expectancy of any development should be planned according to its location; buildings placed near the upper limit of the storm-surge zone should not be designed to last for decades. However, since these ideal conditions seldom exist and, as has been indicated conditions along the shoreline change, what alternatives are available?

Shoreline-protection schemes fall into four categories. Protection designed (1) to stabilize sand, including dune and dike construction, and to use plants to trap sands moved by winds; (2) to construct breakwaters, seawalls, bulkheads, or revetments; (3) to inhibit currents that transport sand with jetties and groins; and (4) to actually replace lost sand through beach nourishment.

Some aspects of beach protection include:

a) Natural Protection

The structure of the beach serves as its own natural protection against wave action. The slope of the beach face absorbs most of the wave energy during normal conditions. During times of elevated water level when waves wash up over the berm, coastal sand dunes form an effective barrier to storm waves and protect low-lying back-barrier areas. Even when breached by severe storms, dunes gradually rebuild themselves to provide protection against future storms. Dune vegetation plays an important role in the development and maintenance of sand dunes. Grasses and other plants act as a trap for windblown sand and tend to stabilize dunes. The importance of dunes as natural beach protection has been recognized, and efforts are being made to restore dunes that had been destroyed during development of the coastal zone.

A natural beach/dune system, that is, one with a wide berm and a relatively wide, low primary dune provides optimal protection of back barrier areas. In addition to providing a natural barrier to storm wave washover, this system also contains large quantities of sand available for offshore transport during storms. This transport process tends to flatten the beach face and nearshore marine area as well as create one or more linear, offshore sand bars. This temporary rearrangement of the beach profile causes storm waves to break further offshore, thus reducing wave energy reaching shore.

In preparation for construction, however, the usual procedure was to level the dunes and beach in order to build as close to the shoreline as possible (Photo 12). Without the defense that the normal shape of the beach affords, buildings can become endangered by even normal seasonal onshore-offshore movement of sand. Moreover, removal of the sand supply contained in the dune does not permit the beach profile to flatten during storm wave attack and, therefore, waves will concentrate their energy on shoreline structures. Even during moderate storms extreme damage can occur as waves remove sand supporting the structure. The absence of protective dunes exposes the back-barrier area, often as heavily built-up as the beach front, to wave attack, wash-over and flooding.

b) Artificial Protection

In many areas of Delaware, development has encroached so close to the shoreline that dune maintenance or construction is impractical. As the threat of beach erosion or flood damage increasing, there is great pressure applied to State and federal governments to provide structural protection for beach front property. The economic feasibility questions involved in beach erosion control will be discussed in the subsequent section. The present discussion will merely analyze the most prevalent techniques for beach or property protection with respect to their effects on shoreline dynamics. These include:

1) Non-structural Techniques

i) Dune stabilization

Natural dune stabilization processes are enhanced or accelerated by the placement of sand fence and planting of beach grass in many of Delaware's coastal areas (Photo 13). While this technique is successful along relatively undeveloped shores, development often encroaches onto the beach or dune and renders this method impractical. It is used primarily to prevent wave overwash during moderate storms and to reduce overwash during severe storms. It has no effect, however, on long-term shoreline recession.

Great care must be taken when "stabilizing" dunes to insure that they are not built so high as to prevent overwash during intense storms and/or they are not built close to the active shore zone so as to substantially increase the angle of the beach profile. As mentioned in the case of Cape Hatteras, N.C., high level, stabilized dunes, that are either built too close to the shoreline or eventually end up there through natural beach recession processes, prevent the landward and upward build-up of the barrier that is characteristic of the washover process. Since storm waves can no longer breach the dunes, the net result, over a period of time, is to undercut the base of the dune and accelerate its removal. The presence of such stabilized, high level dunes offers a false sense of security to back barrier property owners. They are often lulled into the belief that the flooding potential has been removed; when indeed, it has not been. When increased wave energy eventually unstabilizes the dune, its breach can be sudden and catastrophic. It should be kept in mind that it is natural for beaches and dunes to move, yet remain in a basic equilibrium position relative to one another. Substantial alteration of this equilibrium will eventually result in increased damages to property and unnecessary expenditures for beach protection.

ii Beach Nourishment

Beach nourishment is the process of dredging or hauling sand from marine or inland sites and placing it on the beach and near shore zone. The purpose is to replace beach sands that have been removed by littoral processes or storm events and to extend the beach further seaward. Unlike the structural defences discussed subsequently, beach nourishment generally does not adversely affect the beach or adjacent properties. Omitting for the moment the economic questions surrounding this technique, it is also the most effective and least environmentally damaging method of dealing with shoreline "stabilization". Many factors, however, must be taken into consideration to make such an operation workable. The rate of loss and characteristics of the beach material in the natural system must be well understood and material for nourishment must be available and easily accessible. The size and composition of beach fill should closely match that of the natural material. This is essential because the energy of waves impinging upon the beach determine the size of sand particles that will settle out on the beach and in the nearshore marine area. If the fill material is too coarse, storm waves will move it offshore, but the waves that would normally rebuild the beach following the storm will have insufficient energy to move all of this material ashore, resulting in permanent loss of sand to the beach. On the other hand, if the material is too fine, normal wave action will place the beach material in suspension and keep it there until it is eventually removed offshore. The compatibility of fill material with the natural beach material is of particular importance when one considers the large volume of sand necessary for most beach fill projects and the high unit cost.

Possible sources of beachfill material include bays, inland quarries, offshore sites and inlet shoals.

Each of these sources, however, has certain disadvantages with respect to either compatibility, cost or accessibility. Bays behind barrier beaches are generally the least costly and most easily dredged sources. The material obtained is generally that which was deposited by past storm washovers or relict inlet deltas. As a result, this material is located on or just offshore from the back side of barriers. The proximity of this source of sand to the beach has substantial cost advantages over other sources, because transport is the most expensive part of any dredging operation. There are, however, several significant disadvantages with utilization of this supply. First the natural sedimentation and biological processes that occur in these bays result in an accumulation of silt and organic matter in the sand deposit. The presence of such poorly sorted (i.e. greater relative percentages of fine and coarse particles) sediments require additional dredging of fill material to allow for removal of the fine particles by wave action. Moreover, if significant amounts of organic material are present, an odor problem resulting from decay could hamper recreational use of the nourished beach. In addition, research has shown that these bay environments are ecologically sensitive to extensive dredging and are no longer seriously considered as a source of borrow material.

Inland sources, while usually being less environmentally sensitive than bay sources, are generally more costly to utilize. In most cases, upland sediments are poorly sorted and, therefore, contain less compatible beach material. This results in a need to excavate and transport an extra quantity of material to obtain the desired beach profile and to allow for winnowing of the fine particles. Unless inland sites can be found very close to the beach being nourished, use of these areas can be very costly, since the transportation component is by far the most expensive part of the operation. When this is combined with the requirement to excavate excess material, inland sites are usually the least economical.

Offshore borrow sites are the least environmentally sensitive sources of beach material, although the sand is usually finer than native beach sand. As a result, it is necessary to conduct detailed compatibility studies to ensure that the dredged material will remain on the beach for the required length of time. Ideal offshore sources are ancient beach ridges or tidal deltas that were formed when sea level was lower, but detailed sampling studies would be necessary to locate them. There are several disadvantages to offshore sites that result in higher costs of nourishment programs. First, ocean going dredges are in short supply and must often be transported long distances to the site of operation. Second, the dredge and pipeline are susceptible to damage or operational delays when waves exceed certain heights. Third, start-up and operating costs are high. Start-up costs can be significant when projects require more than one season to complete. This often means that the dredge will be taken elsewhere and then returned the following year, resulting in incurrance of start-up costs a second time.

Interior and exterior inlet shoals are the best sources of borrow (Photos 18 and 19). Since these shoals are largely made up of sediments eroded from nearby beaches, and since the strong currents present at inlets winnow out the fine material, sand found here is usually very compatible with the native beach sand. Moreover, removal of these shoals has the advantage of improving navigation. The same currents that are responsible for creating these shoals, however, pose difficulties for extracting and utilizing this material for nourishment purposes. The strong currents can place heavy stresses on floating pipelines and the dredge itself, which increases the potential for damage.

The principal drawback to beach nourishment is its cost and the fact that its effectiveness is temporary. While nourishment material may remain on the beach for a decade or more during times of relatively calm weather, a single intense storm or a few moderate storms can negate the effort in a very short period of time. Moreover, such projects rarely, if ever, outlast the retirement life of the bonds used to finance them.

In some cases, beach nourishment projects are accompanied by the erection of structures designed to impede the movement of sand in the littoral drift stream. These structures will reduce the number of periodic nourishment operations required to maintain a given beach profile. They are expensive, however, and can only be used selectively.

2) Structural Techniques

Great amounts of money have been spent on projects designed to save beachfront structures and property, but most are either ineffective or aggravate existing problems. The most common structural defenses include:

i) Bulkheads, Seawalls and Revetments

These structures are built parallel to the shore to reinforce or replace the function of natural dunes along open coastlines and to prevent the erosion of headlands along sheltered bays or tidal streams. In this latter case, they are usually associated with deepening of the nearshore area to provide boating access.

A bulkhead (Photo 14) is a vertical wall constructed of steel, timber or concrete piling, and is usually a temporary defense against wave action. They are constructed in developed areas where coastal erosion has progressed to a point where beach and dune maintenance is no longer an option for physical or economic reasons. As the beach continues to erode, the bulkhead is exposed to direct wave attack. Waves impinging on the structure are forced downward and cause scour at the toe of the bulkhead. The net result is accelerated beach erosion and eventual removal of the beach itself.

Bulkheads are also quite vulnerable to destruction during severe storms through undermining at the base or ends or by direct wave attack (Photo 15). Once the bulkhead is destroyed, not only are the shoreline properties susceptible to erosion and wave damage, but the bulkhead timbers can also act as battering rams and cause additional damage. A number of privately constructed, timber bulkheads were destroyed at Slaughter Beach, Broadkill Beach and South Bethany during the storms of March 1962 and December 1974, and again in South Bethany in October 1977.

In contrast to bulkheads, seawalls are massive structures designed to withstand direct wave attack. They are constructed in areas where beaches have eroded to the point that major private and public improvements are imminently threatened by waves. Seawalls, like bulkheads, reflect incoming wave energy and scour and eventually remove the beach. The importance of recreational beaches to the people of the State and the economy of Sussex County, coupled with the inordinate expense of these structures, render the construction of seawalls inappropriate.

A revetment is a shore protection device, usually consisting of concrete or layers of stone, placed on the beach and designed to armor the seaward face of the shore. The sloping protection dissipates wave energy and so is less damaging than a seawall. These structures, however, seriously hinder recreational use of the beach and would be inappropriate for use along the Atlantic Coast. On the Delaware Bay, shoreline revetments could provide a measure of protection from recession of the beach. In order to properly perform this function, the structure would have to be a substantial one; costing in the neighborhood of \$100 per lineal foot. There are no areas long the Bay where the benefits would outway a cost of this magnitude.

ii) Breakwaters

Breakwaters are structures designed to reduce wave energy reaching the shore and are generally constructed to protect a harbor and provide shelter for boats, rather than solely for shore protection purposes. The reduction or elimination of wave energy reaching the beach does affect the shoreline immediately landward of the breakwater. No longer subject to normal wave action, the area of quiet water shoreward of the breakwater becomes a site of sediment deposition, shoaling and seaward accretion of the shoreline. Interruption of the littoral transport stream causes rapid erosion of the beach updrift of the breakwater.

iii) Groins

Groins are wall-like structures extending from the backshore into the surf zone, usually perpendicular to the shoreline, that widen the beach by trapping sand moving along shore. The groin interrupts the natural longshore transport of sand and creates a null area on the updrift side which causes the deposition of sand. Waves refracted around the end of the groin are devoid of their normal sand content and as a result have an erosive effect on the downdrift side. (Photo 16). The retreat of the beach on the downdrift side is roughly equal to the beach advance on the updrift side. The usual solution to this problem is to build another groin, and then another and another. However, for every cubic yard of sand that is trapped within the groin compartments, there will be a corresponding loss from the downdrift beach.

The net adverse effect of a groin field on adjacent beaches, of course, depends upon their height and the distance they extend into the surf zone. Long, high groins will trap more sand than short, low groins and, therefore, the effect on downdrift beaches will be greater. Moreover, high groins with vertical

sidewalls can reflect impinging waves seaward and establish small rip currents, which have a tendency to sweep some of the accumulated sand seaward and compound the adverse effects on downdrift beaches. However, regardless of the design of the groins, there will be an effect on adjacent beaches. Often this adverse effect can be mitigated by filling the groin compartments with sand by artificial means. Ideally, once the compartments are full, the system will reestablish equilibrium; that is there will be no net entrapment of sand within the groin field. Following storms, however, the net loss of sand offshore would have to be replaced artificially, otherwise sand would subsequently be trapped from the littoral drift and an effect on downdrift beaches would be felt. It should always be kept in mind that when no beach protection structures are constructed everyone shares the problem. But when one part of the shore is protected the remainder of the shore must supply the sand.

iv) Jetties

Jetties are massive structures, usually constructed of sheet pile or rock, and built at river mouths or inlets to confine the flow of water to a narrow zone (Photo 17). Usually constructed in pairs, they are designed to protect and maintain inlets for navigation purposes. Natural inlets have a tendency to migrate and occasionally close and reopen in another location. Moreover, such inlets are subject to constantly shifting channels and shoals. Without the stabilizing effect of a pair of jetties most inlets would be too hazardous for navigation. While they are beneficial to the channel, jetties are similar to groins in their effect on the shoreline. The interruption of the littoral drift stream produces an accumulation of sand on the updrift side and accelerated shoreline recession on the sediment starved downdrift side (Photo 17). The effects of jetties on beach erosion are of greater magnitude than groins because of their greater size and the presence of an inlet. On the flood tide, most of the sand that bypasses the updrift jetty is swept into the inlet and deposited as a tidal delta in the slack water area behind the inlet. On the

ebb tide, sand bypassing the jetty is swept seaward and deposited in an offshore shoal. Most of this sand is permanently lost from the littoral system and must be replaced, if the beach downdrift of the inlet is to be maintained.

v) Sand Bypass Systems

The "jetty effect" described above can be remedied by pumping or hauling sand from the updrift beach or inlet shoals and depositing it on the downdrift beach. This technique thus reestablishes the littoral drift stream. There are several methods of bypassing sand around inlets and application of any particular one depends upon the magnitude of the problem and the cost of the solution. The principal methods include:

1. The use of trucks and earth moving equipment to periodically transfer sand from the accreting to the eroding side of the jetties;
2. The use of floating dredges to pump sand from inlet shoals or offshore sources (Photos 18 and 19);
3. The use of a suction dredge plant fixed to the updrift jetty; and
4. The use of one or more jet pumps (Figures 14 and 15)

The table lists some of the advantages and disadvantages of these sand bypass techniques as they would apply at Indian River and Roosevelt Inlets.

Because of their cost advantages, the State is examining the use of jet pumps at these two inlets. Roosevelt Inlet appears ideally suited to this system. Its technical and economic feasibility at Indian River Inlet is in question. Additional study will be necessary to decide which bypass method will be most appropriate.

	<u>Advantages</u>	<u>Disadvantages</u>	<u>Advantages</u>	<u>Disadvantages</u>
TRUCKS	<ol style="list-style-type: none"> 1. Equipment and contractors readily available 2. Easy access to beaches and sand can be discharged anywhere 3. No craters formed on the beach 4. No fixed structures on the beach 5. Equipment can be moved in the event of a storm 	<ol style="list-style-type: none"> 1. Periodic nature of operation results in loosing considerable sand to inlet shoals. Does not negate need to dredge these shoals. 2. Adversely affects heavily used recreational facilities at south jetty 3. Funds for periodic operations not always available when needed, particularly after storms. 4. Increased road wear, noise and traffic accidents because 10,000 truck loads would be required annually 	<ol style="list-style-type: none"> 1. NONE 	<ol style="list-style-type: none"> 1. Access to west jetty does not exist
FLOATING DREDGES	<ol style="list-style-type: none"> 1. Sand available in nearby inlet shoals 	<ol style="list-style-type: none"> 1. Exposure to waves and currents could damage the pipeline 2. Funds for periodic operations not always available when needed, particularly after storms. Such delays can unnecessarily endanger the bridge approach 	<ol style="list-style-type: none"> 1. Sand available in nearby inlet shoals 	<ol style="list-style-type: none"> 1. Funds for periodic operations not always available when needed, particularly after storms. Such delays can unnecessarily endanger the back lying structures. 2. High mobilization and demobilization costs 3. Cannot respond to emergency situations

	<u>Advantages</u>	<u>Disadvantages</u>	<u>Advantages</u>	<u>Disadvantages</u>
FIXED DREDGE PLANT	<ol style="list-style-type: none"> 1. Allows for continuous operation. Severe erosion can be remedied in a short time. 2. Eliminates disadvantages 2 and 3 listed under floating dredges 3. Low operation and maintenance costs 4. Intercepts littoral material and reduces shoaling inside the inlet 	<ol style="list-style-type: none"> 1. High capital cost 2. Plant subject to storm damage 3. Adversely affect heavily used recreational facilities at south jetty by creating large crater 4. Location too far landward could result periodically in a land-locked plant and large sand losses around the jetty 5. Location too far seaward may result in ineffective operation until sufficient materials have been impounded by the jetty and are within reach of the intake 6. Location problems may necessitate a movable unit on a trestle which would increase costs. 	<ol style="list-style-type: none"> 1. Allows for continuous operation. Severe erosion can be remedied in a short time. 2. Low operation and maintenance costs 3. Intercepts littoral material and reduces shoaling inside the inlet. 	<ol style="list-style-type: none"> 1. High capital cost 2. Plant subject to storm damage 3. Would require special foundation because of type and deteriorated condition of the jetty. 4. Would not solve the problem of sand transport into the inlet from the east during drift reversal. Periodic dredging of inlet shoals would still be necessary, although less frequently. 5. May require expensive jetty repairs to block littoral drift.

Advantages

Disadvantages

Advantages

Disadvantages

Disadvantages

- 3. High mobilization and demobilization costs
- 4. Sand will still be lost to the ebb tidal shoal
- 5. Cannot respond to emergency situations

- Jet Pumps
- 1. Low capital and operation cost
 - 2. Can be operated under all weather and wave conditions
 - 3. Optional portable installation
 - 4. Can be installed a significant distance from the recreation facilities at the south jetty
 - 5. Can intercept and pump sand flowing either north or south
 - 6. Self installation and recovery
 - 7. Operation requires no special skills
 - 8. Easily floodproofed

- 1. System not yet approved by Waterways Experiment Station, U. S. Army Corps of Engineers for federal cost sharing
- 2. Has not been extensively tested at present
- 3. Operating costs increase significantly when distance to booster pump is greater than about 400 feet

- 1. Low capital and operation cost
- 2. Can be operated under all weather and wave conditions
- 3. Optional portable installation
- 4. Prevent shoaling of inlet throat
- 5. Easily floodproofed
- 6. System can be installed to capture sand during periods of drift reversal
- 7. Self installation and recovery
- 8. Operation requires no special skills

- 1. System not yet approved by Waterways Experiment Station, U. S. Army Corps of Engineers for federal cost sharing.

BEACH AND PROPERTY PROTECTION COSTS

Method	Unit Cost		Remarks
	Delaware Bay	Atlantic Coast	
1. Bulkheads Timber	\$80 - 160/ft.	Not Applicable	DB- Costs based on Corps of Engineers publication "Help Yourself" prepared by the North Central Division for protection of Great Lakes Shorelines (1973) and adjusted for inflation. Subject to failure during storms.
			AC- Unable to withstand ocean wave energy during storms.
			DB- Costs based on the above referenced publication
Steel	\$295 - 440/ft.	Unknown	AC- Expensive. Susceptibility to corrosion. Design life less than the required 50 years for federal projects. Structural integrity requires adequate toe protection
			DB- Cannot be economically justified
Concrete	Not Applicable	≈ \$1,200/ft.	AC- Based on Corp of Engineers Beach Erosion Control and Hurricane Protection, General Design Memorandum, Phase II, February, 1976 and adjusted for inflation.
			DB- Based on the above referenced Corps publication the recently proposed revetment at Port Mahon has been has been estimated to cost \$200/ft.
2. Revetments	\$110-200/ft	Not Applicable	AC- Revetments designed to armor the beachface and withstand the design storm would seriously hamper or eliminate recreational use of the beach.
			These structures are most applicable along steeply sloping shorelines or as toe protection for bulkheads and seawalls.

Beach and Property Protection Costs (Continued)

Method	Unit Cost		Remarks
	Delaware Bay	Atlantic Coast	
3. Seawalls	Not Applicable	Not Applicable	Such massive structures cannot be economically, socially or environmentally justified
4. Breakwaters			
Scrap Tire	\$200-260/ft. (Federal or State) \$50-100/ft (private)	Not Applicable	DB- Government Contract requirements and wage scales add substantially to the cost of such projects. Individuals or communities not subject to these requirements and utilizing non-union labor and local contractors can construct these breakwaters much more cheaply.
Rock	\$150-200/ft. (Federal or State) \$50-75 (private)	\$5,000-7,000/ft.	AC- Not capable of withstanding storm waves. DB- See note under scrap tire breakwaters. Proposed rubble mow breakwater at Kitts Hummock is estimated to cost \$195/ft. (See discussion of Shoreline Erosion Control Demonstration Program)
Sand Filled Nylon Bags	\$150-200/ft (Federal or State) \$40-75 (private)	Not Applicable	AC- Offshore rock breakwaters designed to withstand severe storm and constructed in deep water are considerably more substantial structures and, therefore, much more expensive than those which could be built in shallow, sheltered water of the Delaware Bay. DB- See note under scrap tire breakwaters. Proposed sand bag breakwater at Kitts Hummock is estimated to cost \$185/ft.
Concrete Boxes	Not presently available	Not Applicable	DB- Cost figures for the concrete box section of the breakwater at Kitts Hummock are not available at this time.

BEACH AND PROPERTY PROTECTION COSTS (CONTINUED)

Method	Unit Cost		Remarks
	Delaware Bay	Atlantic Coast	
5. Groins		Not Applicable	AC- Not suited to wave environment
	Sand Filled Nylon Bags	\$25-50/ft.	
	Timber	\$175-200/ft.	\$400-450/ft.
	Steel/Timber	\$225-240/ft.	\$445-535/ft.
6. Dune Maintenance	Rock/Timber	Not Applicable	DB- More expensive than timber groins. Probably not cost effectively AC- Steel sheet piling subject to corrosion.
	Sand Fence	\$1.00-1.25/ft.	\$1.00-1.25/ft. DB- It is not the general practice of the State to install sand fence along the Bay, because of the lack of sand for dune building.
	Beach Grass	\$285-570/acre or \$.20-.39/ft (labor) \$345-1030/acre or \$24-.71/ft (labor)	Same Same
		\$970/acre or \$.67/ft (grass)	Same The cost of planting beach grass varies widely. The lower costs are for planting large areas and the higher costs are for relatively small, scattered areas.

BEACH AND PROPERTY PROTECTION COSTS (CONTINUED)

Method	Unit Cost		Remarks
	Delaware Bay	Atlantic Coast	
Fertilizer	Not Applicable	\$70-90/acre/year	
7. Beach Nourishment			
Cape to I.R. Inlet	_____	\$6.00-7.00/cy (const.) \$2.70-3.00/cy (maint.)	The construction and maintenance costs cited are those derived by the Corps of Engineers (adjusted for inflation at 6% per year) for the Delaware Coast Beach Erosion Control and Hurricane Protection project
I.R. Inlet to Fen. Is.	_____	\$6.00-7.00/cy (const.) 6.80-7.00/cy (maint.)	
Delaware Bay	\$1.25-\$2.50/c.y.		Costs are based on actual State contracts let for work on the Delaware Bay Beaches
8. Sand Bypass			
Truck Haul	Roosevelt Inlet	Indian River Inlet	See Section IV.2. for the advantages and disadvantages of each method
	Not Applicable	\$3.00-3.50/cy	Costs based on "A Coastal Engineering Study of Indian River Inlet Delaware - Delaware Sea Grant Program, Ocean Engineering Tech. Report 14
Large Dredge	Not Applicable	\$1.25-1.50/cy	Costs based on experience. 1978 dredging cost \$1.467/cy for 487,000 cy. Not economical for small quantities of sand.
Small Dredge	\$1.25-2.25/cy	≈ \$2.50/cy	Indian River-Adjusted cost of 1975 dredging operations
Fixed Plant	Not Available	\$2.50-2.75/cy	Roosevelt Inlet-Lower cost is for use of the State-owned dredge. Used primarily for emergency operations. Not a long-term solution. Higher cost is for contracted work.
Jet pump(s)	\$1.00-1.40/cy	\$1.25-1.42/cy	Cost includes operating costs (106,000 cy per year \$1.00/cy and retirement on construction (\$2,140,000 @6% over 20 years) See Appendix C for additional information.

V. Coastal Protection Programs and Costs

a) General Information on the Cost of Protective Works

Delaware has had considerable experience with methods to prevent beach erosion or to protect shore-front property and improvements. Notwithstanding the advantages and disadvantages of any particular protective measure, there is one inescapable conclusion: Beach and property protection is very expensive.

The cost and effectiveness of the various protective measures discussed in Section IV varies considerably and depends upon many variables. These variables, of course, affect the cost of any given technique and the probability that future costs may be incurred to ameliorate the adverse consequences these measures could have on adjacent beaches or property. Because of this, the reader is cautioned against concluding that any particular method will be a cure-all for beach erosion. The protection of any coastal segment usually requires a combination of both structural and non-structural techniques to "stabilize" the shore, even if only temporarily. In Delaware, beach erosion results from two causes; rising sea level and a lack of sand. Nothing can be done about sea level. Therefore, any defense against shoreline retreat must consider the addition of sand to the littoral zone. Structural defenses, however, cannot introduce new sand supplies to the beach; rather they only control the distribution of that sand which already exists within the system and they often do this inequitably. The use of structural defences, therefore, must be accompanied by periodic artificial nourishment, although the reverse is not necessarily true. Artificial nourishment, however, adds substantially to the cost of beach protection, because it must be repeated every few years for as long as the beach is to be maintained.

General statements about the cost of various protective measures are difficult to make, since numerous variables enter into such computations. The design of any protective measure or combination of measures, and therefore their feasibility and cost, is a function of the following:

- a) Project purpose - Is the purpose of the project to prevent beach erosion or to protect against storm damage or both?
- b) Wave energy expected at the site;
- c) Littoral transport processes;
- d) Useful life of the project;
- e) Expected periodic maintenance;
- f) Adverse off-site effects which must be remedied;
- g) Value of improvements to be protected;
- h) Public benefits to be derived;
- i) Location and quality of borrow material ;
- j) Construction materials; and
- k) Storm magnitude and frequency

The cost of protecting any given shoreline segment cannot be made without detailed engineering studies that account for each of the above variables on a site specific basis. The following table of costs, therefore, is designed to provide order of magnitude figures based upon experience in Delaware and elsewhere.

b) Federal Beach Protection Programs

1. Federal Authorities For Erosion Control

The Federal Government, acting through the U. S. Army Corps of Engineers and pursuant to the Rivers and Harbors Appropriation Act of 1899 as amended 33 USC §§ 426e-426i), is authorized to undertake projects for the protection of shores from beach erosion and storm damage. With three exceptions the Federal contribution to such projects is not more than 50 percent of the cost of construction. The exceptions are:

- a) The costs of protecting Federal property shall be borne fully by the the Federal Government.
- b) The Federal share may be increased up to 70 percent for protection of publicly owned shorelines, provided that such areas: include a zone which excludes permanent human habitation; include but are not limited to recreational beaches; satisfy criteria for conservation of natural resources and environmental quality; extend landward a sufficient distance to include dunes and other natural features which serve to protect the uplands from damage; and provide park facilities for public use.
- c) The Federal Government may pay up to 70 percent of the cost of hurricane protection.

All lands and rights-of-way must be provided by the local sponsor at no cost to the Federal Government. The local sponsor is also required to provide for all maintenance costs for the life of a project (usually 50 years). Periodic beach nourishment, however, is considered "construction" for the purposes of the Act.

Privately owned shores will be eligible for Federal assistance if there is benefit such as that arising from public use or from protection of nearby public property or if the benefits to those shores are incidental to the project. Project costs allocated to these shores are eligible for up to 50 percent Federal contribution.

The Corps is also authorized to investigate, study, and construct projects for the prevention or mitigation of shore damages attributable to Federal Navigation works. The cost of installing, operating, and maintaining such projects will be borne entirely by the United States. Projects in excess of \$1,000,000 must be specifically authorized by Congress. It would appear that Delaware is eligible for federal assumption of the costs for protecting the public beaches being adversely affected by the jetties at Roosevelt and Indian River Inlets. The State has heretofore not taken advantage of this provision in the Act, but intends to pursue the possibility in the future.

Pursuant to this Act, the Corps presently has contracts with the State for erosion control work and Broadkill Beach, Lewes Beach and Bowers. The Corps is also designing a project for erosion control and hurricane protection along the Atlantic coast of Delaware. This project is discussed briefly below.

2. Beach Erosion Control and Hurricane Protection Project

Following the Great Storm of March 1962, the Senate Committee of Public Works requested a report from the Corps of Engineers on possible means of protecting Delaware's beaches from storms and coastal erosion.

In 1968, The Chief of Engineers submitted a report entitled Delaware Coast, Beach Erosion Control and Hurricane Protection. Later that year the project described in the report was authorized by Section 203 of the Flood Control Act of 1968 (Public Law 90-483). In 1973 the Office of Chief of Engineers approved a report entitled Delaware Coast, Beach Erosion Control and Hurricane Protection, General Design Memorandum, Phase I. In 1975, the General Design Memorandum, Phase II was submitted as was a supplement in 1976.

The project envisioned was designed to provide beach erosion control and hurricane wave protection along two reaches of the Atlantic Coast of Delaware (Cape Henlopen to Indian River Inlet, 13.6 miles, and from the latter to the Maryland State Line, 10.9 miles). The project could be subdivided into two subprojects and constructed concurrently or sequentially as funds became available. The project proposed the following:

- a) Widening of the beach by placement of suitable sand to provide a beach with a berm varying between 50 and 100 feet in width, generally at elevation + 10 feet sea level datum (s.l.d.);
- b) Construction of a dune with a top width of 25 feet and an elevation of + 16 feet s.l.d;

- c) At Rehoboth Beach, Bethany Beach and South Bethany, where dune construction was impractical, reinforced concrete bulkhead or seawall was to be built to an elevation of + 15 feet s.l.d. and include a 50 foot wide beach berm at elevation + 10 feet s.l.d.;
- d) Planting dune grass and placing sand fences atop the dune; and
- e) Periodic nourishment of the beach for the project life (50 years) with the initial nourishment to be provided during initial construction.

The estimated costs of the project is as follows (1978 prices):

<u>Reach</u>	<u>Federal</u>	<u>State</u>	<u>Total</u>
a) Reach I (Cape Henlopen to Indian River Inlet)	\$14,389,000	\$6,770,000	\$21,159,000
b) Reach II (Indian River Inlet to Many - Land State Line)	13,933,000	6,362,000	20,295,000
	<u>\$28,322,000</u>	<u>\$13,132,000</u>	<u>\$41,454,000</u>

Annual Maintenance Costs

<u>Reach</u>	<u>Federal</u>	<u>State</u>	<u>Total</u>
a) Reach I	\$ 966,000	\$ 1,964,000	\$ 2,930,000
b) Reach II	132,000	575,000	707,000
	<u>\$ 1,098,000</u>	<u>\$ 2,539,000</u>	<u>\$ 3,637,000</u>

Following a detailed review of the proposal by the Coastal Management Program; then-Governor Tribbitt withdrew State support for the project in its original form. In his letter, the Governor cited the following reasons:

- a) Initial construction and annual maintenance costs were beyond the State's means;
- b) It was against State policy to provide storm protection for private property owners at public expense;
- c) Large segments of beach in the State parks did not require artificial nourishment and dune construction; and
- d) The means of cost calculation did not reflect the State's actual method of payment, interest rate and amortization schedule. The analysis indicated that the costs to Delaware on an annual basis were seriously understated.

Instead, Governor Tribbitt recommended that the project be scaled down to meet certain identifiable needs. He recommended that:

- a) A sand bypass plant be constructed at Indian River Inlet to control the erosive effects of the jetties; and
- b) Beach erosion be controlled in the Bethany area since this beach is not only important to recreation, but, it is also the source of most of the sand in the littoral zone.

Early in 1978, Governor du Pont reconfirmed the State's interest in a sand bypass plant at Indian River Inlet and periodic nourishment in the Bethany area. The chief problem with participation in this project is the limited amount of State money available. At present the State anticipates about \$500,000 will be available annually for all beach restoration work. This could seriously hamper efforts to restore Atlantic coast beaches, because of the high unit costs and quantities of sand necessary to do the job.

The beach erosion control and hurricane protection project is presently in abeyance until protection priorities and funding can be worked out.

3. Shoreline Erosion Control Demonstration Program

In 1974, Congress passed the Shoreline Erosion Control Demonstration Act, Section 54 of the Water Resources Development Act. Under this Act, the U. S. Army Corps of Engineers established a national program to develop and demonstrate alternative low cost methods to prevent or control shoreline erosion along sheltered coastlines and to disseminate this information to public and private landowners.

The Act specified that demonstration projects should be undertaken at no less than two sites each on the shorelines of the Atlantic, Gulf and Pacific Coasts; the Great Lakes; and Alaska. The Act also specified that demonstration projects be undertaken at six sites along the Delaware Bay: Pickering Beach, Kitts Hummock, Slaughter Beach, Bowers, Broadkill Beach and Lewes. The program will include the construction of test devices and intensive monitoring to analyze the effectiveness of the structures.

With the exception of actual construction costs, the program is financed almost entirely with Federal funds. The State, as cosponsor of the projects in Delaware, is responsible for 25 percent of construction costs at each site and must assume operation and maintenance upon completion of the demonstration program. At completion of the program, disposition of the project will be left to the discretion of the State. Disposition could include continued maintenance, removal of the structure, or turning the project over to local government. The State must also provide the necessary lands, easements and rights-of-way for construction and subsequent monitoring of the projects.

Preliminary planning has been accomplished at the six Delaware sites in close coordination with DNREC. The following test devices and/or programs have been proposed for these sites: Pickering Beach - offshore floating breakwater; Kitts Hummock - offshore fixed breakwaters; Slaughter Beach - perched beach; Bowers, Lewes and Broadkill - strictly monitoring due to existing Federal projects and protective works. Of these sites, only Pickering Beach has progressed to the point of construction. Kitts Hummock and Slaughter Beach should be underway shortly.

The following table presents the expected costs of each of the proposed projects.

	<u>Total Cost</u>	<u>State Cost</u>	<u>Length of Shoreline</u>	<u>Unit Cost</u>
Pickering Beach	\$210,617	56,340	860	\$245/ft
Kitts Hummock	161,600	40,400	1,000 ft	162/ft
Slaughter Beach	121,248	30,312	1,290 ft	94/ft

4. Land and Water Conservation Fund

The Heritage Conservation and Recreation Service (formerly the Bureau of Outdoor Recreation) administers the Land and Water Conservation Fund for the purposes of providing funds to assist states in planning, acquisition and development of land and water recreation areas and facilities as well as to acquire and develop Federal recreation lands. Funds are provided on a 50/50 matching basis to States and localities. These funds, of course, can be used to acquire undeveloped beach lands, although the State has no plans to buy additional beach frontage at this time. In the long run, however, it would be more cost/effective to purchase these areas than to protect them once they are developed.

5. Federal Flood Insurance Program

Flood hazard regulations are now being adopted in Delaware and used as legal tools to control the extent and type of development permitted on floodplains. The impetus for this action is the Federal Flood Insurance Act of 1968, as amended and the Flood Disaster Protection Act of 1973. The program is administered by the Federal Insurance Administration with the Department of Housing and Urban Development (FIA).

The Flood Insurance Program is specifically intended as a substitute and eventual replacement for federal disaster relief programs for flood occurrences. It is also designed to insure that property owners not only will be more aware of flood hazards and will be permitted to contribute to their own protection, but also so that they will be indemnified when the inevitable flood loss occurs. Prior to this program, the taxpayer had been subsidizing unsafe construction, loss of life and property, and the disaster relief loans and grants that result after floods. To correct for past practices, the Act requires denial of Federal grants, loans or other assistance, such as mortgage insurance, to communities or individuals when such assistance would be for projects in identified flood hazard areas unless the community is participating in the Flood Insurance Program. Moreover, federally regulated institutions are not permitted to make loans on buildings which were occupied after March 1, 1976 unless they are covered by flood insurance.

In order to qualify for flood insurance, a community with identified flood hazards must establish floodplain regulations to discourage floodplain construction or to establish construction practices that will eliminate or substantially reduce potential flood damage. These regulations apply to all new construction or major repair or reconstruction of existing buildings damaged by floods or other causes.

The Flood Insurance Program also covers the collapse or subsidence of land along the shore as a result of erosion or undermining caused by waves or currents of water exceeding the cyclical levels which result in flooding. With regard to flood-related erosion, the National Flood Insurance Program Regulations (F.R., Vol. 41, No. 207, § 1910.5) states the following:

- (a) When the Administrator has not yet identified any area within the community as having special flood-related erosion hazards, but the community has indicated the presence of such hazards by submitting an application to participate in the Program, the community shall:
 - (1) Require the issuance of a permit for all proposed construction or other development in the area of flood-related erosion hazard, as it is known to the community;
 - (2) Require review of each permit application to determine whether the proposed site alterations and improvements will be reasonably safe from flood-related erosion and will not cause flood-related erosion hazards or otherwise aggravate the existing flood-related erosion hazard and;
 - (3) If a proposed improvement is found to be in the path of flood-related erosion or to increase the erosion hazard, require the improvement to be relocated or adequate protective measures to be taken which will not aggravate the existing erosion hazard.
- (b) When the Administrator has delineated Zone E on the community's FIRM (Flood Insurance Rate Map), the community shall
 - (1) Meet the requirements of paragraph (a) of this section; and
 - (2) Require a setback for all new development from the ocean, lake, bay, riverfront or other body of water, to create a safety buffer consisting of a natural vegetative or contour strip. This buffer will be designated by the Administrator according to the flood-related erosion hazard and erosion rate in conjunction with the anticipated "useful life" of structures and depending upon the geologic, hydrologic, topographic and climatic characteristics of the community's land. The buffer may be used for suitable open space purposes, such as for agricultural, forestry, outdoor recreation and wildlife habitat areas and for other activities using temporary and portable structures only.

At present, no flood-related erosion zones have been designated in Delaware. The complexities of designating erosion areas and of insuring against such damages were the subject of the FIA sponsored National Conference on Coastal Erosion in July, 1977. As yet, the special problems and issues of erosion insurance have not been resolved. Indeed, the FIA has concluded that the language in the Act relating to insuring against shoreline erosion is unworkable. The CMP has recognized, however, that most of the Delaware Bay and Atlantic coasts are subject to beach erosion and many of the above cited federal requirements are being met by the State through its beach permit program.

The Federal Flood Insurance Program has been criticized recently for failing to deal effectively with the special conditions that exist in coastal areas. The FIA is aware of many of these problems and is attempting to resolve those which are not inherent in the legislation. Some of these criticisms include:

- a) Currently, actuarial rates for coastal high hazard areas are determined by arbitrarily adding 50 percent to the rate for a coastal flood hazard area that does not have the added hazards of wind-driven waves. This may be insufficient.
- b) The maximum insurance premium for existing buildings is \$.50 per \$100 coverage. Such subsidized low rates raise a question about the rate structure acting as an incentive to maintain high risk.
- c) The present program does not recognize the proximity of new structures to the shoreline when determining insurance rates; consideration is only given to elevation. Such a situation removes the incentive to set structures behind the dune and to provide for its maintenance. Nor does it act to discourage the creation of building lots on or seaward of the dune.

- d) The program does not give adequate consideration to wave setup and wave runup. In coastal locations, these heights can be considerably higher than the stillwater surge elevation used to determine structural elevations.
- e) The federal subsidy does not provide the incentive which would allow market forces to determine acceptable risk.
- f) The availability of flood insurance makes mortgage money accessible to many who would otherwise be unable to obtain financing for coastal construction. This will inevitably lead to accelerated development of the beachfront. In light of the above criticisms, this may prove to be unwise.

With regard to the effect of the Flood Insurance Program on shoreline erosion, the State has the authority to deal with many of these problems along its unsubdivided coast. There are areas, however, where building lots have been created on or seaward of the dune and the present FIA program will act to encourage development or reconstruction in these vulnerable locations. The State, for constitutional reasons, cannot prevent construction on such lots, even though it is known that structures in such locations contribute to their own destruction and aggravate flooding and erosion elsewhere. The State is presently on the horns of a dilemma. To deny all economic use of shorefront property would lay the State open to law suits on the grounds of taking property without just compensation. To permit building on or seaward of the dune creates unnecessary erosion and flood hazards for adjacent or back lying property. The State can presently require owners of beach front lots to take mitigating measures to offset these induced hazards. The effectiveness of such measures taken by owners on a lot by lot basis has not been proven, although they are certainly more beneficial than doing nothing at all.

The only feasible solution to the problem would be the creation, by FIA, of a no insurance zone seaward of the building line. Since the private insurance industry would certainly not write insurance on such properties without federal backing, removal of the subsidy on new or reconstructed structures would permit market forces to dictate use of the beach front. The unavailability of financing for such structures would prevent most beachfront construction and reduce the hazards they cause to others. The CMP urges the FIA go give consideration to this concept in areas subject to velocity waters and flood-related erosion.

C. State Beach Preservation Program

1. Beach Preservation Fund

The Beach Preservation Act of 1972 established the Beach Preservation Fund for the purpose of enhancing, preserving and protecting the public beaches of Delaware. DNREC is authorized to issue bonds up to \$1,000,000 annually to prevent and repair erosion damage to public beaches. This fund is a revolving fund with funds appropriated or bonds authorized annually by the legislature to bring the balance up to \$1,000,000 at the beginning of each fiscal year. Although general fund revenues are permitted to be used to finance beach protection projects, to date all such monies have been raised through the sale of 20 year Beach Preservation Bonds.

As the table below indicates, many beach preservation projects constructed in the past have useful lives on the order of 3 to 5 years. It is not fiscally prudent to use long-term financing for short-term projects. To help reduce the fiscal impacts of financing such projects, the State is embarking on a program to match the debt retirement period on bonds to the expected useful life of a project. This program applies to all State capital improvements and not just beach protection.

Due to the impact abrupt implementation of this program would have on State finances, change-over to this method of financing will be phased over a number of years. During fiscal year 1979, Beach Preservation Bonds will be retired over a 10-year period and after FY 1980, DNREC plans to use 5-year bonds for beach nourishment and dune maintenance.

The following table summarizes work undertaken by DNREC since passage of the Beach Preservation Act of 1972. The table also includes projects under construction or in the final planning stage.

When judged against the expenditures required to protect the State's public and private beaches, the Beach Preservation Fund is clearly inadequate to do the job. Most of the work done to date has been on the Delaware Bay. These beaches and the beach north of Indian River Inlet utilized most of the authorized State funds for beach preservation. So far, the State has not done any major work on the Atlantic Coast. Projects along this shore require substantial construction and maintenance monies which are currently not available.

Based upon information from the Corps of Engineers* construction of a beach and dune system along the Atlantic shore would cost about \$12,774,000 and would require annual maintenance expenditures of \$3,422,000. The State would bear 38% of the cost of initial construction (\$4,825,000) and about 68% of the annual maintenance costs (\$2,324,000). Moreover, since beach maintenance work is generally carried out every three years, the legislature would have to appropriate from the general fund or authorize short term bonds in the amount of about \$7,000,000 every three years for the Atlantic beaches alone.

If the State were to attempt to halt beach recession along the Atlantic Coast and along the developed beaches of Delaware Bay as well as to provide storm wave protection for the densely developed Atlantic coastal communities, the cost over the next 50 years in constant dollars would be about \$250,000,000.

* Delaware Coast - Beach Erosion Control and Hurricane Protection, General Design Memorandum Phase II, Supplement No. 1. The costs cited are approximations adjusted for inflation and are for beach nourishment and dune construction and maintenance only.

Past and Anticipated Expenditures for Beach Preservation Projects

1972-1978

BEACH FILL

Location ¹	Length(ft)	Quantity(c.y.)	Completion		Total Cost	State Cost	Cost Per Cubic Yard
			Date	Date			
Kitts Hummock (south)	1,000	3,000	11/73		\$ 11,500	\$ 11,500	\$3.83
Kitts Hummock (south)	1,600	46,500	9/74		\$ 82,300	\$ 82,300	\$1.54
Kitts Hummock	4,000	75,000	1978		\$141,750	\$141,750	\$1.89
Pickering Beach	2,600	86,000	1978		\$158,240	\$158,240	\$1.84
Bowers Beach	2,400	15,800 ⁴	12/73		\$ 15,800 ⁴	\$ 15,800 ⁴	\$1.00 ⁴
Boers Beach	2,400	28,800	9/74		\$ 28,800 ⁴	\$ 28,800 ⁴	\$1.00 ⁴
South Bowers	830	4,000	6/74		\$ 14,200	\$ 14,200	\$3.55
South Bowers	1,500	15,000	1/75		\$ 15,000 ⁴	\$ 15,000	\$1.00 ⁴
Slaughter Beach (North)	9,600	277,700	9/76		\$347,125	\$347,125	\$1.25
Slaughter Beach (South)	4,700	179,500	9/75		\$270,100	\$270,100	\$1.29
Broadkill Beach (Center)	4,500	118,100	12/73		\$165,450	\$165,450	\$1.30
Broadkill Beach (Center) ²	2,200	59,700	9/76		\$121,950	\$ 60,975	\$2.04
Broadkill Beach (South)	6,500	295,000	6/75		\$558,000	\$558,000	\$1.72
Lewes	3,700	69,800	5/73		\$ 69,800 ⁴	\$ 69,800	\$1.00 ⁴
Lewes ²	4,800	87,000	2/75		\$274,550	\$137,275	\$3.16 ⁴
Lewes	1,000	11,400	9/77		\$ 11,400 ⁴	\$ 11,400	\$1.00 ⁴
Indian River Inlet	5,000	708,400	1/73		\$637,200	\$637,200	\$0.823
Indian River Inlet ³	5,000	142,500	4/75		\$276,550	-0-	\$1.94
Indian River Inlet	5,000	487,000	8/78		\$714,600	\$182,100	\$1.47
		2,710,200			\$3,914,315	\$2,907,015	

Notes: 1. All projects State-funded except as noted.

2. 50/50 State/Federal cost share

3. 100% Federal Cost

4. Work done by State dredge estimated at \$1.00/c.y. +15%

OFFSHORE BORROW INVESTIGATIONS

<u>Location</u>	<u># of Holes</u>	<u>Date</u>	<u>Cost</u>	<u>Material</u>	<u>Date</u>	<u>Cost</u>	<u>Cost Per Foot</u>
Pickering Beach	6	10/76	\$4,250	Timber pile, steel sheeting	05/74	\$78,600	\$280.00
Kitts Hummock	2			Sand-filled nylon bags	05/76		
				Sand-filled nylon bags	05/76		
				Sand-filled nylon bags	07/76	\$38,820	\$ 19.90
				Sand-filled nylon bags	08/76		

GROINS

SAND FENCING

<u>Location</u>	<u>Length (ft.)</u>	<u>Date</u>	<u>Cost</u>
State Lands	20,000	FY 1974	\$ 4,400 + Labor
State Lands	40,000	FY 1975	\$29,000 + Labor
State Lands	20,000	FY 1976	\$12,400 + Labor
State Lands	46,330	FY 1977	\$26,700 + Labor

BEACH GRASS

<u>Location</u>	<u>Amt. (3 stem culms)</u>	<u>Date</u>	<u>Cost</u>
Kitts Hummock	22,500	11/74	\$1,900
South Bowers	20,000	12/74	\$ 800 + Labor
State Lands & Broadkill Beach (S)	107,500	FY 1975	\$4,000 + Labor
State Lands & Slaughter Beach (S)	200,000	FY 1976	\$9,200 + Labor
Slaughter Beach (N) & Dewey Beach	150,000	FY 1977	\$6,900 + Labor

AERIAL FERTILIZATION

<u>Location</u>	<u>Area</u>	<u>Date</u>	<u>Cost</u>
Public Dunes (Ocean Front)	170 Acres	May, July 1975	\$15,000
Public Dunes (Ocean Front)	170 Acres	May, July 1976	\$12,000

SHORELINE EROSION DEMONSTRATION PROJECTS

<u>Location</u>	<u>Project</u>	<u>Length</u>	<u>Date</u>	<u>Total Cost</u>	<u>State Cost</u>	<u>Cost Per Foot of Beach</u>
Pickering Beach	Floating Breakwater	860	1978	\$210,617	\$ 56,340	\$245
Kitts Hummock	Perched Beach	1,000	1979	\$221,640	\$ 55,410	\$222
Slaughter Beach	Offshore Fixed Breakwater	1,290	1979	\$300,310	\$ 75,080	\$233

<u>Grand Total</u>	<u>State Cost</u>	<u>Total Cost</u>
1972-1978	\$3,333,565	\$4,886,602

Of this, about \$165,000,000 would come from State taxpayers. If the State were to finance its share of this work with 20-year bonds, the total outlay would be about \$260,000,000 at present interest rates.

None of the figures cited herein take into consideration added costs that would result from severe storms nor do they account for added costs which would result from rising sea level. These phenomena could add substantially to cost of "holding the line".

It is evident that the Beach Preservation Fund is quite inadequate to serve the purpose for which it was enacted. The fund should be sufficient to periodically repair the damage to beaches caused by the jetties at Roosevelt and Indian River Inlets as well as control erosion on the Delaware Bay at those sites where such work has been carried out in the past. In the future, additional burdens will be placed on the fund from the Corps sponsored erosion control projects at Broadkill and Lewes Beaches. Federal cost sharing at these locations will be phased out in 6 years and the State will be required to bear the entire burden for the life of these projects.

Erosion control work on the Atlantic shoreline will require substantial additional appropriations in the future, if the coast is to be maintained in its present condition. Although beach retreat has not yet reached the crisis stage at most Atlantic Coast locations, the problem is getting worse yearly and some difficult policy and funding decisions lie ahead for the executive and legislative branches of State government.

Given the statutory limitations on capital expenditures and the intense competition for general fund revenues between all other public services, it is unlikely that the State could afford to "hold the line" against beach erosion and storm damage. These fiscal realities will necessitate decisions regarding the magnitude of the State's involvement in beach erosion control; the type, cost and effectiveness of the measures to be employed; and which beach segments will be protected. The CMP recently brought many of these issues before the public through the Governor's Workshop on the Management of Shoreline Erosion and Flood Prone Areas.

It became evident from the workshop that beach dynamics, the adverse effects of erosion control structures, and the economics of beach protection are not well understood by either the public or private sector. Resoulation of the issues involved in beach preservation will require substantial technical input and public debate before State policy can be developed on the magnitude and direction of future State actions to control erosion. For this reason, the CMP has decided to address this issue during the implementation phase of the program. The existing erosion control program is sufficient for the present.

Some of the questions and issues which should be addressed include:

- a) It is feasible to protect beachfront property under alternative financing methods and funding levels?
- b) What responsibility, if any, do State and federal taxpayers have to protect private beachfront development?
- c) Should those who chose to locate in flood and erosion hazard areas be required to bear some or all of the risk for that decision?
- d) If the State undertakes protective measures that benefit flood or erosion prone property owners, should the State recoup the costs proportionate to the private benefits derived? If not, why not and, if so, how?
- e) Which beaches should receive priority consideration, if funds are limited, and on what basis?
- f) Are there alternatives to beach protection in some areas which may be more economical, such as relocation of buildings or acquisition of beachfront land following destructive storms?

In summary, the funds available to prevent and repair erosion damages to beaches are inadequate. In addition, there are questions relating to the ability of the State to finance a comprehensive erosion control program for the entire coastline. There are also questions relating to our ability to halt erosion over the long-term. Science and technology have yet to devise an inexpensive solution to this problem, because coastal dynamics are still poorly understood and the forces responsible for change cannot be controlled. Some experts have argued that present control techniques only postpone the day of reckoning. Others have argued that the costs and benefits are distributed inequitably.

Many of these problems and issues have not been aired adequately enough for reasoned public debate. In some sectors the problem is approached piecemeal following a crisis. Others reason that, if enough money is thrown at the problem one more time, it will be solved once and for all. Beach erosion control is not that simple, however. Experience has shown that it is a never ending, increasingly expensive problem to deal with. The question of whether the State increases or decreases its erosion control efforts must be answered in the public arena with all of the facts presented. The problem is so complex and often emotional that the CMP felt it should be given special attention. This could not be accomplished within the time constraints imposed by the Coastal Zone Management Act Amendments of 1976. The CMP has decided, therefore, to address this issue during the implementation phase of the program.

2. State Beach Preservation Policies

The Beach Preservation Act grants authority to DNREC to control all construction activity on public and private beaches in order to minimize the effects such activity may have on beach and dune stability as well as to take those actions which may be necessary to prevent and repair erosion damages on public or publicly accessible beaches.

The Beach Preservation Act of 1972 and the Regulations Governing Beach Protection and the Use of Beaches, contained in Appendices A and B

respectively, provide the authority upon which the following policies are based:

GENERAL CMP POLICIES FOR BEACH MANAGEMENT

1. THE PUBLIC AND PRIVATE BEACHES OF THE STATE SHALL BE PRESERVED, PROTECTED AND ENHANCED TO PREVENT THEIR DESTRUCTION AND DESPOILATION.

This policy is a cornerstone to the CMP. Numerous studies, reports, task forces, committees and governmental agencies have recognized the value of Delaware's beaches and the need for their protection. The value and vulnerability of the State's beaches were recognized early in the development of the CMP. The program contracted with the University of Delaware for two studies of coastal processes and their effects on beaches and shorefront development. One report, entitled Delaware's Changing Shoreline, described the long-term geological processes causing the coast to retreat landward. The second report, entitled Coastal Storm Damage - 1923 - 1974, examined specific storms, particularly those occurring in 1962 and 1974, and described the effects of storm induced flooding and erosion on a community-by-community basis. Both studies documented the need for managing the beach/dune system as well as the consequences of not doing so.

SPECIFIC CMP POLICIES FOR BEACH MANAGEMENT

2. THE SANDY SHORES AND DUNES OF THE DELAWARE RIVER AND BAY AND THE ATLANTIC OCEAN SHALL COMPRISE THE BEACHES MANAGED PURSUANT TO THE CMP. BEACHES ARE THOSE PORTIONS OF THE SHORE WHICH EXTEND FROM THE MEAN HIGH WATERMARK INLAND 1,000 FEET, OR TO A ROADWAY FOR AUTOMOBILES, WHICHEVER IS CLOSER. IN ADDITION TO THE BEACH AREAS REGULATED, THE AREA REGULATED SHALL EXTEND SEAWARD AND LANDWARD FROM THE SHORE A DISTANCE NECESSARY TO CONTROL ANY ACTIVITY WHICH MAY FOSTER BEACH OR DUNE EROSION.

This policy simply identifies which beaches and adjacent areas are subject to regulatory control. Although the State has many miles of inland shoreline, research conducted on behalf of the CMP by the University of Delaware (Delaware's Changing Shoreline, Technical Report #1) demonstrates that significant shoreline erosion only occurs along the Delaware Bay and Atlantic Ocean, and therefore, regulatory control for erosion purposes is necessary only in these areas.

3. EXCEPT AS NOTED IN POLICY NO. 5, NO NEW CONSTRUCTION OR OTHER ACTIVITY ADVERSELY AFFECTING BEACHES AND DUNES SEAWARD OF THE BUILDING LINE, AS ESTABLISHED BY POLICY NO. 6, SHALL BE PERMITTED.
4. THE FUTURE SUBDIVISION OF BEACH LAND IN SUCH A MANNER AS TO CREATE BUILDING LOTS OF INSUFFICIENT SIZE OR SHAPE TO ALLOW THE CONSTRUCTION OF BUILDINGS WHOLLY LANDWARD OF THE BUILDING LINE SHALL BE PROHIBITED.
5. IN THOSE CASES WHERE EXISTING LOTS ARE OF SUCH SIZE AND SHAPE TO PRECLUDE THE ERECTION OF A BUILDING WHOLLY LANDWARD OF THE BUILDING LINE, SUCH BUILDINGS MAY BE PERMITTED PROVIDED THAT:
 - (A) THE BUILDING IS CAPABLE OF WITHSTANDING THE NATURAL FORCES AND CONDITIONS WHICH MAY BE EXPECTED DURING THE DESIGN STORM; AND
 - (B) THOSE MEASURES ARE TAKEN WHICH ARE NECESSARY TO PROTECT ADJACENT PROPERTIES FROM EROSION OR FLOODING WHICH MAY BE INDUCED BY THE PRESENCE OF THE BUILDING..

IN THOSE CASES WHERE STRUCTURES, OTHER THAN BUILDINGS, ARE PROPOSED, SUCH STRUCTURES MAY BE PERMITTED PROVIDED THAT:

- (A) THE STRUCTURE REQUIRES A BEACHFRONT LOCATION TO CARRY OUT ITS INTENDED PURPOSE;
- (B) ALL SUCH STRUCTURES SHALL BE CAPABLE OF WITHSTANDING THE NATURAL FORCES AND CONDITIONS WHICH MAY BE EXPECTED DURING THE DESIGN STORM; AND
- (C) THE STRUCTURE SHALL NOT CAUSE ADVERSE EFFECTS DUE TO INCREASED EROSION OR FLOODING POTENTIAL ON ADJACENT BEACHES OR PROPERTY; OR, WHEN SUCH STRUCTURES MAY CAUSE ADVERSE EFFECTS ON ADJACENT BEACHES OR PROPERTY, THOSE MEASURES DESIGNED TO MITIGATE THESE ADVERSE EFFECTS MAY BE REQUIRED.

Policy Numbers three through five form the backbone of the CMP beach efforts. Experience with and research into coastal erosion and storm damage has pointed to a number of causes of beach related problems. Those problems result primarily from destruction or alteration of natural protective barriers to storm waves and interference with littoral transport processes. In order to properly manage beaches, those actions having adverse effects on them must be controlled.

Prior to State control of the beaches, the underlying cause of many of the problems facing the shoreline was the subdivision of beachland in such a manner as to create lots located on and seaward of the dune. Construction on such lots, of course, altered or destroyed the dune and increased the potential for flooding and beach erosion on such properties as well as adjacent properties. Once such lots are

created, there are legal questions as to whether or not construction can be prohibited altogether. There is, however, substantial judicial precedent for the establishment of setbacks and other regulatory controls which prevent conditions that may be injurious to the public health, safety and general welfare. Recognizing this, the CMP has established a policy to break the chain of events which has led to destruction of the dune.

A problem arises, however, regarding construction on lots which do not contain adequate room landward of the building line for erection of structures and which were created prior to the establishment of State regulatory controls. If such cases entail new construction or reconstruction of buildings, the CMP policy may require measures to mitigate the potential adverse effects the construction may pose to adjacent beaches or property. This policy balances the interest of adjacent property owners to be secure from unreasonable dangers to life and property which can result from unregulated beachfront development, with the interests of beachfront property owners to reasonably use their property. The CMP, however, reserves the right to deny beachfront buildings and other structures when the dangers posed by them are such that mitigation of the potential impacts cannot be assured.

6. A BUILDING LINE SHALL BE ESTABLISHED AND MAINTAINED WHICH SHALL GENERALLY PARALLEL THE COAST AND BE LOCATED 100 FEET LANDWARD OF THE SEAWARD 11-FOOT CONTOUR ABOVE THE NATIONAL GEODETIC VERTICAL DATUM (NGVD) ALONG BEACHES EXTENDING FROM ROOSEVELT INLET TO THE DELAWARE-MARYLAND STATE LINE. FOR THOSE BEACHES BETWEEN ROOSEVELT INLET AND LISTON POINT, THE LINE SHALL GENERALLY PARALLEL THE COAST AND BE LOCATED 75 FEET LANDWARD OF THE SEAWARD 9 FOOT CONTOUR ABOVE THE NGVD.

This policy establishes the seaward limit of construction except in those instances noted in Policy 5. The establishment and maintenance of the building line is the responsibility of the Delaware Department of Natural Resources and Environmental Control (DNREC), pursuant to its regulations.

7. PEDESTRIAN OR VEHICULAR ACCESS ACROSS THE PRIMARY DUNE ON ANY STATE OWNED BEACH SHALL BE PROHIBITED EXCEPT AT THOSE LOCATIONS SPECIFIED BY DNREC FOR SUCH USE. MOREOVER, DAMAGE OR DESTRUCTION OF VEGETATION ON ANY STATE OWNED BEACH OR DAMAGE OR REMOVAL OF BEACH PRESERVATION WORKS INSTALLED OR MAINTAINED BY DNREC ON ANY BEACH SHALL BE PROHIBITED.
8. AFFIRMATIVE ACTIONS DEEMED NECESSARY BY DNREC TO PREVENT AND REPAIR DAMAGES FROM EROSION OF PUBLIC BEACHES SHALL BE TAKEN WITHIN THE LIMITS OF FUNDS MADE AVAILABLE FOR SUCH PURPOSES.

The "affirmative actions" contemplated by the policy statement include those beach protection measures discussed previously. That discussion makes it clear that there are drawbacks involved in the use of such measures. Thus, they are not always desirable, and DNREC-- which has considerable practical experience with the utilization of beach protection methods--is given flexibility to determine when they are appropriate.

9. AFFIRMATIVE ACTION TO REDUCE SHORELINE RECESSION ON PRIVATE BEACHES SHALL BE TAKEN BY DNREC ONLY UNDER THE FOLLOWING CONDITIONS:
 - (A) WHERE DANGEROUS CONDITIONS EXIST ON ANY PRIVATELY OWNED BEACH WHICH CONSTITUTE AN EMERGENCY; OR

- (B) WHERE PRIVATE BEACH OWNERS
REQUEST ASSISTANCE OF THE STATE
TO ENHANCE, PROTECT OR
PRESERVE THEIR BEACHES AND ARE
WILLING TO ALLOW FREE PUBLIC ACCESS
TO SUCH BEACHES IN RETURN FOR
SUCH ASSISTANCE.

This policy recognizes the traditional rights of private property owners to use their property as they see fit as long as others are not endangered. It also gives the public an interest in assisting private beach owners when the owners are willing to accommodate public use of the resource.

10. A SYSTEM OF PRIORITIES SHOULD BE ESTABLISHED FOR THE EXPENDITURE OF LIMITED BEACH PRESERVATION FUNDS.

The Delaware Beach Preservation Act establishes a \$1,000,000 revolving fund for the purpose of enhancing, preserving and protecting beaches. It has been demonstrated over the years the Act has been in existence that the monies available, including federal matching funds, are not adequate to prevent beach erosion. It is, therefore, recommended that a priority system be established to guide the State in protecting its most valuable beaches. Consideration should be given to the adoption of the following general criteria:

1. First priority should be given to those beaches which suffer substantial and chronic erosion due to the presence of public navigation works;
2. Second priority should be given to those intensely used, publicly owned beaches undergoing critical erosion. This category should be subdivided further according to the degree of public use,

ease of access, rate of erosion, value of the area to the economy and possible beneficial effects protection efforts may have on downdrift Delaware beaches. Protection of private beachfront structures should not be an overriding consideration;

3. Third priority should be given to all remaining publicly owned recreational beaches;
 4. Fourth priority should be given to intensely used, publicly accessible private beaches;
 5. Fifth priority should be given to sparsely used, publicly accessible beaches; and
 6. The last priority should be given to privately owned, restricted beaches. In fact, consideration should be given to denying all beach protection funds and State disaster-related reconstruction aid to such individuals unless and until the beaches are opened to public use.
11. ALL BONDS ISSUED FOR BEACH PRESERVATION PROJECTS SHOULD NOT BE ISSUED FOR A PERIOD LESS THAN THE EXPECTED USEFUL LIFE OF THE WORK BEING FINANCED.

Since the Beach Preservation Act was established, it has been standard practice to issue 20-year bonds for beach protection projects. Experience has shown, however, that many of these projects, particularly beach nourishment, have useful lives considerably less than this. Sound financial practice dictates that the debt service on any capital project should be retired prior to the expiration of the project's useful life. Thus, the CMP recommends that no bonds be issued if the project's expected useful life does not at least match the period required to repay the debt.

3. Authorities

Management of the barrier beaches in Delaware is vested in DNREC, primarily pursuant to Title 7, Chapter 68 of the Delaware Code (Beach Preservation Act of 1972) and regulations adopted thereunder. As a result of CMP planning efforts, these regulations were amended recently to reflect the CMP policies. The specific authority for each policy statement appears in the Authorities Table below.

In addition to the Beach Preservation Act, several other State statutes used to implement the CMP by protecting various natural resources also help protect the beaches. In this regard, the Delaware Environmental Protection Act, the Delaware Wetlands Act, and the Delaware Coastal Zone Act are particularly important. These statutes are discussed elsewhere in the CMP document and in Appendix E (Legal Authorities and Organization) of that document.

AUTHORITIES TABLE

<u>Policy Number</u>	<u>Authority</u>
1	7 Delaware Code 6801, 6803 and 6810
2	7 Delaware Code 6803(c); Regulations Governing Beach Protection and the Use of Beaches, Section 10.
3	Regulations Governing Beach Protection and the Use of Beaches, Section 3.01
4	Regulations Governing Beach Protection and the Use of Beaches, Section 3.01
5	Regulations Governing Beach Protection and the Use of Beaches, Section 4.02(a), 4.02(c), 4.02(d), 4.01, 3.01, 4.05; <u>Atlantis I Condominium Assc. v. John Bryson,</u> 49 Civil Action, 1977, Sussex County Superior Court (June, 1978)
6	Regulations Governing Beach Protection and the Use of Beaches, Section 2.11 and 2.12.

<u>Policy Number</u>	<u>Authority</u>
7	7 Delaware Code, Sections 6803(c) and 6803(d); Regulations Governing Beach Protection and the Use of Beaches, Section 3.02.
8	7 Delaware Code, Sections 6803(b) and 6806.
9	7 Delaware Code, Sections 6801, 6803(f), 6806, and 6810; Regulations Governing Beach Protection and the Use of Beaches, Section 2.01.
10	Executive Order Number 61
11	Executive Order Number 61

4. Procedures for Handling Erosion Effects

In order to develop a procedure for handling erosion effects, the literature was surveyed to determine the adequacy of procedures and methods used in the past and to establish future management priorities. Section IV describes the advantages and disadvantages associated with specific erosion control techniques. This research indicates that non-structural beach management methods are to be preferred. This emphasis is based upon the following findings:

- a) The dynamic stability of the coastline is dependent upon the ability of natural processes to continue uninterrupted. Preserving natural buffering capabilities afforded by the beach/dune system reduces the need for costly structural "solutions" and protects downdrift areas from their erosive effects.
- b) There is a need to control construction practices and building location in natural buffer areas because of the adverse effects caused by development of the dune and immediate beachfront.

- c) Recent studies by the Corps of Engineers and others point to the inadequacies of structural "solutions" alone and show, in many cases, the exacerbation of erosion problems through the construction of groins, bulkheads, breakwaters, etc. Many of these problems have been observed near existing protective structures in Delaware.

These findings form the basis of the CMP procedure which is articulated in the above policies. Basically, priority is given to non-structural protection of dunes and beaches through restriction or conditioning of development along private beaches and through dune construction, stabilization and, in some cases, beach nourishment along public beaches. In defining permissible uses in this area, the protection of the natural buffering function of the beach and dune was considered the most important determinant. Moreover, the history of erosion control in Delaware, whether measured by the number of projects or monies expended, shows that emphasis has been and will continue to be placed upon non-structural techniques. Structural measures to lessen the effects of erosion on beaches or upland property are only deemed appropriate in densely developed areas of significant value to the public and where the dune has been irrevocably lost. All such cases, however, are to be reviewed on a case by case basis to ensure that adverse effects on other areas are minimized.

5. Designation of Erosion Control Areas

Since monies available for erosion control are severely limited in this State, the establishment of a priority system for erosion control projects was recommended in Policy 10. It is the intent of this system to rank coastal segments in order of their value to the public and to allocate erosion control funds to those projects which yield the greatest public benefit. It is not the intent of this system to protect only the most important beaches and ignore the remainder. Rather, it is designed to decide between projects which are competing, at any given time, for a limited amount of money. It is therefore, quite possible for a beach segment in category 4 to be funded, if at the time the project is to be constructed,

no other projects in the higher priority categories are required at that time. Moreover, it is also possible for a lower priority project to be funded, if the cost of the higher priority project is greater than the amount set aside in the Beach Preservation Fund. This situation is likely to arise in the near future along the Atlantic Coast where major restoration projects will cost substantially more than the legal funding limit of \$1,000,000. Such projects will not only require a special appropriation for construction, but they will also require substantial maintenance funds in the future, which will eventually strain the Beach Preservation Fund.

Although the recommended priority system has not yet been fully developed. The CMP has recognized that two areas merit designation as Areas for Preservation or Restoration. These beaches are located at Lewes, just east of Roosevelt Inlet and on the north side of Indian River Inlet.

At Roosevelt Inlet, the steel sheet pile jetties are severely corroded. This condition allows waves from the northwest to travel over them largely unimpeded during times when strong fair weather winds are blowing from that direction. Despite the condition of the jetties, however, the inlet still serves as a sink for sand traveling in the predominant west to east littoral drift stream. Moreover, during times of drift reversal, the corroded condition of the jetties allows sand to enter the inlet from the east rather than impounding it, as would normally be the case. The net result is continuous erosion of Lewes Beach. The problem has increased in recent years to the point that private structures lying behind the public beach are threatened. Since private as well as public property is being jeopardized by a public facility, the CMP has determined that the public has a responsibility to ensure that unnecessary threats to property owners and the public recreational beach are minimized. The beach being adversely affected by the inlet jetties has, therefore, been designated by the CMP as an area for restoration.

At Indian River Inlet, the jetties are causing chronic erosion on the north beach. This erosion has periodically threatened to undermine the foundation of the approach to the inlet bridge. The large public investment in the highway warrants designation of this area for restoration. Moreover, the natural tendency for inlets to migrate is causing erosion of the public lands on the north side of the inlet interior., and therefore, this area has also been designated for restoration.

The designation of other beach lands as APR's (which have not been so described by the CMP for other reasons, such as natural areas preservation) will be made on a case by case basis and should meet one or more of the following criteria:

Areas for Preservation

1. Beaches to be acquired for preservation should be largely free of human encroachment and should represent a significant addition to the State Park system.
2. They should possess significant ecological, recreational, aesthetic or historic values.

Areas for Restoration

1. Coastal segments designated for restoration can be those which are unduly adversely affected by any publicly owned, operated and maintained navigation facility or shore protection facility, regardless of shoreline ownership.
2. The coastal segment is publicly owned and heavily utilized for recreational purposes and is being seriously threatened by coastal erosion. Under this criterion, the protection of private structures shall not be a consideration in such designation.

Failure to designate any particular coastal segment as an area for restoration does not necessarily mean that the State intends to ignore the erosion problem there, nor does it mean that the State does not recognize the importance of these beaches. It simply means that beaches so designated should receive priority consideration in the competition for limited funds and that they are of such importance or are being harmed unduly by public shore protection or navigation facilities that they warrant long term, continuing protection.

IV. ILLUSTRATIONS

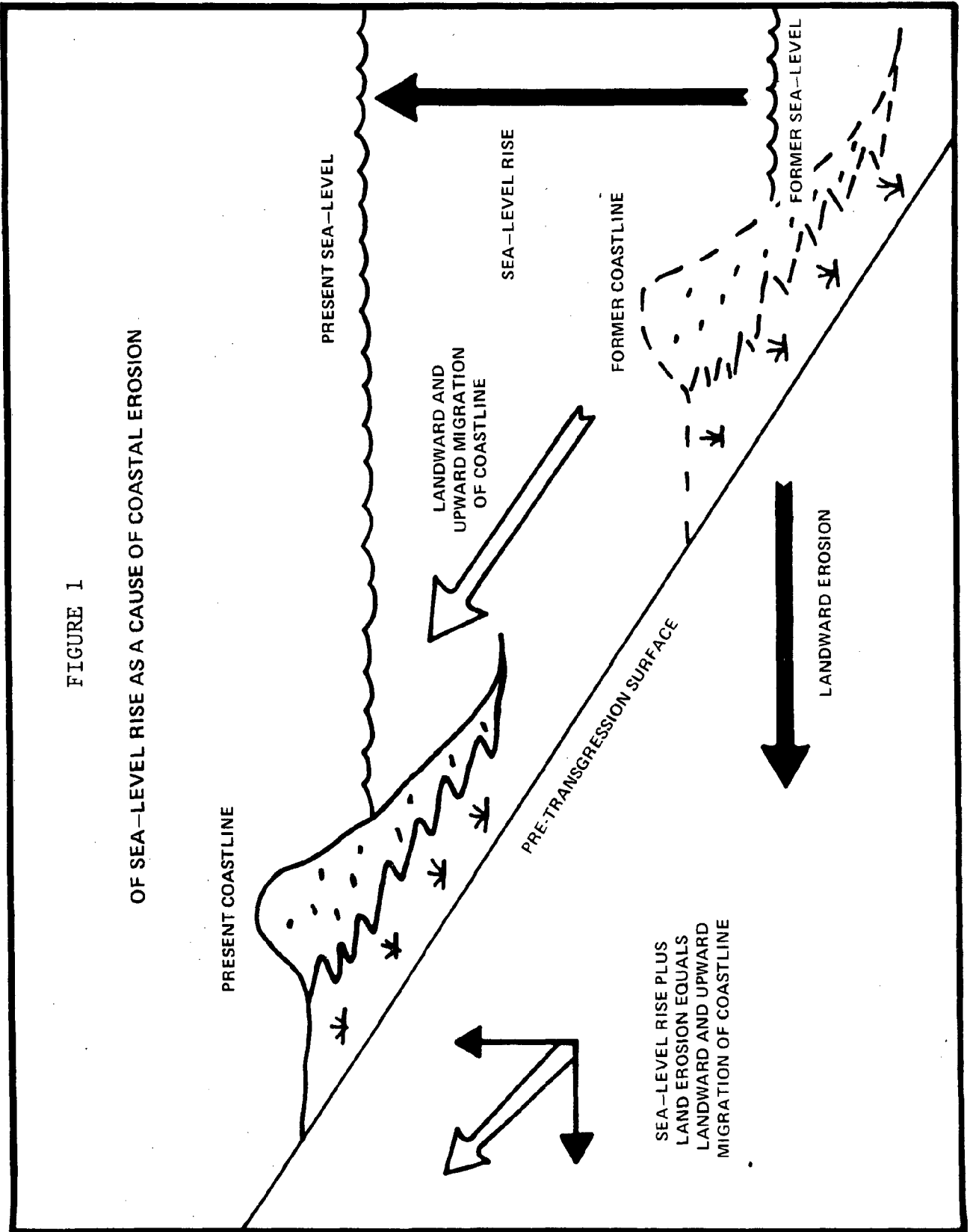
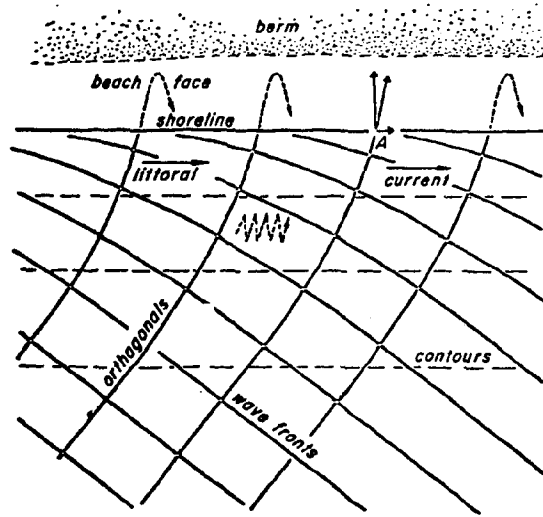


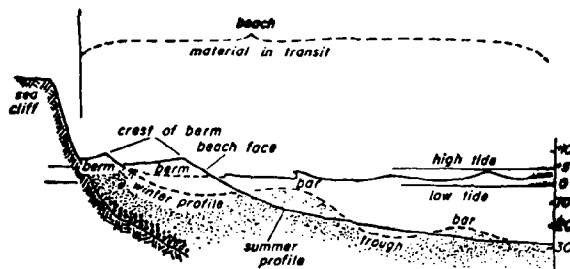
FIGURE 1
OF SEA-LEVEL RISE AS A CAUSE OF COASTAL EROSION

FIGURE 2



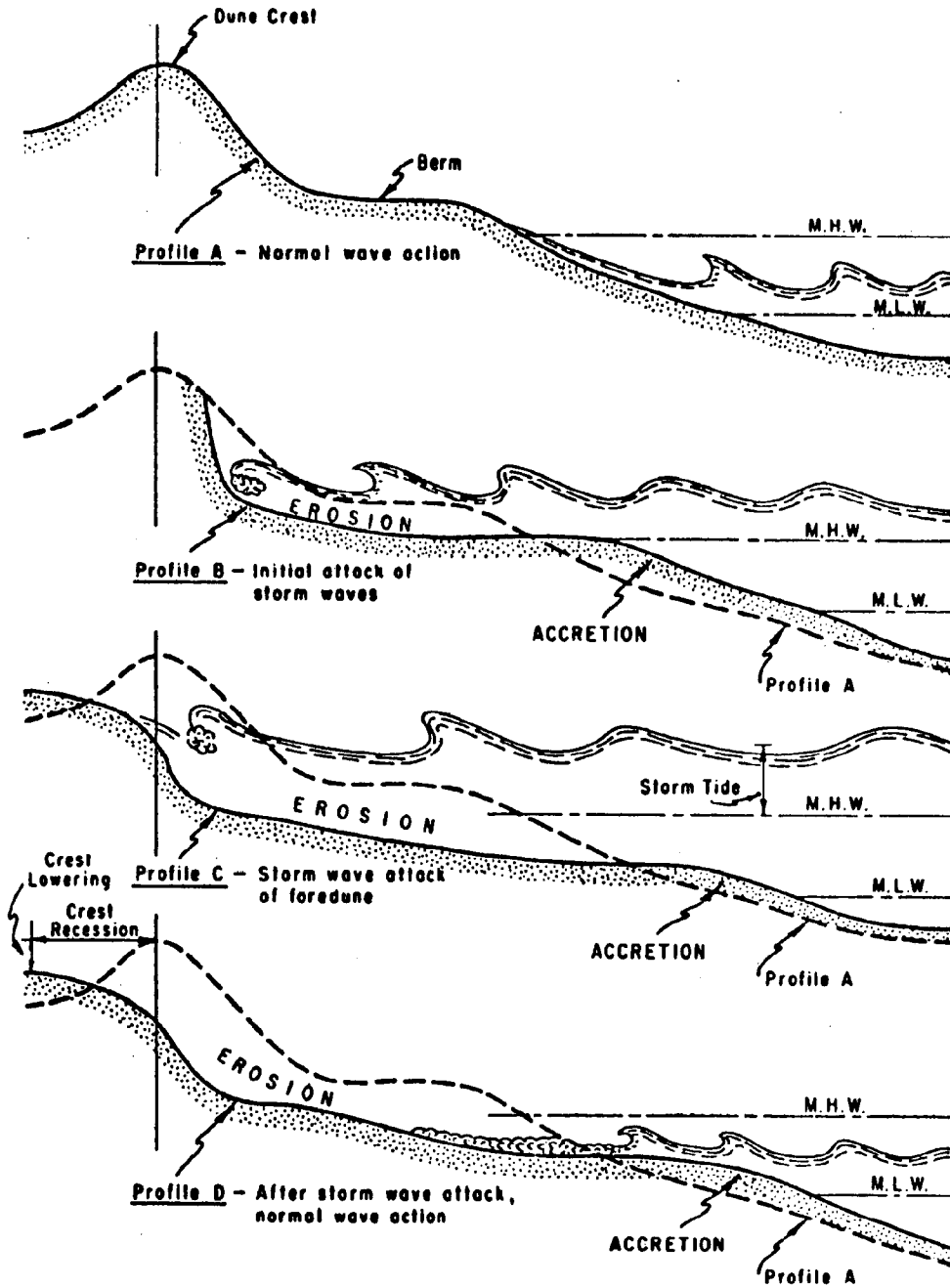
Waves approaching a straight shoreline at an angle are not completely refracted. The remaining alongshore component (marked A) is responsible for the littoral current. Paths of sand grains moving to the right with every wave are shown by dotted lines

FIGURE 3



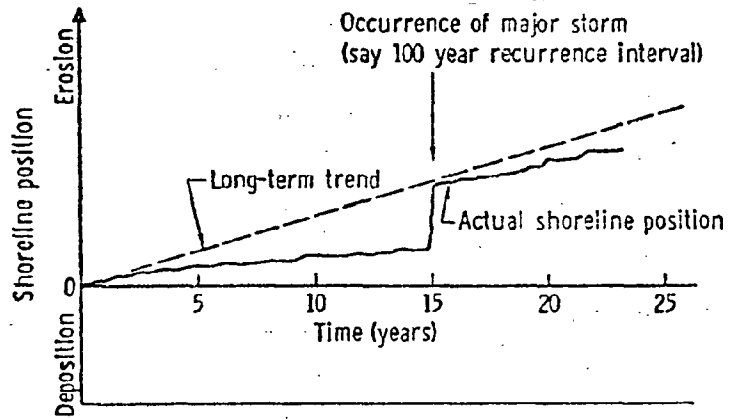
Generalized beach profile showing seasonal changes in the distribution of sand
 In the summer the beach is wide, with a prominent convex-upward beach face and usually flat, barless submarine profile. In the winter, large waves move sand offshore, producing a narrow berm and one or more submarine bars.

FIGURE 4



Schematic diagram of storm wave attack on beach and dune

FIGURE 4(a)



Effect of a long duration of mild wave activity followed by a major storm.

FIGURE 5

GEOMORPHIC SUBDIVISIONS OF DELAWARE'S COASTAL ZONE

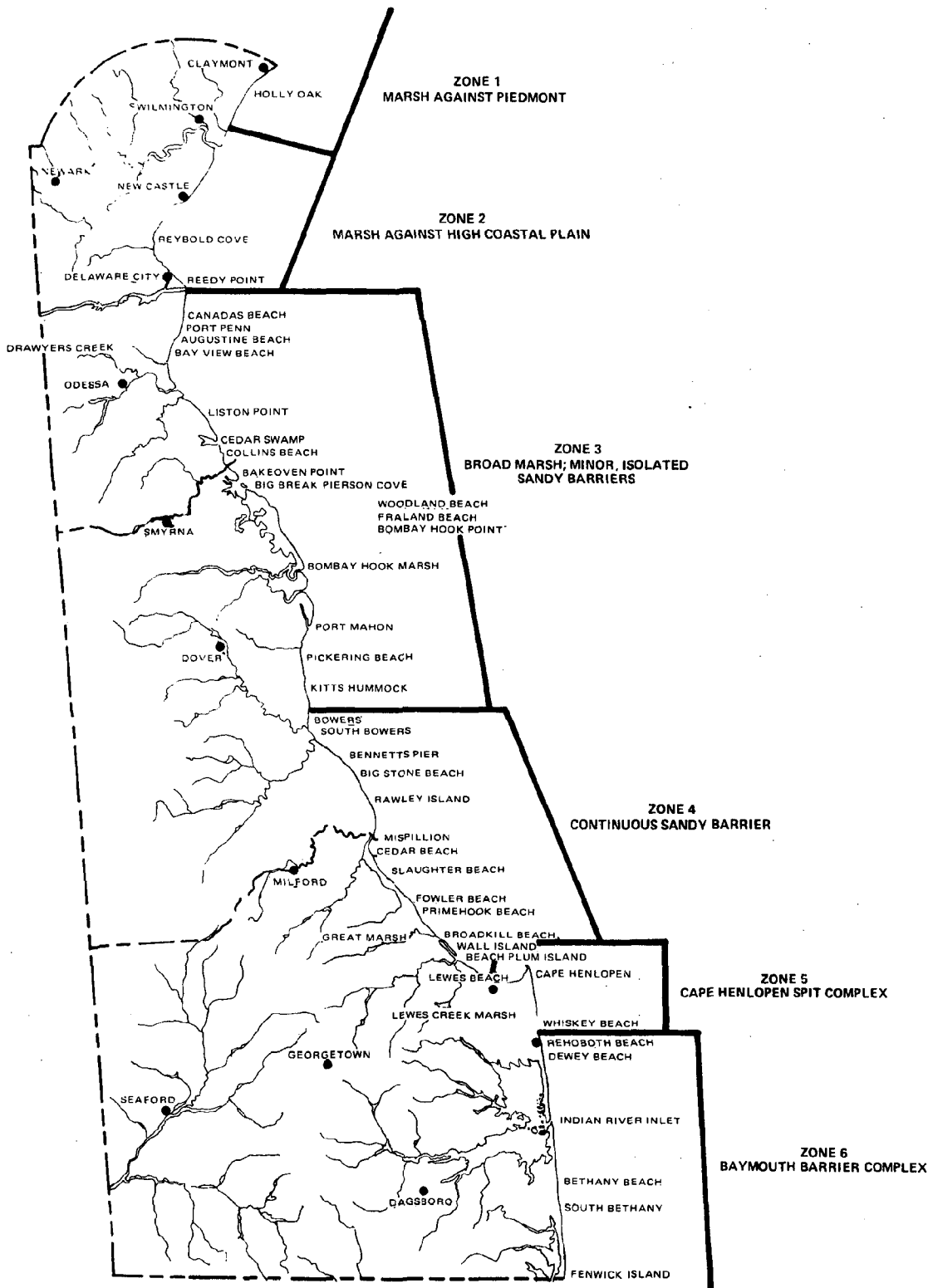
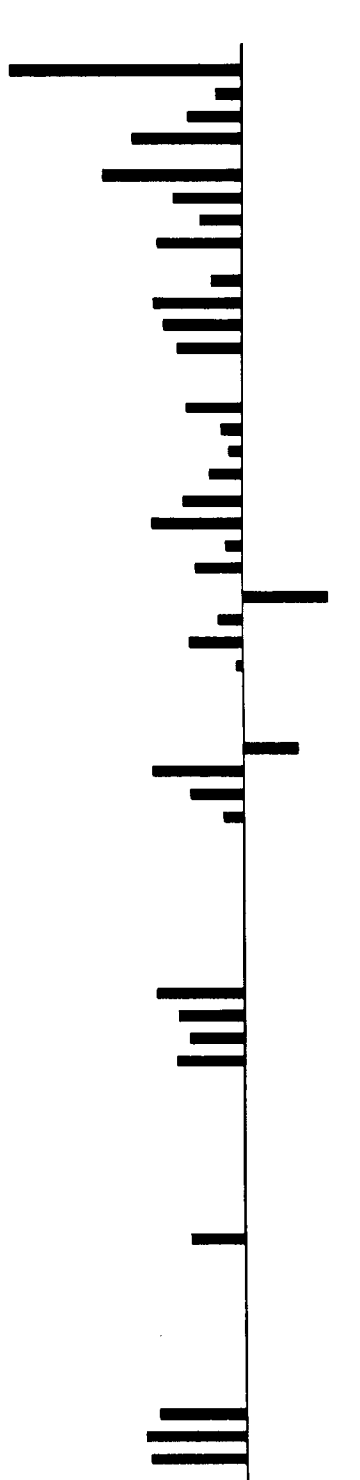
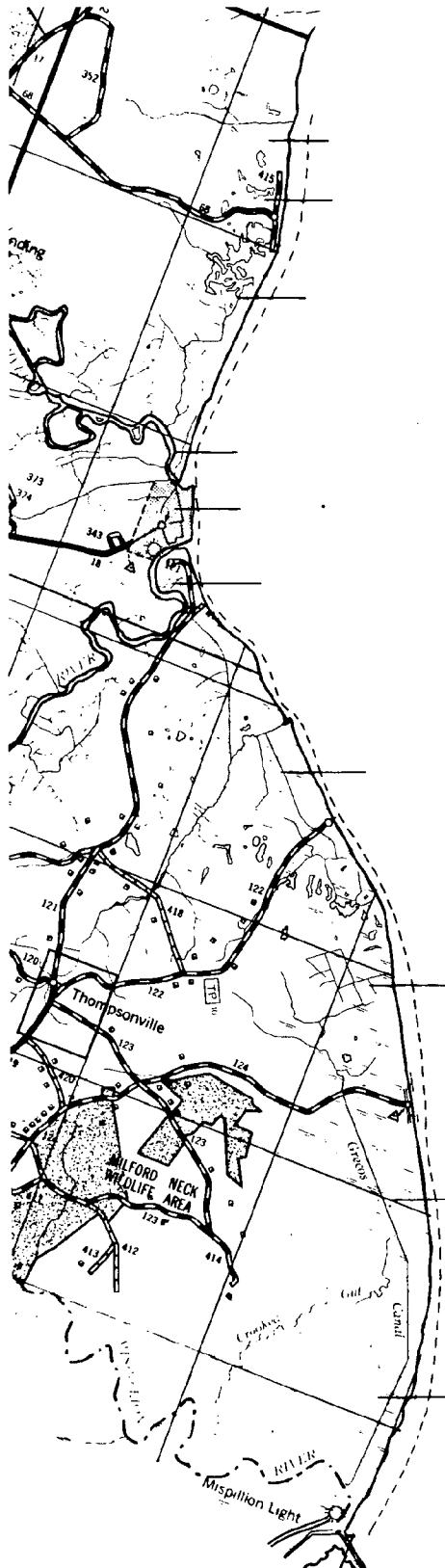


FIGURE 6

AVERAGE ANNUAL RATES OF COASTAL CHANGE ALONG THE DELAWARE BAY SHORELINE, KITTS HUMMOCK TO MISPILLION RIVER



INTERVAL	TOTAL CHANGE	AVERAGE CHANGE
1843-1884	800'	20.0'
1884-1910	50	2.0
1910-1954	200	4.5
1843-1954	1,050'	9.5'
1843-1884	500'	12.0'
1884-1910	150	5.8
1910-1954	150	3.4
1843-1954	800'	7.2'
1843-1884	100'	2.4'
1884-1910	200	7.8
1910-1954	300	6.8
1843-1954	600'	5.4'
1843-1884	200'	4.9'
1884-1910	50	1.9
1910-1954	50	1.1
1843-1954	300'	2.70'
1843-1884	200'	4.9'
1884-1910	200	7.7
1910-1954	50	1.1
1843-1954	450'	4.0'
1843-1884	+300'	+ 7.3'
1884-1910	50	1.9
1910-1954	200	4.5
1843-1954	+ 50'	0.4'
1843-1884	+200'	+ 4.9'
1884-1910	200	7.7
1910-1954	200	4.5
1843-1954	200'	1.8'
1843-1884	300'	7.3'
1884-1910	150	5.7
1910-1954	200	4.5
1843-1954	650'	5.8'
1843-1954	500'	4.5'
1843-1884	300'	7.3'
1884-1954	600	8.6
1843-1954	900'	8.1'

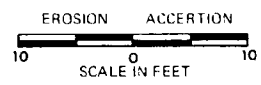


FIGURE 7

**AVERAGE ANNUAL RATES OF
COASTAL CHANGE ALONG THE DELAWARE BAY SHORELINE
SLAUGHTER BEACH TO ROOSEVELT INLET**

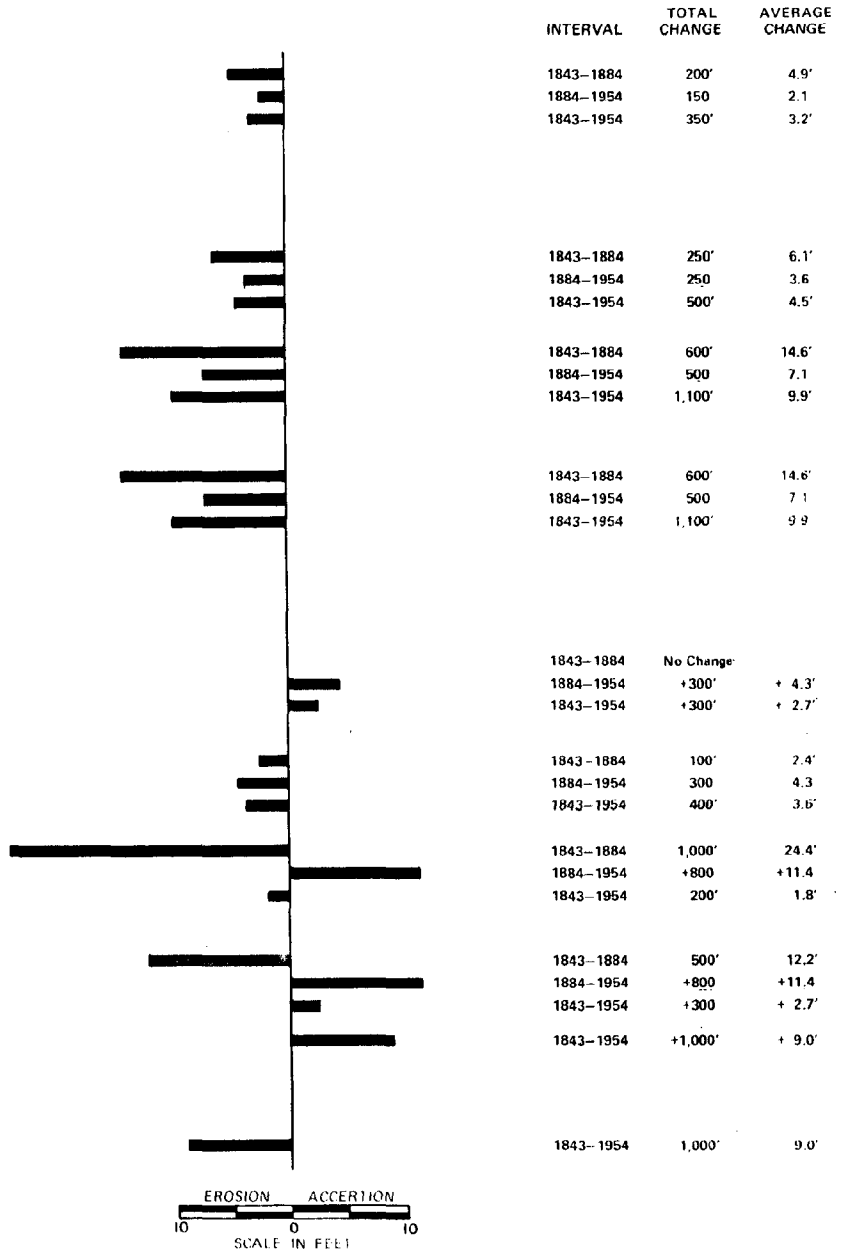
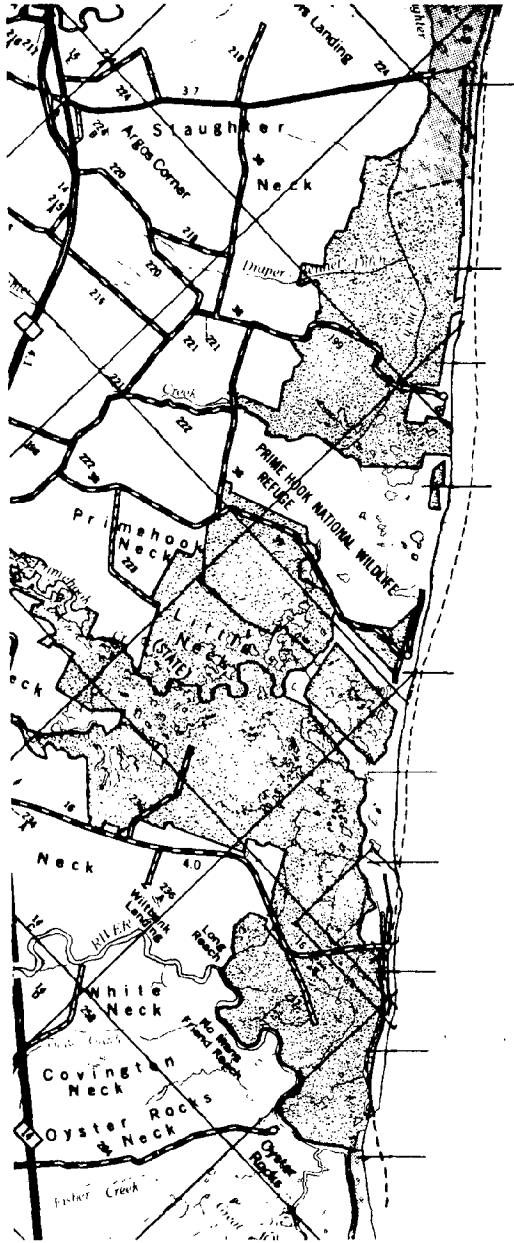


FIGURE 8

Geomorphic Elements of the Cape Henlopen Spit —
Dune — Marsh Complex

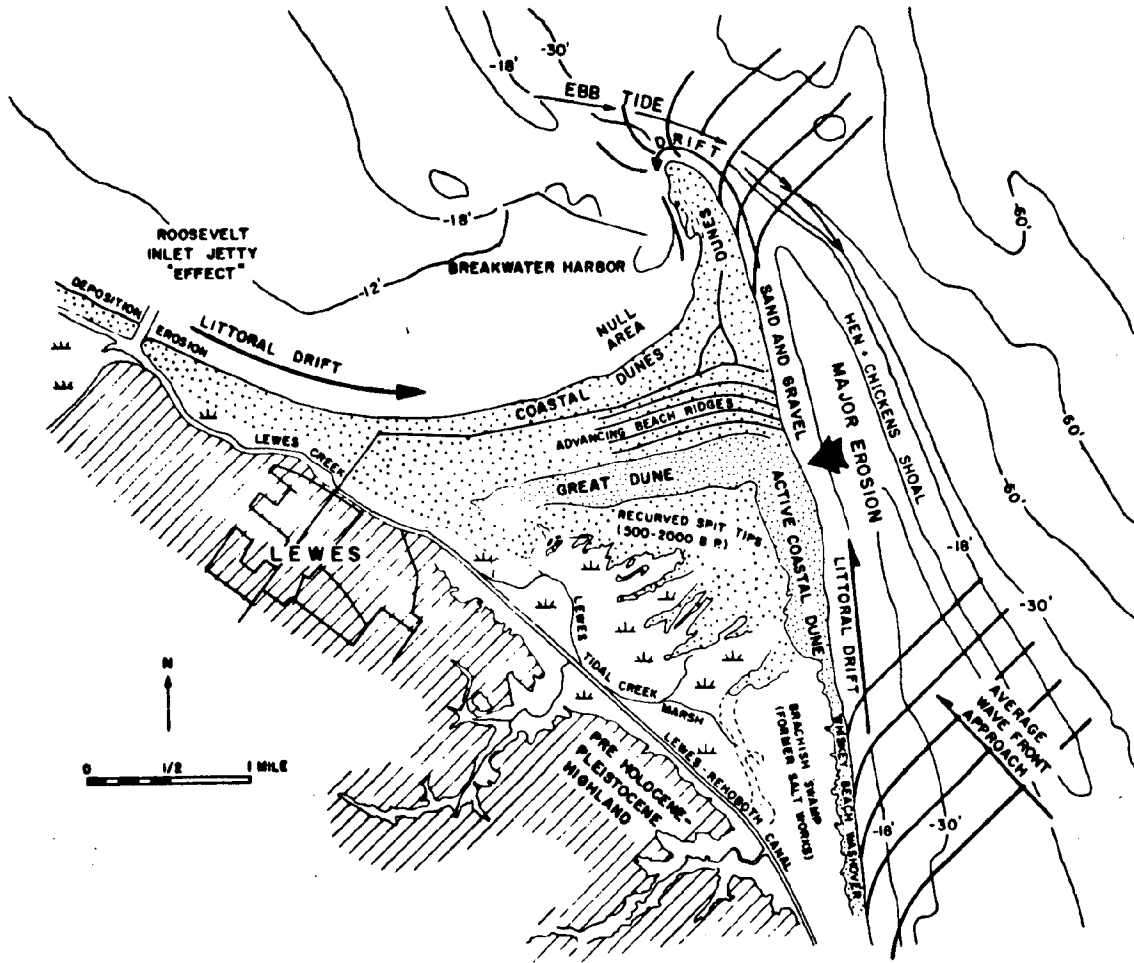


FIGURE 9

Rates of Coastal Change and Spit Advance at Cape Henlopen

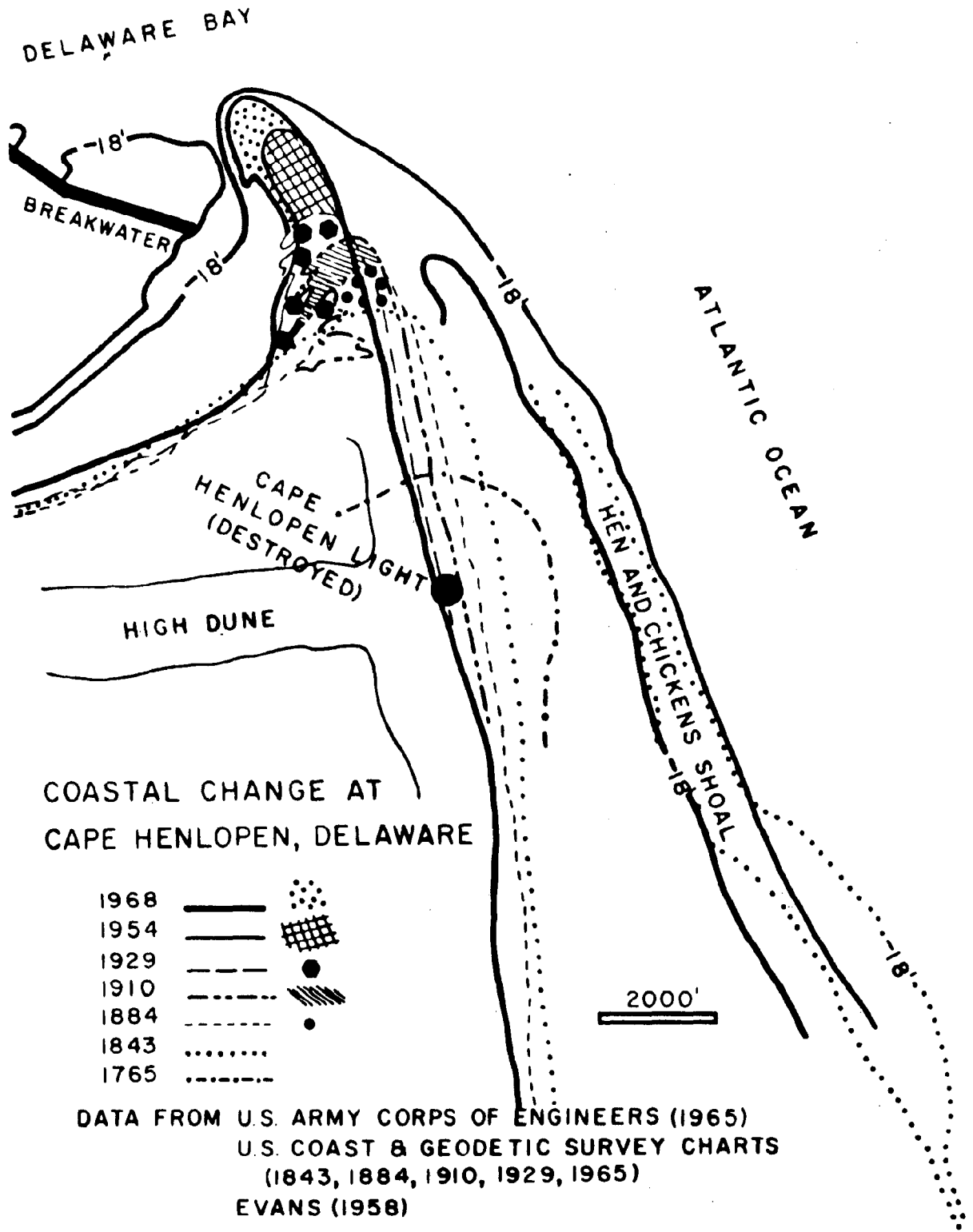


FIGURE 10

Interaction Between Dynamic Elements of Breakwater Harbor

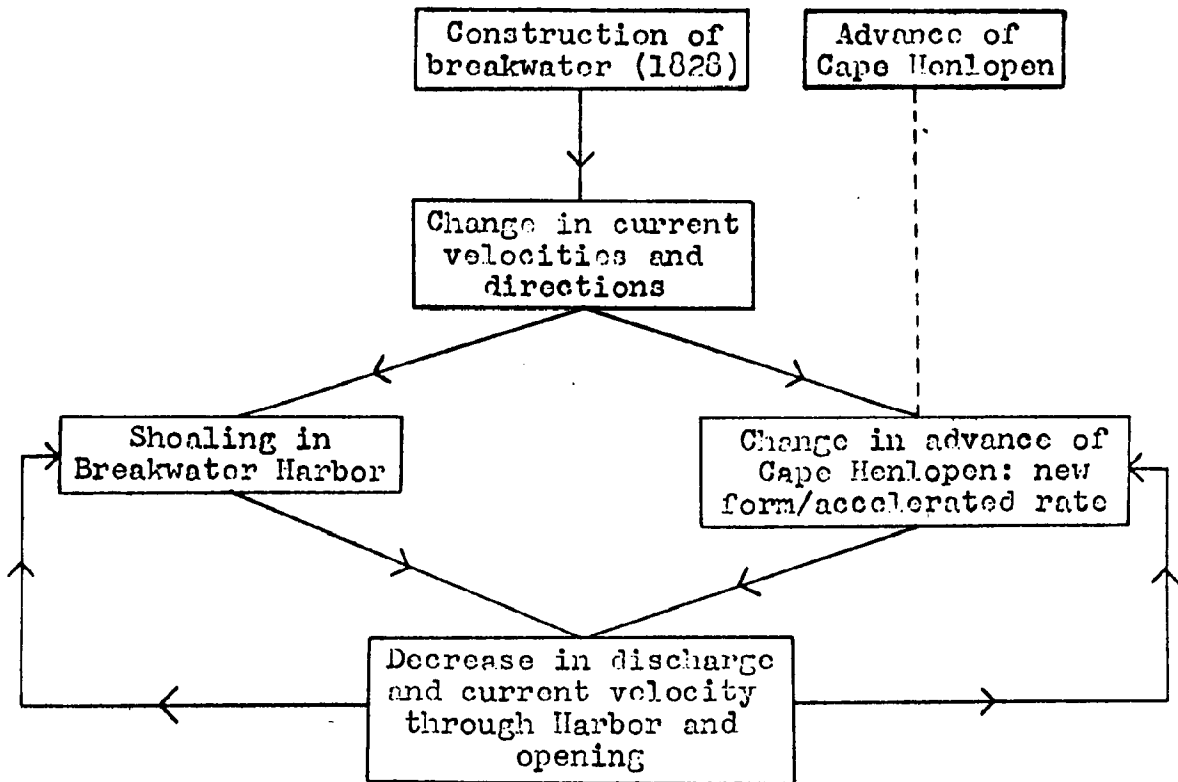


FIGURE 11

AVERAGE ANNUAL RATE OF COASTAL CHANGE ALONG CAPE HENLOPEN AND VICINITY

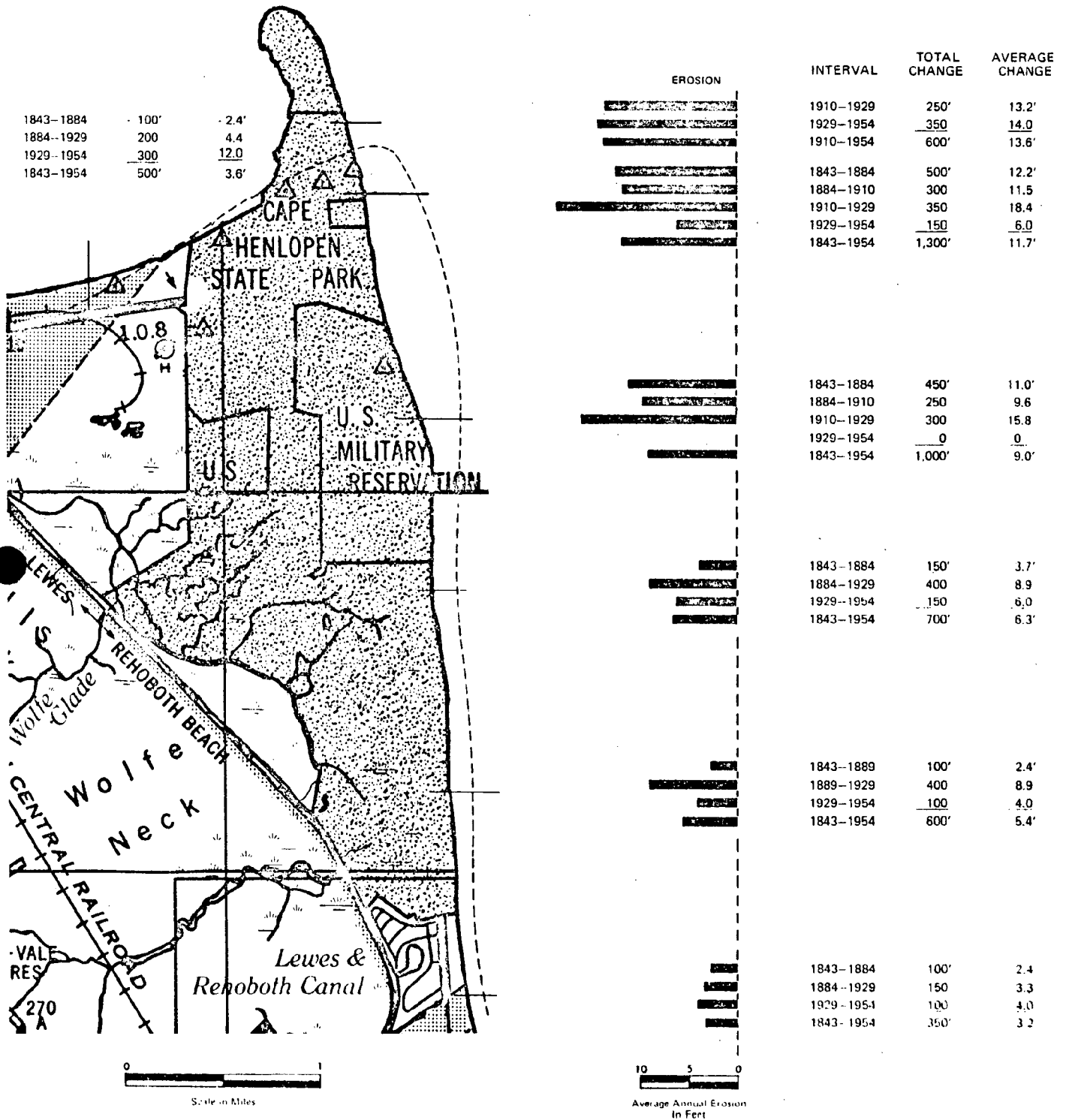
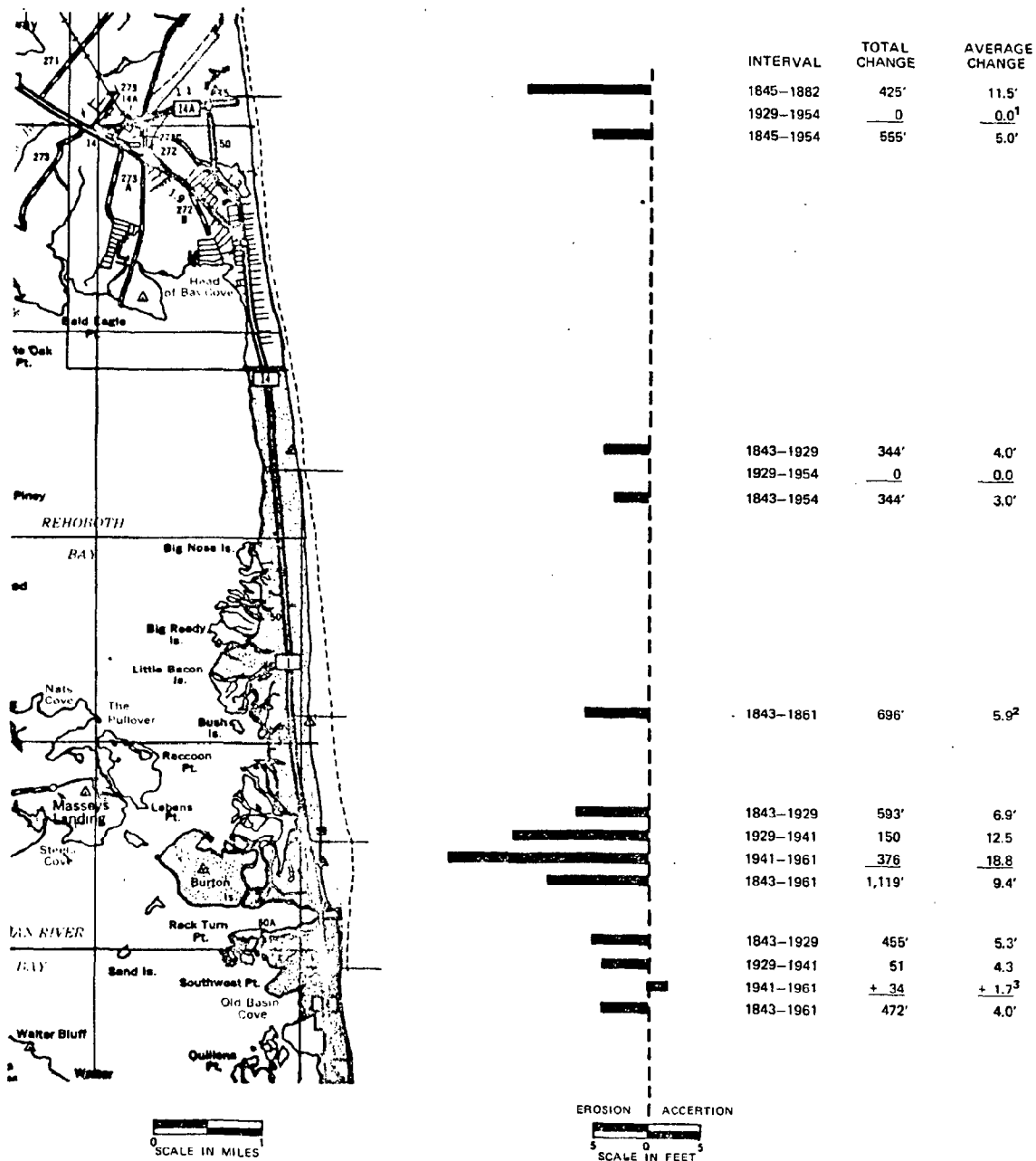


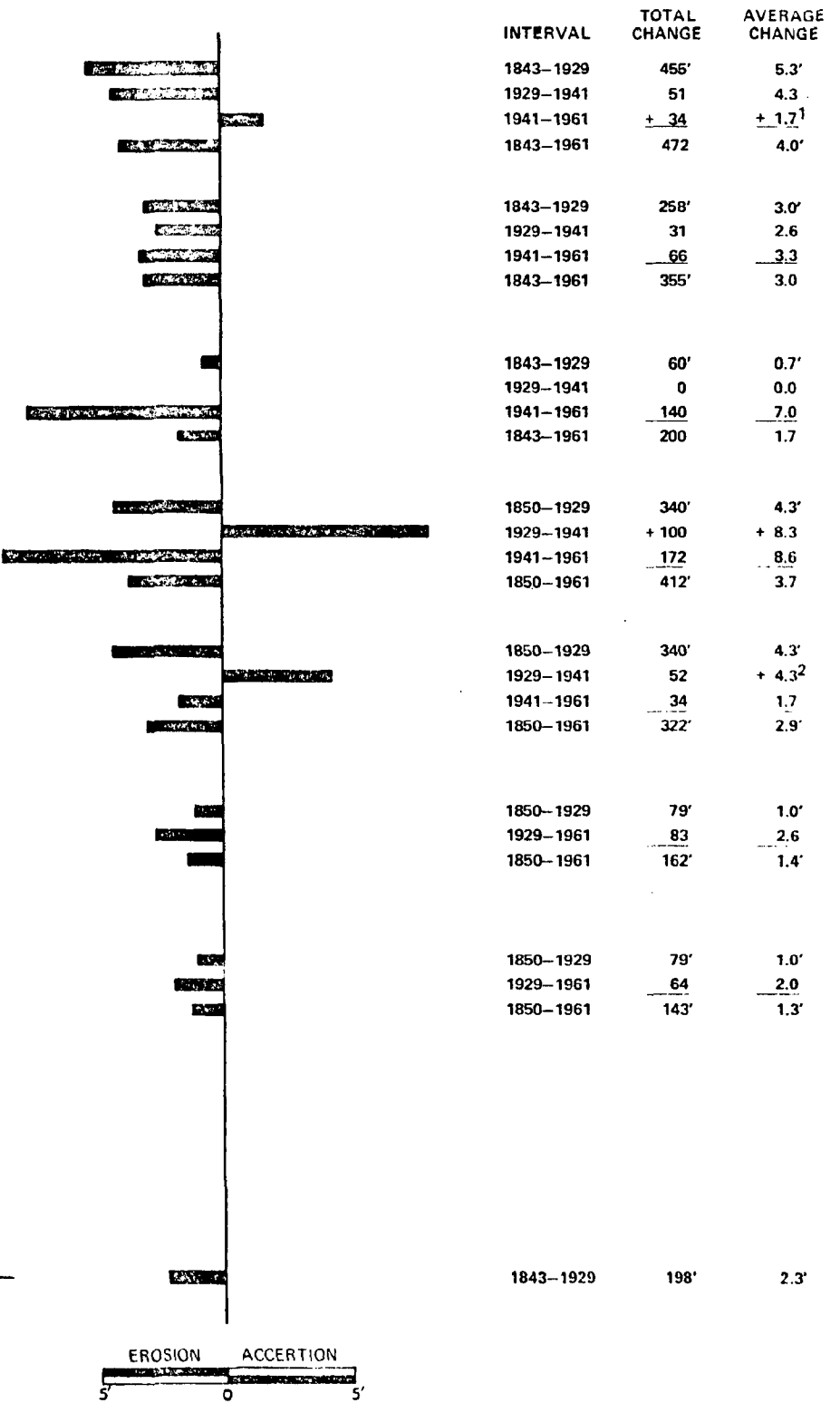
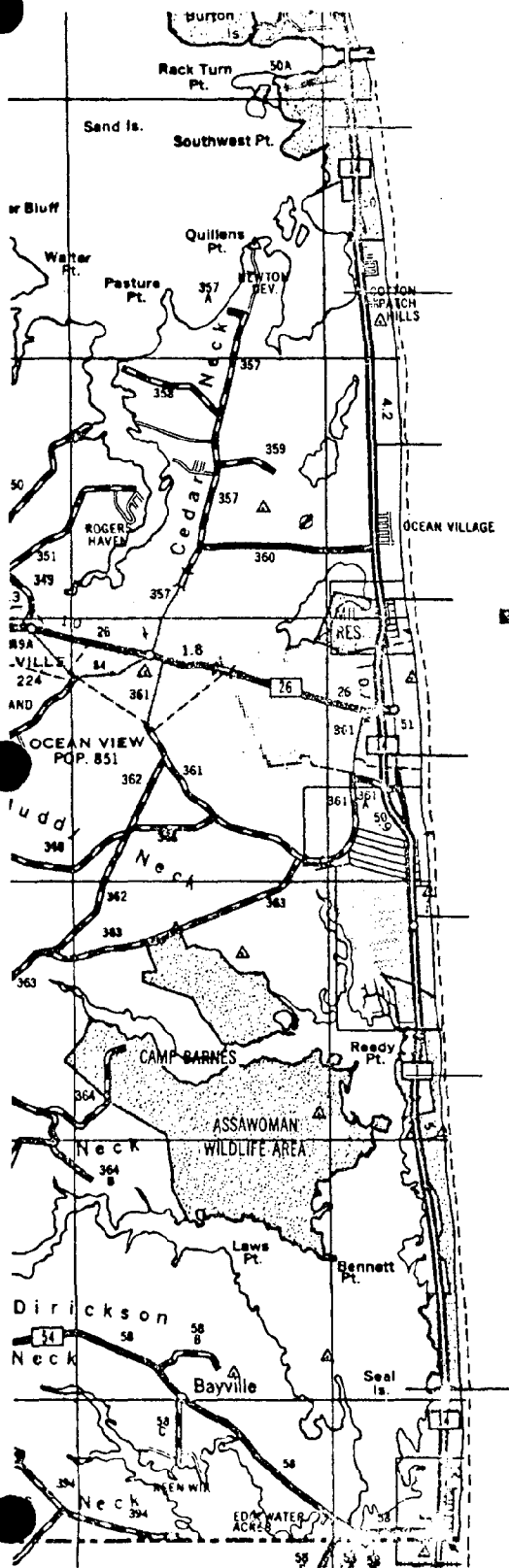
FIGURE 12
**AVERAGE ANNUAL RATE OF COASTAL CHANGE ALONG
 THE ATLANTIC COAST OF DELAWARE, FROM REHOBOTH BEACH
 TO INDIAN RIVER INLET**



NOTES

1. Six groins built at Rehoboth Beach (1922-1925) creating a stabilizing effect on shoreline during this interval (1929-1954).
2. Parallel jetties built in 1939 at Indian River Inlet. Sediment supply cut off, resulting in accelerated erosion on north (down drift) side of jetties. Army Corps of Engineers approved beach nourishment program in 1973 to forestall damage to Route 14.
3. Accretion south of jetties as sand in littoral system parallel to coast (from North to South) is trapped by obstruction.

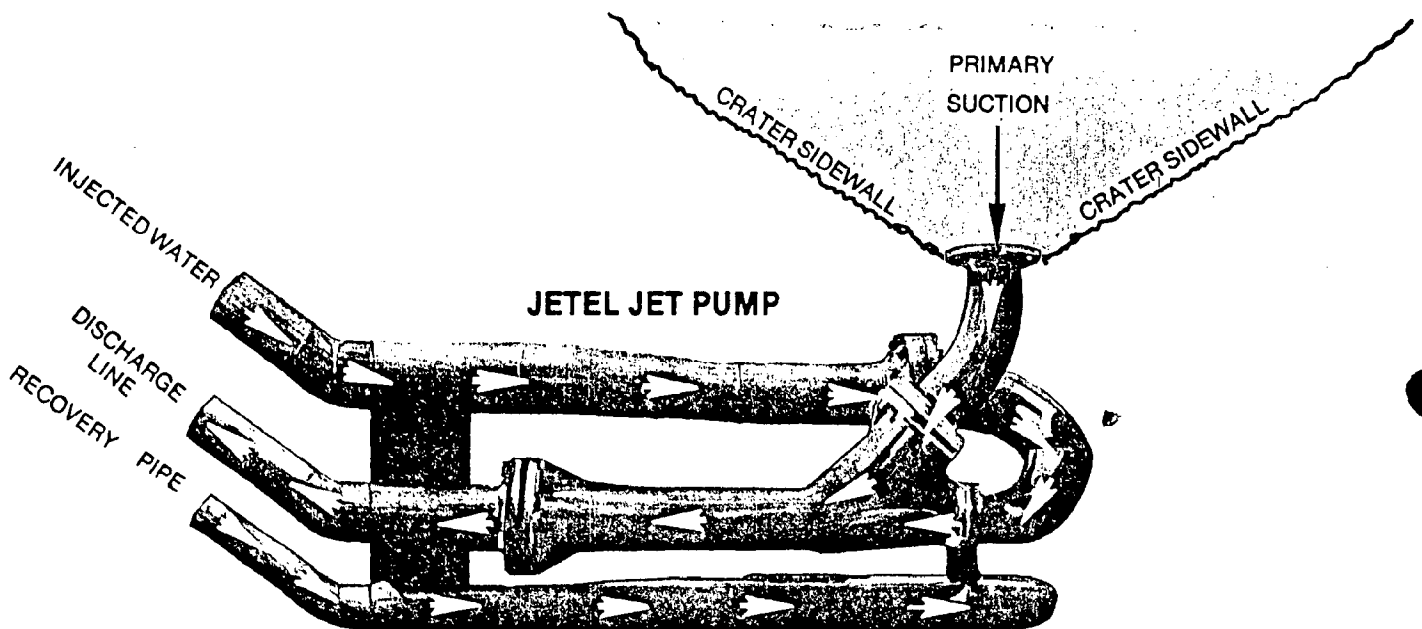
AVERAGE ANNUAL RATE OF COASTAL CHANGE ALONG THE ATLANTIC COAST OF DELAWARE, FROM INDIAN RIVER INLET TO FENWICK ISLAND



¹ Accretion south of jetties as sand moving in littoral system parallel to coast (from south to north) is trapped by obstruction.

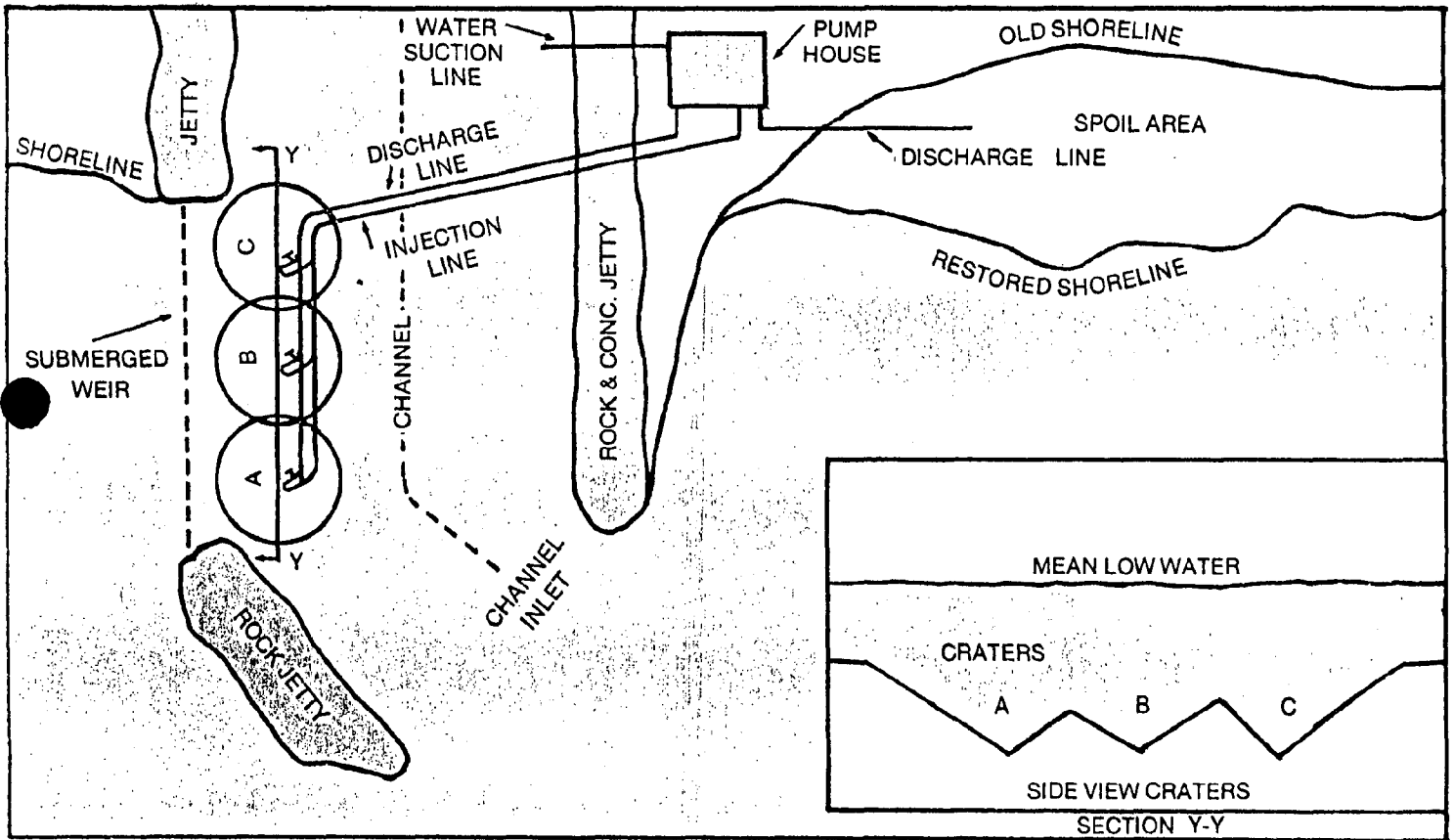
² Four groins constructed in 1938 at Bethany Beach; trap sand (transported from south) to create a "bulge" effect.

FIGURE 14



HOW A JET PUMP OPERATES: A high pressure stream of water is injected through a nozzle into the venturi section of the jet pump. This reduces the pressure inducing a flow of sand and water into the primary suction of the jet and provides the energy for transporting the solids water slurry out of the discharge. This design allows the jet pump to operate effectively even when buried under 15-20 feet of sand. (Courtesy of Charles Pekor, Jet Systems, Inc.).

FIGURE 15



Typical installation of a series of jet pumps for bypassing sand across inlets. (Courtesy of Charles Pekor, Jet Systems, Inc.).



Photo 1. Drowned forest exposed in surf zone by storm erosion of overlying sand - south of Dewey Beach.



Photo 2. Coast Guard Station north of Indian River Inlet (Note washover fans in upper left) - March 1962.

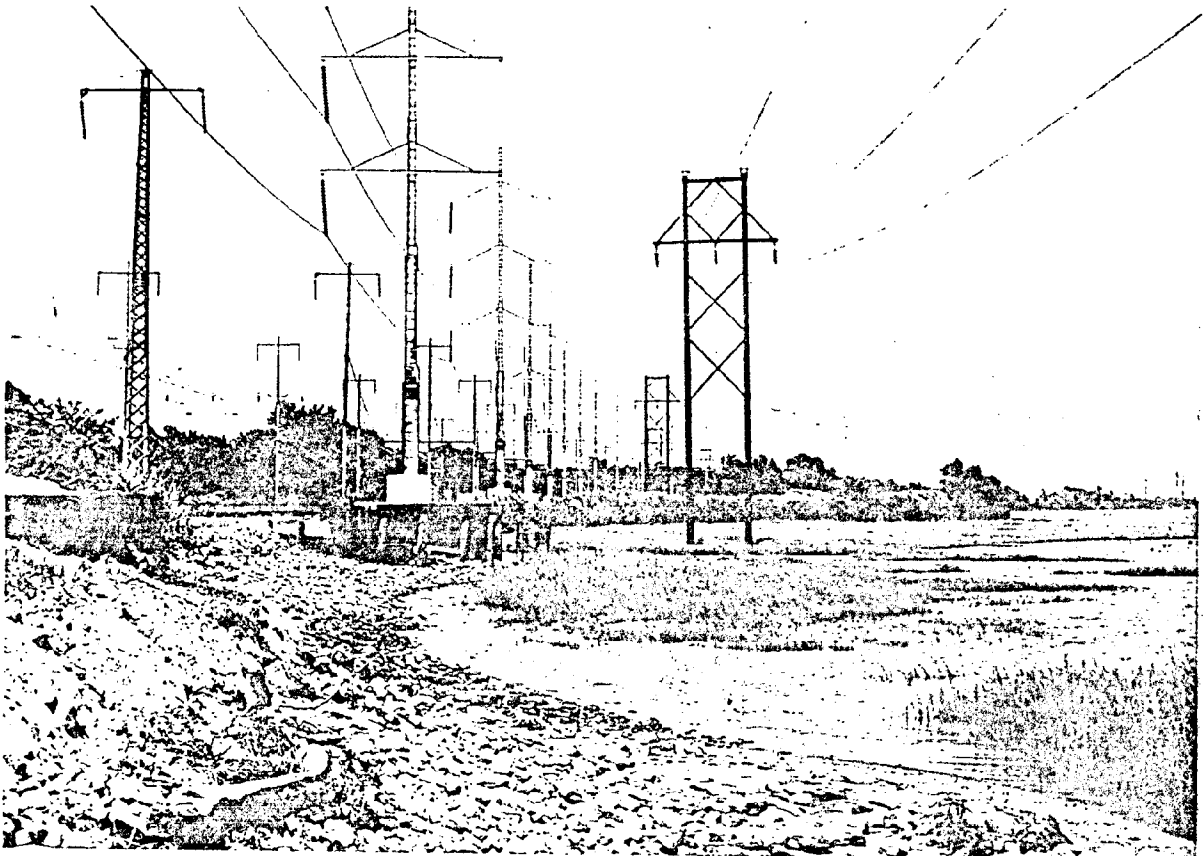


Photo 3. Photograph at Holly Oak near Wilmington, a natural marsh on the narrow coastal plain abutting rocky fill of the Penn Central system.

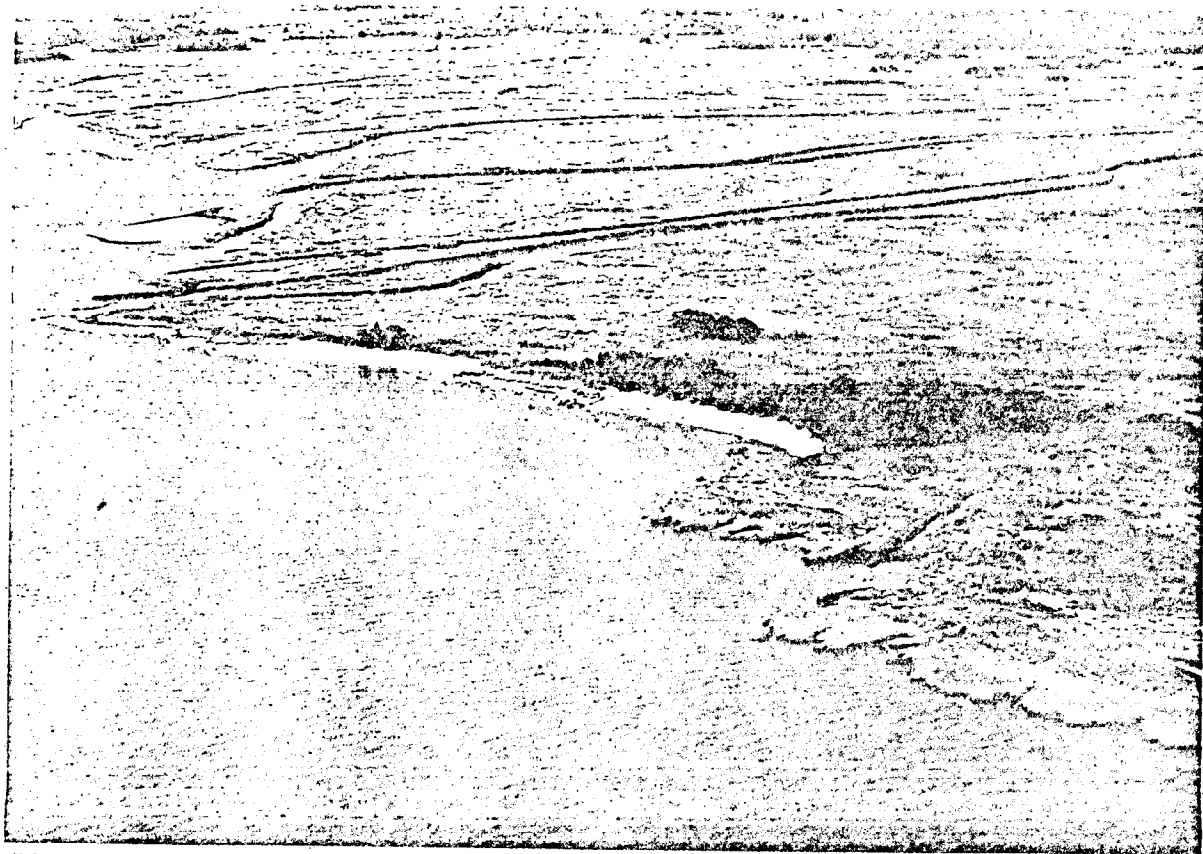


Photo 4. Aerial photograph of Bakeoven Point showing the northern Bay shoreline (zone 3) of broad marsh with minor, isolated sandy barriers.

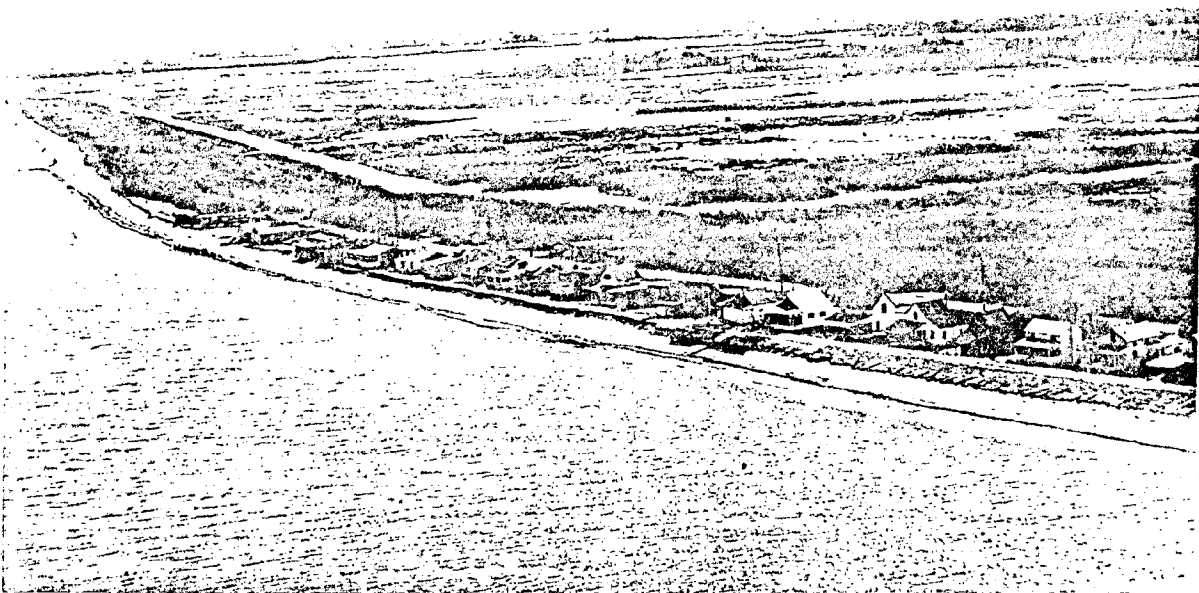


Photo 5. Aerial photograph of Primehook Beach (Shorts Beach) showing a bay town situated on a sand barrier. This is a zone 4 shoreline of continuous sandy barriers.

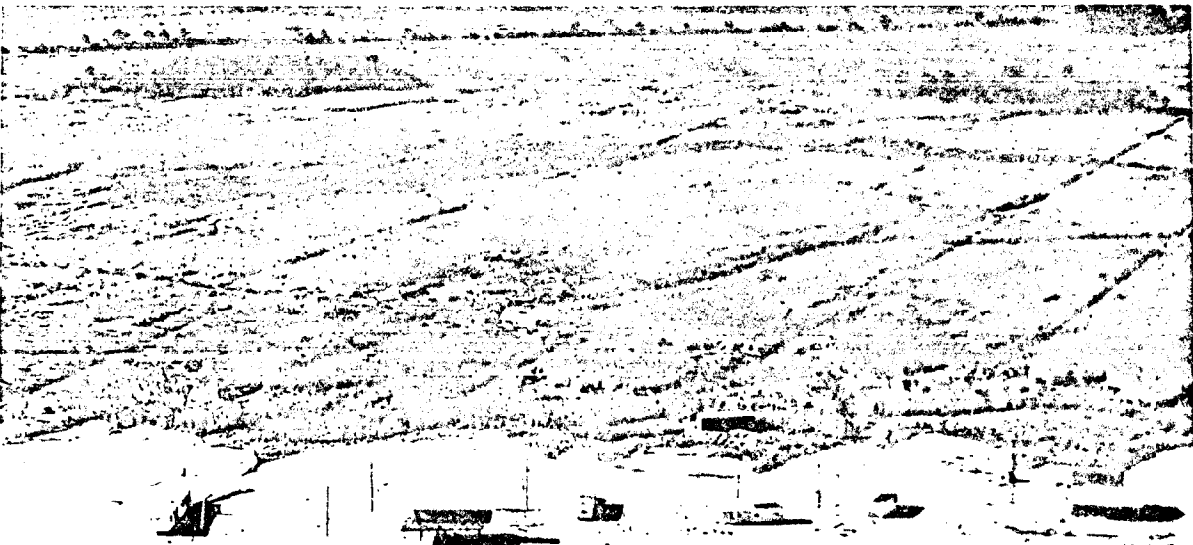


Photo 6. Aerial photo of Broadkill Beach area, Delaware Bay, following the December 1974 storm. Breached dunes and washover fans are typical consequences of even mild storms.

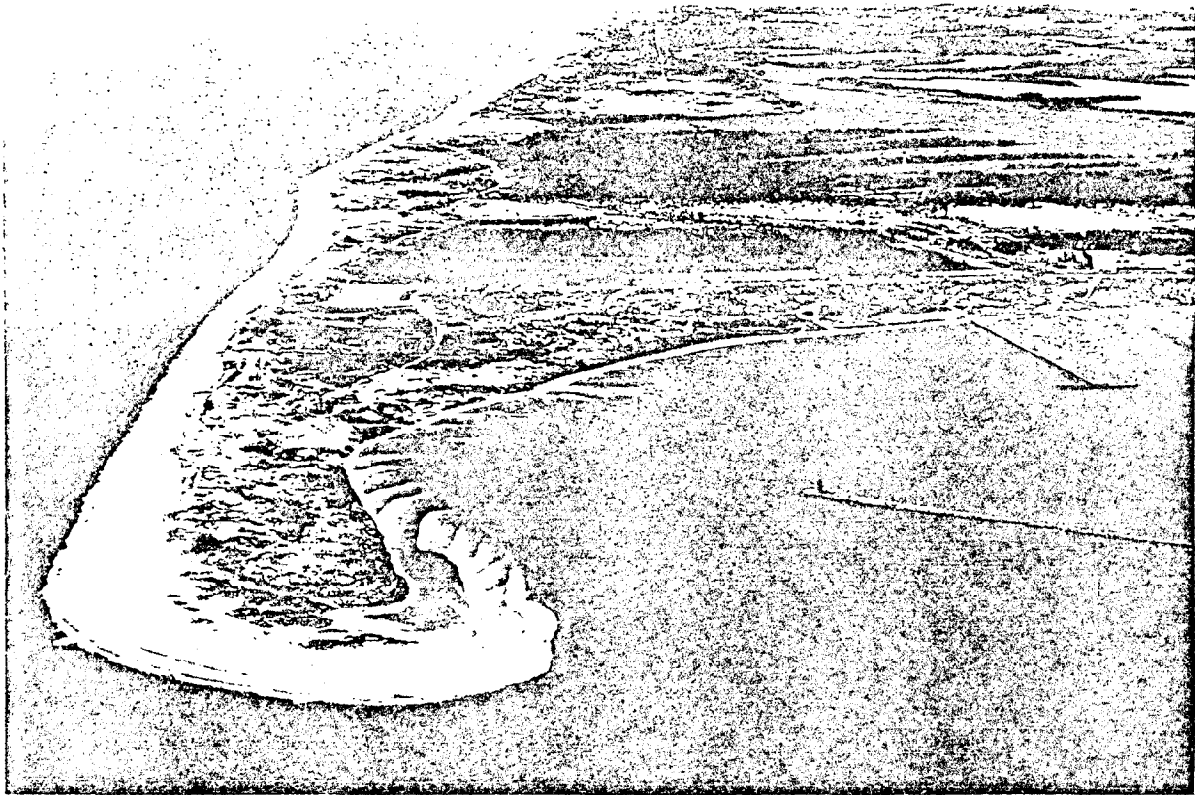


Photo 7. View of Cape Henlopen looking south. Growth rings of sand and gravel at the tip of the Cape indicate that the Cape is building toward the north and northwest. Waves refracting around the spit tip generate swash bars that migrate across the tidal flat.

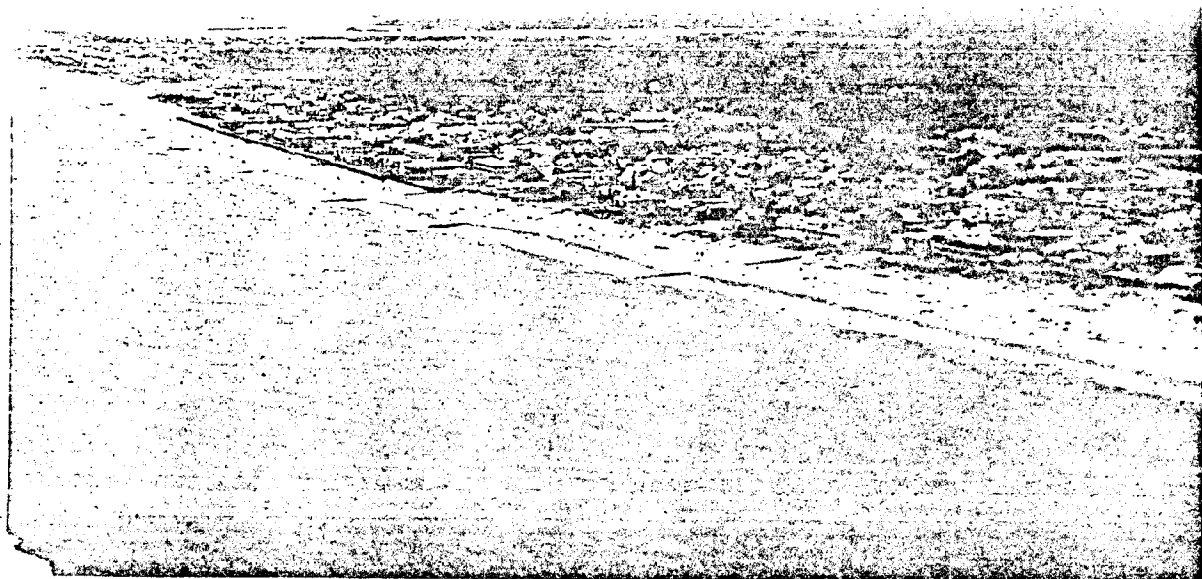


Photo 8. Groins at Rehoboth Beach. Note the accretion of sand on the southern side of the groins and erosion on the northern side. The shoreline bulges at the groin field.

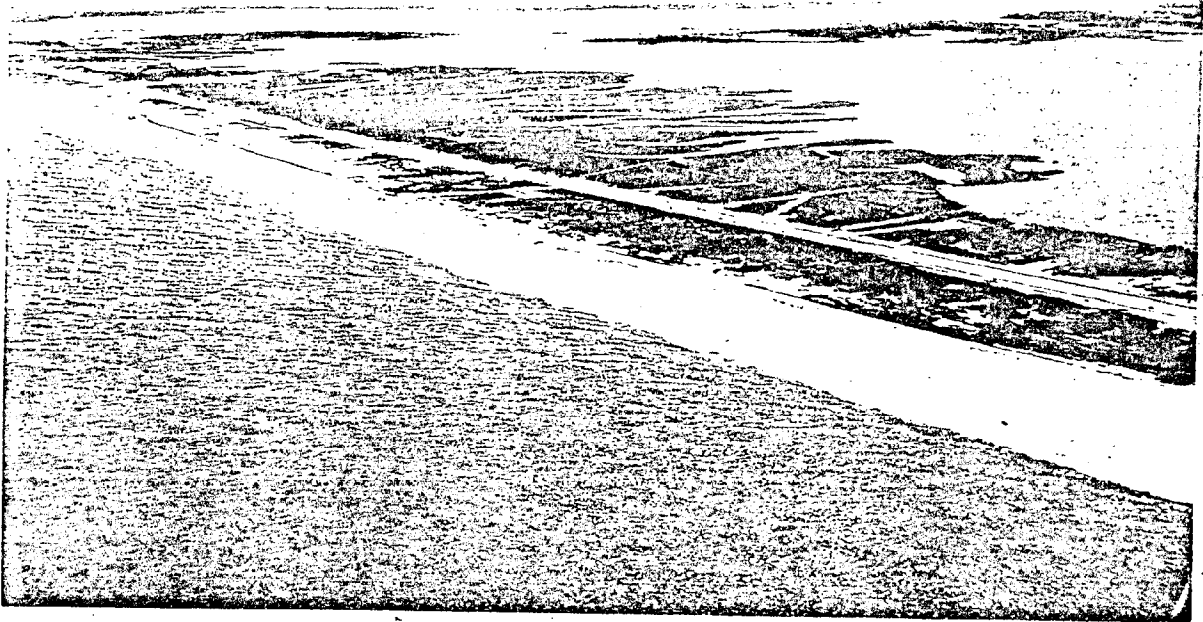


Photo 10. Abandoned tidal channels and the presently marsh-covered former tidal delta-inlet area in Rehoboth Bay.

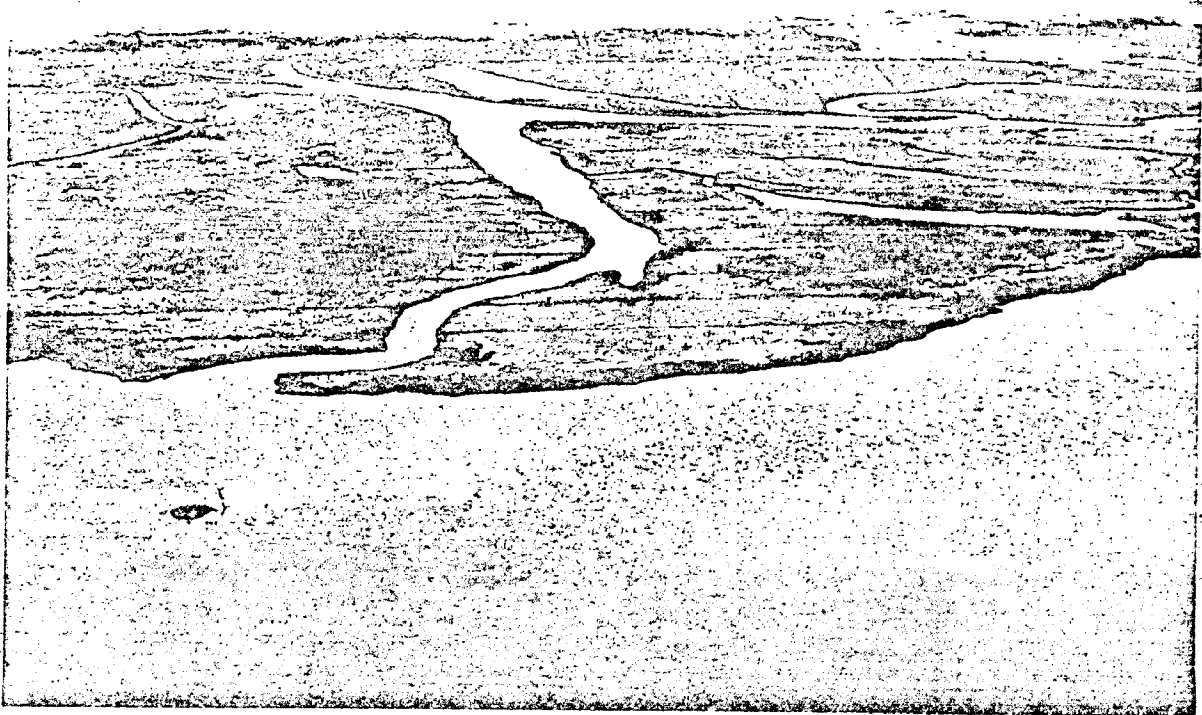


Photo 11. An eroding cliff at Thompsons Island, at the northern shore of Rehoboth Bay.

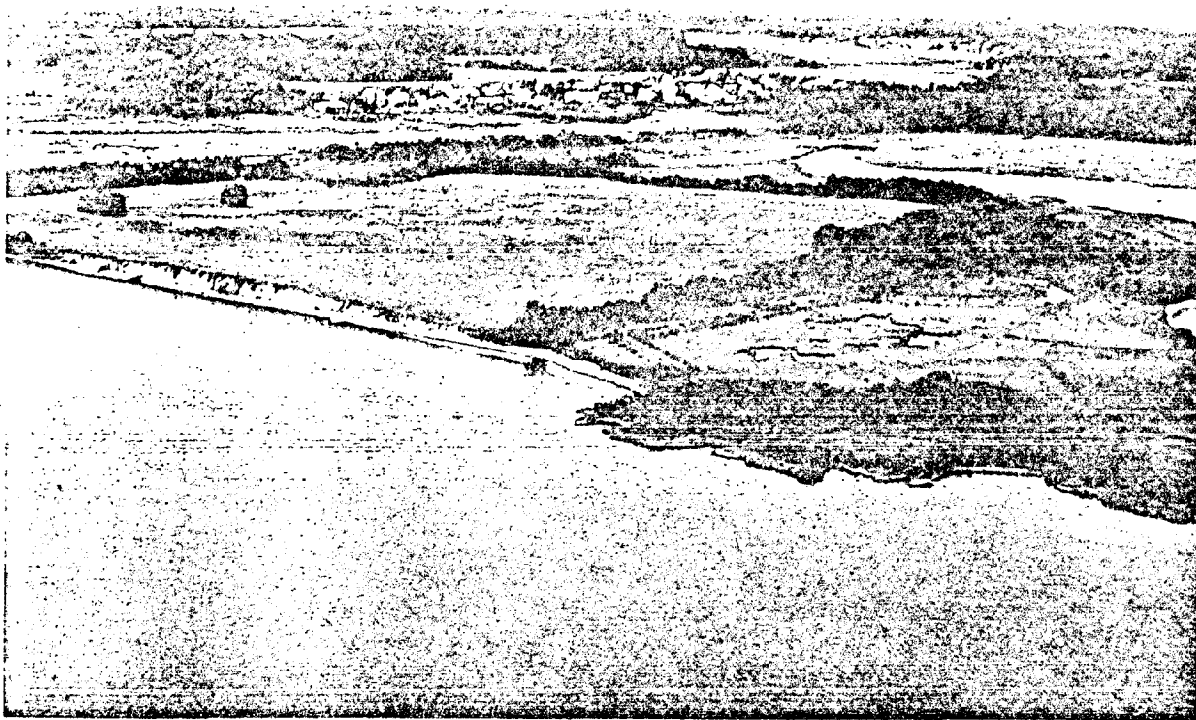


Photo 9. The Atlantic baymouth barrier looking southward from Dewey Beach. Rehoboth Bay is seen in the background. Between the bay and the barrier is the ancient tidal delta-inlet complex covered with back-barrier marsh.

Appendix A

Beach Preservation Act of 1972

CHAPTER 566

FORMERLY SENATE SUBSTITUTE
NO. 1 FOR SENATE BILL NO. 732

AN ACT TO AMEND TITLES 17 AND 7, DELAWARE CODE, TO TRANSFER BEACH EROSION CONTROL FROM THE DEPARTMENT OF HIGHWAYS AND TRANSPORTATION TO THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL; TO PROVIDE PENALTIES FOR DAMAGING OF BEACHES AND TO AUTHORIZE THE SECRETARY OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL TO ISSUE CEASE AND DESIST ORDERS TO PREVENT SUCH DAMAGE; TO AUTHORIZE THE ISSUANCE OF BONDS TO FINANCE A REVOLVING FUND TO COMBAT BEACH EROSION AND PLEDGING THE FULL FAITH AND CREDIT OF THE STATE THEREFOR; AND TO MAKE A SUPPLEMENTAL APPROPRIATION.

Be it enacted by the General Assembly of the State of Delaware (three-fourths of all the members elected to each branch thereof concurring therein):

Section 1. Title 17, Delaware Code, is amended by striking section 142 and 143 thereof in their entirety.

Section 2. Title 7, Delaware Code, is amended by adding thereto a new chapter 68 to read as follows:

CHAPTER 68. BEACH EROSION CONTROL**§ 6801. Purposes**

The purposes of this chapter are to enhance, preserve, and protect the public and private beaches of the State of Delaware, to prevent beach erosion, to make certain acts destructive of beaches punishable as crimes, to prescribe the penalties for such acts, and to vest in the Department of Natural Resources and Environmental Control ("The Department") the authority to adopt such rules and regulations as it deems necessary to effectuate the purposes of this chapter.

§ 6802. Definitions

For purposes of this chapter:

(a) A "Beach" is that portion of the shore of any body of water which extends from the mean high water mark inland one thousand feet, or to a roadway for automobiles, whichever is closer.

(b) "Beach Erosion" or "Erosion" is the wearing away of a beach by water or the elements.

(c) An "Emergency" is the existence of beach conditions unreasonably dangerous to persons or property.

§ 6803. Authority to enhance, preserve, and protect beaches

(a) Authority to enhance, preserve, and protect public and private beaches within the State of Delaware shall be vested solely in the Department of Natural Resources and Environmental Control.

(b) The Department shall prevent and repair damage from erosion of public beaches. To this end, the Department shall, when it deems it necessary, provide, construct, reconstruct, and maintain groins, jetties, banks, dikes, dunes, bulkheads, seawalls, breakwaters, and other facilities or make any other repairs or take any other measures along or upon any public beach or shoreline area in this State. All structures, devices, and facilities existing now or in the future which are devoted to the enhancement, preservation, and protection of beaches shall be under the sole jurisdiction, management, and control of the Department.

(c) No substantial change in the existing characteristics of any beach shall be made without prior written approval of the Department.

(d) No dune buggy, truck, automobile, motorized bicycle, mechanized vehicle or machine shall be operated on any public beach except in accordance with rules and regulations promulgated by the Department.

(e) The Secretary of the Department shall, as soon as

practicable, promulgate rules and regulations to effectuate the purposes of this chapter.

(f) The authority of the Department shall extend to privately owned beaches whenever, in the judgment of the Governor, such dangerous conditions exist in a location specified by the Governor as to constitute an emergency. Before taking any action with respect to a privately owned beach, the Department shall, whenever practicable, give reasonable notice to the owner thereof that a condition of potential emergency must be corrected, and wait a reasonable period of time for the owner to correct the matter. If the owner does not correct the matter, the Department shall do so.

§ 6804. Cease and desist orders

The Secretary of Natural Resources and Environmental Control ("The Secretary") shall have the power to issue a cease and desist order to any person violating any provision of this chapter or rule or regulation promulgated pursuant thereto. Any such cease and desist order shall expire (1) after thirty (30) days from the date of its issuance, or (2) upon withdrawal of said order by the Secretary, or (3) when the order is superseded by an injunction, whichever occurs first.

§ 6805. Penalties

(a) Whoever, without authority from the Department, alters, moves, or carries away any substantial amount of beach material (including but not limited to sand or pebbles), groin, jetty, bank, dike, dune, bulkhead, seawall, breakwater, or any other facility, improvement or structure installed or maintained by the Department for enhancement, preservation, or protection of a beach, or violates any regulation duly promulgated pursuant to this Act, or violates a cease and desist order of the Secretary, shall be fined not less than \$100 nor more than \$5,000 or imprisoned for not more than two (2) years, or both, and, in addition, shall reimburse the Department for its reasonable expenditures in remedying damage created. The maximum penalties hereunder shall be imposed for a wilful or malicious violation.

(b) Justices of the Peace shall have original jurisdiction to hear and determine violations of this section.

§ 6806. Beach preservation fund

(a) A special fund is created in the State Treasury to be known as the "Beach Preservation Fund", hereafter referred to in this chapter as "The Fund".

(b) The Fund may be used as necessary to effectuate the purposes of this chapter.

(c) The balance of the Fund shall be at least \$1,000,000 at the beginning of each fiscal year after the effective date hereof. Such sums as are necessary to restore the Beach Preservation Fund to a balance of \$1,000,000 shall be appropriated annually from the General Fund or borrowed annually after fiscal year 1973 by the issuance of bonds or bond anticipation notes upon the full faith and credit of the State of Delaware as may be authorized within the annual Capital Improvement Program. Such bonds and notes shall be issued in accordance with the provisions of Chapter 74 of Title 29 of this Code. For purpose of identification, the bonds issued pursuant to such authorization may be known, styled, or referred to as "Beach Preservation Bonds of 1972."

§ 6807. Federal aid; other funds

The Department may cooperate with and receive moneys from the Federal government or any industry or other source. Such moneys received are hereby appropriated and made available for study and action directed at beach preservation.

§ 6808. Inconsistent laws superseded; all other laws unimpaired; certain uses are not authorized

All laws or ordinances inconsistent with any provision of this chapter are hereby superseded to the extent of the inconsistency.

§ 6809. Severability

If any provision of this chapter, or of any rule, regulation, or order promulgated thereunder, or the application of any such provision, regulation, or order to any person or circumstances shall be held invalid, the remainder of this chapter or any regulations or order promulgated pursuant thereto or the application of such provision, regulations, or order to persons or circumstances other

than those to which it is held invalid, shall not be affected thereby.

Section 3. The following are transferred to the Department of Natural Resources and Environmental Control to effectuate the purposes of this Act:

All funds allocated to the Department of Highways and Transportation for purposes of beach preservation by Volume 55, Chapter 167; Volume 56, Chapter 469; Volume 57, Chapter 299; Volume 58, Chapter 347, and not disbursed before the effective date hereof, along with personnel, equipment, records and resources of whatever kind allocated to or utilized for beach preservation by the Department of Highways and Transportation.

Section 4. The sum of \$62,270 is hereby appropriated to the Department of Natural Resources and Environmental Control for fiscal year 1973, to effectuate the purposes of this Act. This is a supplementary appropriation and funds hereby appropriated shall be paid out of General Fund moneys not otherwise appropriated. Funds hereby appropriated remaining unexpended shall revert to the General Fund on June 30, 1973.

Section 5. There is hereby appropriated to the Beach Preservation Fund the sum of \$1,000,000 or so much thereof as shall be received from the sale of bonds and notes thereafter authorized.

Section 6. The funds appropriated in section 5 of this act may be used as necessary to effectuate the purposes of Title 7, **Delaware Code**, Chapter 68. So much of the funds appropriated by this Act as shall be (1) necessary and (2) reimbursable from the United States Army Corps of Engineers, but not more than \$500,000, shall be used immediately to dredge the Indian River Inlet and to fill the beach north of the inlet jetty to protect the inlet bridge and Route 14.

Section 7. The said sum of \$1,000,000 shall be borrowed by the issuance of bonds and bond anticipation notes upon the full faith and credit of the State of Delaware. Such bonds and notes shall be issued in accordance with the provisions of Chapter 74, Title 29, **Delaware Code**, and Chapter 75, Title 29, **Delaware Code**, where applicable. For purposes of identification, the bonds

issued pursuant to this authorization act may be known, styled or referred to as "Beach Preservation Bond of 1972".

Section 8. There is appropriated from the General Fund of the State of Delaware such sums as may be necessary for the expenses incident to the issuance of the bonds and notes herein authorized, and such further sums as may be necessary to pay any interest which becomes due on such bonds and notes during the current fiscal year and such further sums as may be necessary for the payment of the expenses incident to the issuance of bonds and notes and for the interest and payment of said notes shall be signed by the Secretary of State by and with the approval of the issuing officers. Any moneys received from the premium and accrued interest on the sale of said bonds shall be deposited to the credit of the General Fund.

Section 9. The budget appropriation bill which shall be enacted and approved by the General Assembly for the fiscal year next following the effective date of this Act and for each subsequent fiscal year shall contain under the debt service item provisions for the payment of interest and principal maturities of the bonds (or notes which are not to be funded by the issuance of bonds) issued under the authority of this Act, and such of the revenues of the State of Delaware as are not prohibited by constitutional provisions or committed by preceding statutes for other purposes are hereby pledged for the redemption and cancellation of said bonds and payment of interest thereon.

Section 10. This Act may be known, styled or referred to as the "Beach Preservation Act of 1972".

Approved July 22, 1972.

CHAPTER 254

FORMERLY: SENATE BILL NO. 213
AS AMENDED BY
SENATE AMENDMENT NO. 1
AND
HOUSE AMENDMENT NO. 1

AN ACT TO AMEND TITLE 7, DELAWARE CODE, TO GIVE THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL THE POWER TO EMINENT DOMAIN WHEN NECESSARY TO CARRY OUT THE PURPOSES OF CHAPTER 68.

Be it enacted by the General Assembly of the State of Delaware:

Section 1. Chapter 68, Title 7, Delaware Code, is amended by adding a new Section 6810 to read as follows:

§6810. Eminent domain

(a) The Secretary may, through negotiation or condemnation proceedings under Chapter 61, Title 10, Delaware Code, acquire the fee simple or any lesser interests in the land whenever: two thirds or more of the property owners of property included in the project area along a private beach, as defined by the Department, have agreed to allow the Department to undertake any or all necessary works to protect, and enhance the beaches; and allow free public access to the beach; providing, however, that the agreeing property owners own at least two-thirds of the property included in the project area.

(b) The Secretary may include the costs of obtaining any such fee simple or lesser interests including but not limited to, attorney's fees, appraisal costs, surveying charges, title search, and land acquisition costs in the total project costs.

(c) The authority granted in this section shall be limited in application to those beaches on the shores of the Delaware Bay."

Approved February 5, 1974.

Appendix B

Regulations Governing Beach Protection The Use of Beaches

The regulations contained herein are proposed modifications of those which were adopted in 1974 and which are currently in effect. This proposal was presented at a public hearing on August 30, 1978. As a result of that hearing, the Hearing Officer may recommend changes. If these recommended changes are significant, another public hearing will be scheduled before adoption by the Secretary. These proposed regulations are, therefore, still tentative and should be viewed from that perspective.

REGULATIONS GOVERNING BEACH PROTECTION
AND THE USE OF BEACHES

Beach Preservation Act of 1972
Department of Natural Resources
and Environmental Control
Soil and Water Division

Document # 10-003-78-07-11

SECTION 1. Definitions

As used in these Regulations, the following terms shall have the meanings indicated below, unless the text clearly indicates otherwise:

Act - means the Beach Preservation Act of 1972, (Title 7, Delaware Code, Chapter 68).

Artificial Nourishment - means the process of replenishing a beach with material (usually sand) obtained from another location.

Bank - means the rising ground bordering a lake, river or sea; on a river, designated as right or left as it would appear facing downstream.

Beach - means that portion of the shore of any body of water which extends from the mean high water mark inland one thousand feet, or to a roadway for automobiles, whichever is closer.

Beach Access Facility - means any structure, improvement or facility constructed, installed or maintained for the primary purpose of obtaining or facilitating access to and from the berm and foreshore of the beach over, on or across the primary coastal dune.

Beach Erosion - means the carrying away of beach materials by wave action, tidal currents, littoral currents, flooding, wind, or the action of humans.

Berm - means the nearly horizontal part of the beach between the foreshore and primary dune formed by the deposit of material by wave action.

Breakwater - means a marine structure constructed to protect a shore area, harbor, anchorage, or basin from the undesirable effects of wave action.

Building - means any roofed and walled structure built for permanent use.

Building Line - means a line established by the Division generally paralleling the coast and located 100 feet landward of the seaward 11-foot contour above the National Geodetic Vertical Datum along beaches extending from Roosevelt Inlet to the Delaware-Maryland state line. For those beaches between Roosevelt Inlet and Liston Point, building line shall mean a line established by the Division generally paralleling the coast and located 75 feet landward of the seaward 9 foot contour above the National Geodetic Vertical Datum. (See Sections 2.11 and 2.12 for Division procedures to establish the building line.)

Bulkhead - means an upright structure or partition built parallel or nearly parallel to the shoreline, to retain or protect land from beach erosion and damage from wave action.

Coastal Construction - means any work or activity which is likely to have a substantial physical effect on existing coastal conditions or natural shore processes.

Department - means the Department of Natural Resources and Environmental Control.

Design Storm - means a storm which produces a tide stage which has a calculated probability of occurrence of 1 percent in any given year. This tide elevation shall be based upon the Flood Insurance Rate Maps published by the Federal Insurance Administration.

Dike - means a wall or mound built around a low lying area to prevent flooding.

Division - means the Division of Soil and Water Conservation of the Department of Natural Resources and Environmental Control.

Dune - means a mound, hill or ridge of windblown sand or other earthen material either bare or covered with vegetation, naturally or artificially accumulated.

Primary Dune - See Page 3.

Emergency - means the existence of beach conditions unreasonably dangerous to persons or property.

Excavation - means the process of digging out material.

Filling - means the process of depositing or placing material to raise the level of a certain area.

Foreshore - means the part of the shore lying between the crest of the seaward berm (or upper limit of wave action at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall.

Geology - means the relationship of the earth and the materials of which it is composed, to the changes which it has undergone, is undergoing, or is likely to undergo.

Geomorphology - means the form and general configuration of the earth's surface and the changes that take place in the evolution of land forms.

Groin - means a shore protection and improvement structure built perpendicular or nearly perpendicular to the shoreline to trap littoral drift or retard the erosion of the shore.

Hydraulics - means the effects of water or other fluids in motion.

Jetty - means a structure extending into a body of water, and designed to prevent shoaling of a channel by littoral materials, and to direct and confine the stream or tidal flow.

Littoral Current - means a longshore current generated by waves breaking at an angle to the shoreline, and which moves generally parallel to and adjacent to the shoreline within the surf zone.

Meteorology - means the atmosphere and its phenomena especially as relating to weather.

Person - means any legal entity including individual, firm, association, organization, partnership, business trust, corporation, company, contractor, user, operator, owner, or any State or local governmental agency (except as noted in Section 2.04) or public district or any officer or employee thereof.

Primary Dune - means that dune which roughly parallels the shoreline in a more or less continuous fashion and is generally the first and largest dune encountered moving landward from the shoreline.

Public Beach - means any beach owned in fee simple title by the federal or state government or any county, city, town or municipality.

Revetment - means a facing of stone, concrete, or similar material built to protect a bank, embankment, or shore structure against erosion by wave action or currents.

Roadway - means any improved roadway in existence on the effective date of the Act.

Sand Fence - means a barrier made of posts, wires and boards or synthetic materials including plastic, nylon and polyester intended primarily to trap and collect wind-blown sand, but which may also be used to channel human and vehicular traffic.

Seawall - means a massive structure separating land and water areas, primarily designed to prevent erosion and other damage due to wave action.

Secretary - means the Secretary of the Department of Natural Resources and Environmental Control.

Shoreline - means the intersection of the sea with the land. The line delineating the shoreline on National Ocean Survey nautical charts and surveys approximates the mean high water line at the time of the survey.

Structure - means any house, commercial establishment, groin, jetty, seawall, bulkhead, revetment, or any other piece of work artificially built.

Substantial Amount - means any amount, the moving, alteration, or removal of which could significantly increase danger of erosion, storm damage or flooding.

Substantial Change - means any alteration in the existing characteristics of the beach, as determined by the Secretary, that could significantly increase the danger of erosion, storm damage or flooding and includes the moving,

digging, or removal of beach material or the erection of any permanent or semi-permanent structure.

SECTION 2. Administrative Principles

2.01 The primary purpose of these regulations is to enhance, protect, and preserve public beaches of the State. Private beaches may come under the purview of the regulations only under the following conditions: (1) where activities on any private beach may adversely affect any public beach or another private beach owned by a different owner; (2) where dangerous conditions exist on any privately owned beach which constitute an emergency; or (3) where private beach owners request the assistance of the Department to enhance, protect or preserve their beaches and are willing to allow free public access to such beaches in return for such assistance.

The authority for State regulation of private beaches in accordance with this principle is derived from the Beach Preservation Act, most notably Sections 6301, 6303(c), 6303(f), and 6310.

2.02 No person shall commence or conduct any work for which a permit is required unless and until approval and the proper permit has been issued.

2.03 These Regulations shall not apply to any projects for which on-site construction has begun, as determined by the Division, prior to the effective date of these Regulations. (, 1978), however, those regulations in effect at the time of commencement of on-site construction shall apply.

- 2.04 The Department, in the performance of its duties pursuant to the authority granted by the Beach Preservation Act of 1972 (Title 7, Delaware Code, Chapter 68), shall be exempt from the requirements of these Regulations.
- 2.05 In the event of the partial or complete destruction of any structure seaward of the building line, no person shall undertake any restoration of the structure without a permit from the Division. In cases of extreme urgency involving grave and imminent danger of major harmful consequences, those measures necessary for safety of persons or property may be taken.
- 2.06 The Department may exempt by procedure set forth in Section 10, those portions of the statutory beach area, the utilization of which shall not adversely affect the enhancement, preservation or protection of the beach, in accordance with the purposes of the Act.
- 2.07 All structures, devices and facilities for the enhancement, preservation or protection of beaches shall be under the sole jurisdiction of the Department. None of these shall be changed in any way except as provided in these Regulations.
- 2.08 The Division, in considering applications, shall take into account the geology, geomorphology, meteorology and hydraulics of the area.
- 2.09 If any part of these Regulations or its application is held invalid or unconstitutional, the application of the part to other persons or circumstances and the remainder of these Regulations shall not be affected.

2.10 A permit obtained under these Regulations does not exempt the applicant from obtaining any permits required pursuant to law other than the Beach Preservation Act or these Regulations.

2.11 The Division shall establish the building line by comprehensive field shoreline where privately owned structures, whether existing or potential, may be affected by the establishment of the building line. Each station shall be carefully surveyed and referenced to the State Plane Coordinate System. The appropriate seaward contour above the National Geodetic Vertical Datum shall be established by connecting the appropriate elevations between stations with a straight line. Except as provided in Section 2.12, this line shall remain fixed for a period of five years, at which time the building line shall be resurveyed. Between the effective date of these regulations (, 1973) and establishment and adoption of the building line or portion thereof by the Division, the appropriate contour elevation shall be provided by the applicant.

2.12 When, in the opinion of the Secretary, storms or other natural phenomena cause a substantial change in the seaward contour used to establish the building line, the Division shall reestablish the building line by survey.

SECTION 3. Prohibited Activities

3.01 Construction

The construction of any dwelling, commercial establishment or other

building on any parcel of land sub-divided after the effective date of these Regulations (, 1978) and which contains insufficient space to construct a lawful structure landward of the building line in accordance with the minimum requirements of any applicable zoning, subdivision or building code duly established by a local unit of government shall be prohibited, unless the Division determines in writing that: (1) such construction or reconstruction does not threaten the enhancement, preservation or protection of beaches; and (2) such structure or facility requires a beach location to reasonably utilize the structure or facility for its intended purpose. Such structures may include, but not necessarily be limited to boardwalks, pipelines, piers, docks, wharves, boat ramps or other harbor works. In the case of such a determination by the Division, a permit shall be required pursuant to Section 4.02(c). A permit for such construction must be obtained pursuant to the procedure set forth in Section 6.

See Section 4.02 for permit requirements for parcels that are entirely or almost entirely seaward of the building line.

3.02 Other Activities

The following activities are prohibited:

a. the operation of any motorized vehicle or machine on, over or across the primary dune on any State-owned beach except at those locations specified by the Department for such use (see current State Parks Rules and Regulations for additional rules).

b. walking on, over or across the primary dune on any State-owned beach except at those locations specified by the Department for such use;

c. the alteration, moving or removal of any facility, improvement or structure installed or maintained by the Department for enhancement, preservation or protection of any beach; or

d. the damaging, destruction or removal of any trees, shrubbery, beach grass or other vegetation growing on any State-owned or maintained beach.

SECTION 4. Activities Requiring a Permit from the Division

4.01 Construction or Placement of Shore Protection Structures or Facilities

No person shall, without a permit therefor from the Division, commence or conduct construction, reconstruction or alteration of any structure or facility on any beach, the primary function of which is beach protection or erosion control including, but not limited to, groins, jetties, seawalls, breakwaters, revetments, bulkheads, and beach nourishment; except that ordinary dune maintenance, as determined by the Division, including the proper installation of sand fence and the planting and fertilization of stabilizing vegetation, shall not require a permit. Procedures for permit applications for these activities are contained in Section 5.

In rendering its decision, the Division shall make a determination regarding the potential adverse effects of the proposed structures. If, in the opinion of the Division, the potential for damage to the subject beach or adjacent beaches is increased as a result of the proposed structure, the Division may require the applicant to take mitigating measures (including, but not limited to beach nourishment, dune maintenance, dune construction) to reduce such damage. When the

Division requires such mitigating measures, the applicant, his heirs and assigns, shall be required to maintain these measures for the life of the structure. Failure to comply with the mitigating measures prescribed by the Division shall be cause for removal of the structure and restoration of the beach to its original condition at the owner's expense.

4.02 Other Construction Activities Seaward of the Building Line

a. Notwithstanding any prior or existing subdivision, zoning ordinance or building code, no person without a permit from the Division shall commence construction, reconstruction or alteration of a dwelling, commercial establishment or any other building seaward or partially seaward of the building line established pursuant to these regulations. Construction shall be barred from the seaward area of the building line when a structure could be constructed landward of the building line by modification of design, placement or reduction in size, with minimum standards under pertinent zoning ordinances and building codes being met.

b. If, through sudden or gradual change in the geomorphology of the coastline, the Department finds it necessary to redefine the building line, structures to be constructed or reconstructed on lots lawfully created in accordance with these Regulations, but which thereafter contain insufficient space to construct a lawful structure landward of the newly established building line in accordance with the minimum requirements of any applicable zoning, subdivision or building code, shall thereafter require a permit.

c. A permit shall also be required for the construction or reconstruction of any pipeline, dock, pier, wharf, ramp or other harbor

works which transect any beach or which may increase beach erosion on a subject beach or any adjacent beach.

d. In rendering its decision, the Division shall make a determination regarding the potential adverse effects of the proposed structure. If, in the opinion of the Division, the potential for damage to the subject beach or adjacent beaches is increased as a result of the proposed structure, the Division may require the applicant to take mitigating measures (including, but not limited to beach nourishment, dune construction, dune maintenance) to reduce such damage. When the Division requires such mitigating measures, the applicant, his heirs and assigns, shall be required to maintain these measures for the life of the structure. Failure to comply with the mitigating measures prescribed by the Division shall be cause for the Division to take the necessary actions to bring the owner into compliance and to place a lien on such property for all reasonable costs and expenses incurred by the Division.

e. Issuance of a permit under this section will be conditional upon the application meeting basic design criteria established to provide protection of the structure during the design storm, as determined by the Division. Procedures for permit applications under this section are contained in Section 6.

4.03 Other Activities

a. No person shall commence or conduct any of the following activities on any beach without a permit therefor from the Division: the alteration, digging, mining, moving, removal or deposition of any substantial amount of beach or other materials or removal of vegetation on any beach seaward of the building line which may affect

enhancement, preservation or protection of beaches. Procedures for permit applications under this section are contained in Section 5.

b. No person shall commence or conduct construction of any beach access facility without a letter of approval therefor from the Division. Procedures for requests for letters of approval are contained in Section 4.04.

c. In rendering its decision, the Division shall make a determination regarding the potential adverse effects of the proposed activity. If, in the opinion of the Division the potential for damage to the beach or adjacent beaches is increased as a result of the proposed activity, the Division may require the applicant to take mitigating measures (Including, but not limited to dune maintenance, dune construction) to reduce such damage. When the Division requires such mitigating measures, the applicant, his heirs and assigns, shall be required to maintain these measures for the life of the activity. Failure to comply with the mitigating measures prescribed by the Division shall be cause for termination of the activity and restoration of the beach to its original condition at the expense of those persons conducting the activity.

4.04. Construction Activities Landward of the Building Line and Within the Beach Area

No person shall commence or conduct construction within the Beach area landward of the building line without a letter of approval therefor from the Division. To obtain the written approval, the applicant shall furnish to the Division:

a. A letter requesting the approval, containing:

1. legal name and mailing address of the applicant and, if the applicant is a corporation, the name of the principal officer or agent;

2. date;

3. location of work including city or town or a statement that it lies outside a city or town, development, block or section;

4. description of work including all construction methods that may affect the land; and

5. signature of the owner or proprietor of the land upon which the work is to take place, or his authorized agent (with evidence of the authorization).

b. a plan view drawn to scale, with the scale graphically shown, showing the location of the proposed structures, any existing structures on this property, lot lines and all relevant dimensions and distances.

c. a cross-sectional view of the project drawn to scale, showing the existing ground profile before construction and the proposed ground and structure profile of the structure after construction. Show all relevant dimensions and distances, and elevations above an established Government datum plane at the locality. This plane is usually mean low water (MLW) or National Geodetic Vertical Datum (NGVD).

d. a facsimile copy of the deed to the property.

e. any additional information requested by the Division which it deems necessary to determine the effects on beach enhancement, preservation or protection.

Upon receipt of an application for approval, the Division shall consider the effect of the proposed project on beach enhancement, preservation and protection. The Division may undertake any investigation or activity it deems necessary to carry out the purposes of this Act. If the Division determines such a project may have a substantial effect on beach enhancement, preservation and protection, the applicant shall follow application procedures as outlined in Section 6 and be subject to the fee in Section 4.05. The Division shall make a decision on the application that may include terms and conditions which it determines will best implement the purposes of the Act and these Regulations. The Division shall give written notice with reasons to the applicant.

4.05 Miscellaneous

All proposed structures for which a permit is required under Sections 4.01, 4.02, and 4.03(a) shall be: (1) subject to a permit fee of \$150; and (2) certified by a registered professional engineer. This certification shall indicate that all structures were designed according to sound engineering principles and practice and with due consideration of natural forces and conditions which may be expected to be encountered at the site during the design storm.

SECTION 5. Procedures for Permit Application for Construction or Placement of Shore Protection Structures or Facilities

5.01 Application Contents

An application for a permit shall be filed with the Division and shall consist of the following:

- a. a letter requesting the permit;
- b. a project location map;
- c. a plan showing the extent and character of the project.

5.02 Letter of Application

The letter of application shall including the following:

- a. legal name and mailing address of the applicant. If the applicant is a corporation, the name of the principal officer or agent;
- b. date;
- c. name of waterway on which or adjacent to which the work is to take place;
- d. location of work, including the city or town within which the work lies, or a statement that it lies outside of the limits of a city or incorporated town;
- e. description of work;
- f. explanation of the plans necessary to enable the Department to determine exactly what is proposed and to show the effect of the proposed project on the property of the applicant, the property of others, and the effect on the shore. In particular, the relation of the proposed project to beach erosion, storm damage and flooding shall be included;
- g. if dredging, excavation, dumping or filling is proposed give exact location, dimensions, amounts and type of material involved;
- h. the names and mailing addresses of all owners of property immediately adjacent to and landward of the property on which the project is to take place. (For these purposes the term property

shall not include roadways or easements for pedestrian or utility access);

i. signature of the owner or proprietor of the land upon which the work is to take place or his authorized agent (with evidence of the authorization).

5.03 Location Map

The location map shall be a map of small scale showing the location of the structure or activity. The location map may be a separate sheet or included as an inset map on a corner of the plan sheet. It may be traced from a National Ocean Survey (formerly Coast and Geodetic Survey) or Geological Survey Chart, road map, or other general map, and shall bear a note identifying the source as, "Traced from National Ocean Survey Chart 1219." The name of the waterway and the names of towns and prominent points shall be placed on this map. The location of the structure or proposed activity shall be marked in red ink on all copies of this map. All maps must have the usual meridian arrow showing North.

5.04 Plan Drawings

Plan drawings shall be prepared in accordance with the following guidelines.

a. the drawings shall be on sheets no larger than 8 1/2 by 14 inches in size, measured from edge to edge. Supplemental plans in the form of additional or supporting information need not meet this size requirement. As few sheets as possible shall be used to show clearly what is proposed.

b. all drawings must be drawn to scale and the scale shall be :

shown graphically. All maps must have the usual meridian arrow showing North. When two drawings are shown on the same sheet, they shall be so drawn that their meridians are parallel. North shall be at the top of the map.

c. all soundings and elevations shall be shown in feet, and will refer to the established Government datum plane at the locality. This plane is usually mean low water (MLW) or National Geodetic Vertical Datum (NGVD). Plans for structures adjacent to tidal waterways shall contain indication of the tidal range.

d. all work shall be neatly and carefully done, so as not to obscure any details of the drawing.

e. each drawing shall have a simple title, in the lower right-hand corner, to identify the structure or work and the name of the landowner.

f. Plans for Seawalls, Revetments, Bulkheads, and Similar Structures

The plan of the proposed structure shall show the shoreline (both the high and low water line) and any existing structures in the immediate vicinity. The depth of water in the vicinity of the proposed structure shall be shown by soundings. Where practicable, the proposed work shall be referenced by distance and direction to some established monument of definite mark. If harbor lines have been established in the locality, these shall be accurately shown on the drawing. The outer lines of the proposed structure shall be drawn in red ink on all copies. A typical cross section of the structure shall show the type of construction and the elevation of the deck or

top above the datum plane. All plan drawings shall show the elevation of the storm tide as indicated on the Flood Insurance Rate Map for the locality published by the Federal Insurance Administration. (Maps are available from local governments).

g. Plans for Groins, Jetties, Dikes and Similar Structures

The plan and cross section as required for seawalls, revetments and bulkheads shall be shown and in addition an elevation of the structure shall be included, together with a profile of the bottom extending at least 100 feet beyond the end of the structure. The outer lines of the proposed structure shall be drawn in red ink on all copies. The elevation of the top above the datum plane shall be shown in figures. All plan drawings shall show the elevation of the storm tide as indicated on the Flood Insurance Rate Map for the locality published by the Federal Insurance Administration. (Maps are available from local governments).

h. Plans for excavation and filling

The map shall show the area to be excavated and/or filled. These areas shall be drawn in red ink on all copies and suitably designated by words. Present elevations above the established Government datum on and in the vicinity of these areas shall be indicated. If the deposit is to be behind a bulkhead, either in the waterway or on shore, the plans must be sufficiently detailed to show that the structure will be adequate to confine the material. The elevation of the finished excavation or fill above the datum plane and the amount of material to be removed or filled in cubic yards shall be shown by an appropriate note. All plan drawings shall show the elevation of the

finished excavation or fill above the datum plane and the amount of material to be removed or filled in cubic yards shall be shown by an appropriate note. All plan drawings shall show the elevation of the storm tide as indicated on the Flood Insurance Rate Map for the locality published by the Federal Insurance Administration. (Maps are available from local governments).

5.05 Additional Information

Applicants shall furnish any additional information or plans which are requested by the Division as necessary to determine the effects of the proposed project.

SECTION 6. Procedures for Other Construction Activities
Seaward of the Building Line

6.01 An application for a permit shall be filed with the Division and shall consist of the following:

- a. a letter requesting the permit, containing:
 1. legal name and mailing address of the applicant, and, if the applicant is a corporation, the name of the principal officer or agent;
 2. date;
 3. location of work including city or town or a statement that it lies outside a city or town, development, block or section;
 4. description of work including all construction methods that affect the land; and
 5. signature of the owner or proprietor of the land upon which the work is to take place, or his authorized agent (with

evidence of the authorization).

b. the names and mailing addresses of all owners of property immediately adjacent to and landward of the property on which the project is to take place. (For these purposes the term property shall not include roadways or easements for pedestrian or utility access).

c. a plan view drawn to scale, with the scale graphically shown, showing the location of the proposed structure, any existing structures on this or adjacent property, lot lines and all relevant dimensions and distances.

d. a cross-sectional view of the project drawn to scale, extending from the mean low water line to the landward limits of the lot, showing the existing ground profile before construction and the proposed ground and structure profile of the structure after construction. Show all relevant dimensions and distances, and elevations above an established Government datum plane at the locality. This plane is usually mean low water (MLW) or National Geodetic Vertical Datum (NGVD). All plan drawings shall show the elevation of the storm tide as indicated on the Flood Insurance Rate Map for the locality published by the Federal Insurance Administration. (Maps are available from local governments).

e. a facsimile copy of the deed to the property.

6.02 Applicants shall furnish any additional information or plans which are requested by the Division and deemed necessary by the Division to determine the effects of the proposed project.

SECTION 7. Procedures for Processing of Applications

7.01 Division of Soil and Water Conservation

Applications shall be considered and permits issued or denied by the Division of Soil and Water Conservation of the Department. If a proposed project requires other permits from the Department, the application process shall be coordinated.

7.02 Notice

Upon receipt of a permit application in proper form, the Division shall advertise in a daily newspaper of state-wide circulation and in a newspaper of general circulation in the county in which the activity is proposed:

- a. that the application has been received;
- b. a brief description of the nature of the application; and
- c. that comments will be received for 15 calendar days by the Division regarding the application.

The Division shall notify all adjacent property owners as listed in permit applications. The application shall be available for public inspection at the Dover office of the Division. All notice shall be made not less than 20 calendar days before a decision is rendered.

7.03 Consideration Factors

- a. The Division shall consider:
 1. any comments received;
 2. the effect of the proposed project on beach erosion, flooding, and potential damage to the subject property and to other properties, taking into account the storm damage data in the findings;
 3. the feasibility of alternate protection from storm damage that may be available.
 4. the local, long-term average shoreline recession

rate and its relationship to the location and expected useful life of any structure or activity.

b. The Division may:

1. make a site inspection;
2. hold informal conferences;
3. confer with any person;
4. undertake other investigation or activity as deemed necessary to carry out the purposes of the Act; and
5. establish special conditions for, or require modifications to, any new structure or activity in order to prevent increased erosion damage to the subject property or adjacent properties, or to reduce the need for public beach protection expenditures.

7.04 Decision

The Division shall make a decision on the application which it determines will best implement the purposes of the Act and these Regulations. The Division shall give written notice with reasons to the applicant, to adjacent property owners and to other persons who have requested that they be notified of the decision on that application.

SECTION 8. Appeal From the Division's Decision

8.01 Activity Pending Appeal

The applicant shall not commence any activity regulated under Sections 3 and 4 until such time as a final determination has been rendered on the matter, all appeals have been exhausted and the appeal period has expired.

8.02 Procedures

a. Any person whose interest is substantially affected by any action of the Division may appeal to the Secretary by giving notice of appeal by certified or registered mail within twenty (20) calendar days after the Division has announced the decision. In the case of any appeal, a public hearing shall be held.

b. The public hearing shall be conducted as follows:

1. For any hearing on an application, notification shall be served upon the applicant as summonses are served or by registered or certified mail not less than twenty (20) calendar days before the time of said hearing. Not less than twenty (20) calendar days notice shall also be published in a newspaper of general circulation in the county in which the activity is proposed and in a daily newspaper of general circulation throughout the State.

2. The appellant may appear personally or be represented by counsel at the hearing and produce any competent evidence in his behalf. The Secretary or his authorized designee may administer oaths, examine witnesses, and issue, in the name of the Department, notices of hearings or subpoenae requiring the testimony of witnesses and production of books, records or other documents relevant to any matter involved in such hearing. Subpoenae shall also be issued at the request of the applicant. In case of refusal to obey a notice of hearing or subpoena under this Section, the Superior Court in the county in which the hearing is held shall have jurisdiction upon application of the

Secretary to issue an order requiring such person to appear and testify or produce evidence as the case may require.

3. A verbatim transcript of testimony at the hearing shall be prepared and shall, along with the exhibits and other documents introduced by the Secretary or other party, constitute the record. The Secretary or his authorized designee shall make findings of fact based on the record. The Secretary shall then enter an order that will best further the purposes of the Act and these Regulations, and the order shall include reasons. The Secretary shall promptly give written notice of the order to parties who participated in the hearing.

SECTION 9. Violation and Penalties as Enacted
in Section 6305 of the Beach Preservation Act

9.01 Violators of any of these Regulations shall be fined not less than \$100 nor more than \$5,000, or imprisoned not more than two (2) years, or both; and, in addition shall reimburse the Department for its reasonable expenditures in remedying any damage created.

SECTION 10. Procedures for Adoption of a Regulation
or an Area Exemption

10.01 Hearing

The Secretary, or his authorized designee, shall hold a public hearing on any Regulation or area exemption that he shall propose for adoption. For a hearing on a regulation or area exemption proposed for adoption, notification shall be published in a newspaper of general circulation in each county and in a newspaper of general circulation in this State. Such notification shall include (i) a

brief description of the regulation or area to be exempted, (ii) the time and place of the hearing, and (iii) the time and place where copies of the proposed regulation or maps of the area to be exempted may be obtained. Such notice shall also be sent to any persons who have requested notification from the Department by providing their name and mailing address.

10.02 Decision

Following the public hearings the Secretary may adopt or modify the proposed regulation or area exemption. This adoption or modification shall be a final order for purposes of Section 11.

SECTION 11. Appeal From the Secretary's Decision

11.01 Any person aggrieved by a final order of the Secretary may within 30 calendar days appeal to the Superior Court as provided in Rule 72 of the Civil Rules of the Superior Court.

SECTION 12. References

12.01 Authorities

For guidance in preparing applications:

SHORE PROTECTION MANUAL, Volumes I-III, third edition, 1977 published by the Department of the Army, Corps of Engineers, Coastal Engineering Research Center is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Storm Damage Data (excerpted from)

a. U. S. Army, Corps of Engineers (December 1962) POSTFLOOD REPORT - COASTAL STORM OF 6-7 MARCH, 1962, SOUTHERN NEW JERSEY AND DELAWARE.

b. U. S. Army, Corps of Engineers (August 1963) REPORT ON
OPERATION FIVE-HIGH - MARCH 1962 STORM.

c. U. S. Army, Corps of Engineers (December 30, 1966) BEACH
EROSION CONTROL AND HURRICANE PROTECTION ALONG THE DELAWARE COAST.

Appendix C

Feasibility of Fixed Jet By-Pass Systems
At Roosevelt and Indian River Inlets, Delaware

FEASIBILITY OF FIXED JET BY-PASS SYSTEMS
AT ROCSEVELT AND INDIAN RIVER INLETS, DELAWARE

A. GENERAL BACKGROUND

1. Fixed dredge by-pass systems have been tried in the past, but have always suffered from the problem of getting the sand to the pump suction. Devices for swinging the suction are expensive to operate and highly vulnerable to wave damage. Long suction pipes are defeated by cavitation which severely limits the distance from intake to pump. The pump and its prime mover therefore have to be placed close to the suction, in an exposed location.

2. Early attempts to employ jet pumps in the fixed application failed due to inadequate understanding of the design criteria required for the jet pump to perform when the suction is completely buried.

3. We have recently improved jet pump dredging technology so that it is now possible to bury one or more jet pumps in areas where they can intercept littoral drift and pump the slurries through centrifugal relay pumps for great distances. Since submerged sand has an approximate angle of repose of 30 degrees, quite large craters can be formed to function as sand traps. The jet pump can operate continuously during periods of high sand transport, or periodically during low transport.

4. Since the pump and its piping can be buried below the surface of the craters, it is secure against wave action and can operate during storms when any other dredging system would be immobilized or damaged. Its operation can be automated so a pressure cell mounted near the pump suction will turn on the pump as soon as sand builds up to a predetermined depth.

5. The capability of the jet pump to operate with its suction buried is essential to this concept. This capability has been demonstrated by field tests at the Waterways Experiment Station, Vicksburg, MS and at Mexico Beach and Destin, FL, Rudee Inlet, VA, and Santa Cruz, CF. The jet pumps were operated successfully in the fixed mode at Mexico Beach and Santa Cruz.

6. The most efficient employment of the fixed jet by-pass is in a location where the littoral drift can be intercepted in a relatively narrow band. For instance, a jet pump emplaced 30' below the normal ocean floor creates a bottom crater roughly 100' in diameter. Two such craters can be overlapped across a littoral transport zone to create a sand trap roughly 150' perpendicular to the flow and 70 - 100' parallel to the flow.

The same factors which cause sand to deposit in a channel cause it to deposit in the crater. The waves are dampened over the deeper water of the crater, the horizontal component of velocity is reduced below the point required to maintain the particles in suspension, and they fall or slide to the bottom of the crater. They are then transported in a slurry pipe to a discharge point downdrift of the channel. Economic considerations limit the distance that the jet pump can discharge so one or more centrifugal dredge pumps may be required to relay the slurry. A typical 6" suction jet pump can move the slurry 500 - 600' without a relay.

B. UNIVERSITY OF DELAWARE STUDIES OF ROOSEVELT AND INDIAN RIVER INLETS

1. The writer has reviewed these studies to extract the data necessary to make preliminary designs for both inlets, and found them to be comprehensive, lucid and logical.

2. The sand tracer study at Roosevelt Inlet (Fig. 35) clearly shows how the sand moves in a narrow belt along the boundary, which in this case is the previously deposited lobe. This situation is ideally suited for intercepting this narrow belt of moving grains with a crater having a pump at the apex continuously removing the deposited material.

3. At Roosevelt Inlet, the report suggests that significant quantities of sand are being lost from Control Section B, either into the Broadkill River, the canal or offshore (p. 133). If a crater is located in the vicinity of the west lobe, it should intercept virtually all of the sand entering the inlet from the west. If this sand is then by-passed to the east beach, there should be very little sand escaping either into the river or into the ebb tide plume. The by-pass system should therefore greatly reduce losses from Control Section B.

4. The Roosevelt report (p. 182) indicates the need to by-pass about 80,000 CY of sand every two years to nourish Lewes Beach, suggesting dredging every two years. If the by-pass is accomplished by conventional

dredging, economics demand that a sufficient quantity of sand be available to justify the mobilization and demobilization costs of the dredge, which dictates in this case a long period, such as two years, between dredging contracts. In the meantime, the starved beach must be allowed to deteriorate significantly. However, with a fixed by-pass plant, the dredging can be accomplished almost continuously, depriving the downdrift beach, at any time, of only the sand that is allowed to collect in the pump crater between cycles, which can be regulated at will.

Also, assuming that losses at the inlet become small and that the by-passing operations are substantially continuous during periods of sand transport, the quantity and quality of the sand being delivered downdrift should be exactly the same as if the inlet did not exist.

5. The Indian River report, on page 202, comments on the distribution of sand from the pump discharge point during heavy by-passing. In the writer's experience, this has not proven to be a problem. Since the wave energy that moves the sand to the pump suction on the up-drift beach is the same as the wave energy being applied at the pump discharge on the down-drift beach, it appears to redistribute the sand in the surf zone very quickly, just as if the inlet did not exist. Of course, the discharge point must be located far enough from the down-drift jetty to avoid being sheltered in the lee of the jetty. In practice, this distance has been quite short without any apparent inhibition to the resumption of normal movement.

6. At Indian River (p. 203), the writer concurs in locating the by-pass pipe on the bridge structure. The high velocities through the inlet have scoured out the sand, exposing the underlying non-granular bottom. It would be very difficult to bury or anchor the pipeline on the bottom. Recovery for maintenance or removal of a blockage would be very expensive.

7. At Indian River (p. 214), if the integrity of the south jetty tip becomes questionable, sand could be supplied from the south beach either by stopping the pumps or directly from the slurry pipeline through a lateral.

C. PRELIMINARY BY-PASS DESIGN AT ROOSEVELT INLET

1. A Preliminary design was based on data in the University of Delaware report. Distances were scaled from the reduced scale figures. Obviously, more accurate data would be required for a final design, but it is believed that the data used was adequate to determine technical feasibility.

2. Two craters were assumed on the west side of the inlet. The outer crater was located opposite Sta. 1+00 SW and tangent to the west jetty. The inner crater was located about opposite Sta. 1+50 SW, and 100' east. The depth was assumed to be 20' below MLW, so that the two craters would overlap slightly at zero elevation. If these two pumps were emplaced immediately after the west lobe had been removed by conventional dredging, they should promptly intercept any new sand entering the inlet near Sta. 0+00 SW, preventing any future deposition in the lobe area.

3. A pump station was assumed about 100' west of the west jetty baseline and close to the Broadkill River. Suction would be taken in the river by the high pressure clear water injection pump. The injector main would supply the two jet pumps on the west side. Slurry from the jet pumps would return to the pump station where it would be relayed in a slurry main under the channel to a point on Lewes Beach 150' east of the east jetty. The distance from the jet pump to the relay pump is critical. The distance from the relay pump to the discharge could be increased if desired.

4. It was assumed that only one pump would operate at a time, each having a fully loaded capacity of 140 CY/Hr. Switching from one pump to the other would require closing two valves and opening two valves.

5. A solution was found using 4" suction jet pumps, requiring 160 BHP for the injector pump and 120 BHP for the slurry relay pump. The estimated cost of materials and equipment, at current prices, is about \$60,000. To this would be added the cost of bringing power to the pump house at 460 volts and the labor, overhead and profit required for the installation.

6. An effort was made to design a pump crater on the east side of the channel at the location of the existing lobe, using the same pump station that would serve the west side jet pumps. Routine techniques failed to find a solution, due to the distance from jet pump to relay or discharge point being excessive. However, it is quite possible that further study would yield a solution. If not, a separate pump station would be required on the east side of the inlet, possibly consisting of a relay pump only.

7. A crude estimate of the installed cost of three pumps at Roosevelt Inlet would be in the range of \$100,000 to \$150,000, depending on how the east side installation could be resolved and on construction costs which are hard to predict. The marginal cost of adding or subtracting

one jet pump in a system served by a common pump station would probably be about \$10,000. Operating costs would involve electrical power, the part time services of a person to monitor the sand accretion and operate the pumps as required, plus maintenance and repairs. The latter should be quite nominal provided there are few large tramp objects available to clog the section strainers. The pipe and pumps are normally good for several hundred thousand yards of sand before replacements are required.

D. PRELIMINARY BY-PASS DESIGN AT INDIAN RIVER INLET

1. The feasibility of emplacing jet pumps in the inner shoal was considered. The distance from a shore-based pump station to the shoal area is too great for the use of the most economical pump size. There are a number of possible approaches. However, all would involve additional investigative effort beyond the scope of this study, and it is likely that the cost per unit pumped would be relatively high.

2. Following the recommendations of the University of Delaware study, a preliminary design was made for a small array of jet pumps located opposite Sta. 20+00 S, extending across the littoral transport zone at both high and low tides. The length and capacity of a sand trap depend upon assumed design conditions. The definition of a design storm and best crater configuration requires study in cooperation with oceanographers. It is assumed that four 6" suction pumps would be required, probably operated either singly or in pairs. Each would have a fully loaded capacity of about 390 CY/hr.

3. Calculations were made for a single pump operation which indicated technical feasibility. More study would be required to examine parallel operation of two or more pumps, but this mode would also be feasible. It is probable that two relay pumps would be required, one at Sta. 20+00 S, and one south of the bridge structure. Once the pipe fills, however, a siphon is created so that the only real cost penalty due to elevating the pipe is the simple friction losses in the vertical legs.

4. Since considerable detailed study would be required to select the best design at Indian River, a cost estimate at this stage cannot be reliable. A rough estimate was made, however using conservative assumptions and conservative pricing, to arrive at a high side estimate of approximately \$720,000. Based on a 10 year life, this would translate to an annual estimate cost for operation and depreciation of around \$135,000 to \$150,000 per year.

E. CONCLUSIONS

1. At Roosevelt Inlet, the fixed jet pump sand by-pass is clearly feasible from a technical standpoint. The economic comparison with periodic conventional dredging appears favorable, requiring more detailed design for better definition.

2. At Indian River, the fixed jet system is technically feasible. A rough first estimate indicates significant economic advantages for the jet system.

3. In both cases, a significant additional advantage of the jet system is that it remains permanently in place, capable of by-passing sand whenever needed, so that the channel stays open and the beaches are nourished continuously, just as if the inlet did not exist.

4. Compared to all other methods of by-passing the jet system is the only one capable of operating during conditions of heavy wave activity, which is the very time when sand movement is at its maximum.

5. It is believed, therefore, that jet by-passing systems offer the best solution to both problems and should be favorably considered.

Chas. B. Pekor. P.E.

Appendix D

Federal Regulations Governing
Shoreline Erosion and Mitigation Planning

§ 923.26 Shoreline

(a) Requirement. In order to meet the requirements of subsection 305(b)(9) of the Act and to coordinate these requirements with those of subsections 305(b)(3) and 306(c)(9), States must include a planning process that can assess the effects of shoreline erosion. Evaluation must include assessment of ways to mitigate, control or restore areas adversely affected by erosion. This process must include:

- (1) A method for assessing the effects of shoreline erosion;
- (2) Articulation of State policies pertaining to erosion, including policies regarding preferences for non-structural, structural and/or no controls;
- (3) A method for designating areas for erosion control, mitigation and/or restoration as areas of particular concern or areas for preservation and restoration, if appropriate;
- (4) Procedures for managing the effects of erosion, including non-structural procedures; and
- (5) An identification of legal authorities, funding programs and other techniques that can be used to meet management needs.

(b) Comment. Statutory Citation, Subsection 305(b)(9):

The management program for each coastal state shall include... (9) A planning process for (A) assessing the effects of shoreline erosion (however caused), and (B) studying and evaluating ways to control, or lessen the impact of, such erosion, and to restore areas adversely affected by such erosion.

(1) The basic purpose in developing a process to evaluate and, if appropriate, to control and mitigate shoreline erosion is to assure consideration of erosion impacts within the purview of a State's management program. Since the specific planning requirements called for in this section are closely related to the broader requirements of areas of particular concern and areas for preservation and restoration, many of the requirements called for in paragraph (a) above can be met by completing the work called for in §§ 923.21 and 923.24.

(c) Comment. With respect to the requirement of (a)(1) above, States should consider the following: (1) Loss of land along the shoreline or along estuarine banks, whether this loss is caused by actions of man or by natural forces, and whether these actions are regularly occurring, cyclical, or one-time events; and (2) the cause of these effects (e.g., manmade vs. natural forces), the effects of erosion on adjacent land and water uses as well as the impacts of mitigation or restoration of eroded areas on adjacent shorelines, littoral drift, and other natural ecological processes such as accretion.

The purpose of such assessments will be to determine how, if at all, States will want to handle erosion control, mitigation and/or restoration.

(d) Comment. In addressing the requirements of (a)(2) above, States should consider non-structural and structural options as well as the possibility of allowing erosion and accretion to continue to occur without management intervention. It is not the intent of these planning requirements to imply that an appropriate State response to erosion necessarily requires control (either of a structural or nonstructural nature). In some locations along a State's coast, it may be appropriate to articulate a policy of noncontrol, given the cause of erosion, the configuration of the coastline or the adverse impacts that may result from control techniques. An example of where a policy of noncontrol may be appropriate is along barrier islands where there is substantial natural erosion and accretion due to littoral drift. In cases where State policy is not to control erosion, either in selected locations or along the entire coastline, the rationale for such policy should be stated explicitly. In evaluating ways to control or lessen erosion impacts, either through non-structural or structural techniques, States should take into account such considerations as shoreline configuration, extent of the problem, costs of alternative solutions, and incorporation of existing management techniques. States also should take particular account of the National Flood Insurance Program (24 CFR 1909 et seq.), and regulations of the Federal Insurance Administration on flood-related erosion-prone areas (24 CFR 910.5).

(e) Comment. In addressing the requirements of (a)(3) above with respect to areas for preservation or restoration, States may consider complete re-establishment of the pre-erosion shoreline or other more limited rebuilding of an eroded area. Both natural and developed areas may be considered for restoration purposes. Due to restrictions on the use of section 306 funds (see § 923.95), not all means of restoration proposed by States may be eligible for section 306 funding, or funding under other sections of the Act.

Despite this restriction on the use of section 306 funds, States should not feel restricted as to the means of restoration proposed, as part of the management program and should give particular attention to coordination of shoreline erosion management objectives with funding programs pursuant to the U. S. Army Corps of Engineers Beach Erosion Control Program (33 U.S.C 426 et seq.) and the Hurricane Protection Program (33 U.S.C. 701 et. seq.) and other statutes as may be appropriate.

(f) Comment. State coastal zone management programs that are submitted and approved prior to October 1, 1978, may submit this planning element as a program amendment by, but no later than, September 30, 1978, or this element may be included as part of the basic program submission submitted and approved prior to October 1, 1978. State coastal zone management programs submitted prior to October 1, 1978, but approved on or after that date, must include this planning element as part of the basic program submission. State coastal zone management programs submitted for approval after October 1, 1978, must include this element as part of the basic program submission.

SHORELINE ACCESS AND PROTECTION PLANNING

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I. INTRODUCTION

Section 305(b) of the Coastal Zone Management Act, as amended, states that " the management program for each coastal state shall include . . . a definition of the term 'beach' and a planning process for the protection of, and access to, public beaches and other coastal areas of environmental, historic, esthetic, ecological or cultural value." (Sec. 305(b)(7)).

With specific reference to Section 305(b)(7), the House Committee which drafted it notes that:

"The Committee wants, by this requirement, for state Coastal Zone Management Programs to identify their publicly held coastal areas and to provide for their protection, where that is appropriate as with ecologically significant wildlife areas, and for their ready access as is appropriate with a public beach. Whereas the present management programs must include an inventory and designation of 'areas' of particular concern, this new requirement focuses particular attention on publicly held properties and direct that plans for their best management be included in the state program."

Further guidance on the intent of this section is provided in the Committee discussion of the need for this legislation:

"Access to public beaches and other attractions in public ownership in the coasts has come to be identified as one of the critical problems facing local and state governments . . . The Committee position is that action is needed now to help provide the needed access, especially in urban areas, and that to wait will only mean additional expense to the taxpayers. The key again is that the purchase of such access, as is provided in the addition to Section 315 . . . be tied to a comprehensive plan. That is the intent of this new requirement under 305 program development - that all such purchases fit into an overall program for each state."

Section 315(2) of the Coastal Zone Management Act provides that:

"The Secretary may, in accordance with this section and in accordance with such regulations as the Secretary shall promulgate, make grants to any coastal state for the purpose of . . . acquiring lands to provide access to public beaches and other public coastal areas of environmental, recreational, historic, esthetic, ecological, or cultural value, and for the preservation of islands. The amount of any such grant shall not exceed 50 percentum of the cost of the project involved."

The House Committee Report accompanying the 1976 amendments discussed the shorefront access provision as follows:

"This authorization complements the new requirement the Committee has added to section 305 for a beach protection and access planning process. Because time is of the essence in acquiring access, particularly in or near urban coastal areas, it was felt advisable to accompany the planning requirements with funds to carry out the plans.

"The Committee does not intend to authorize the purchase of lands for beaches or other public uses. The concern is that there are areas already in public ownership on the shore which, for one reason or another, are not readily accessible to the public.

"The Committee's further concern is that in providing the means of opening up this access, we do not overburden the resources. That is why this authorization is tied to the planning requirement of section 305--the intent is to see to it that this expanded means of access fits into an overall recreational plan and that due care is given to protect areas susceptible to damage from excess use."

The Senate Report discussed why the bill included these provisions, as follows:

"In recent years--both before and after passage of the Coastal Zone Management Act--coastal states have realized the increasing difficulty of assuring public access to and protection of beaches and islands in the coastal zone. Time is of the essence, since property values are rising steeply and quickly on waterfront property.

"The Committee is persuaded that providing assistance to the states for the acquisition of lands for these purposes is amply justified and in the national interest. With population and leisure trends pointing to increased demands on limited waterfronts, it is imperative to protect these properties. To wait longer would mean the public will have to pay higher prices for the properties needed for enjoyment of public beaches."

From the legislative history, the Office of Coastal Zone Management has concluded that section 315(2) is intended to provide ways of getting to areas presently in public ownership and is not for adding to those areas. Congress did not intend that funds from this section be used to add to beach areas. Also, the word "public" appears before "beaches" and the listing of the other shorefront areas to which access might be provided. Thus, it is clear that Congress did not intend for access to be provided to privately held property. However, it would seem appropriate to provide the right of access through private property to public areas.

Although the Act addresses access to and protection of all public shorelines, its emphasis is clearly on access to public beaches.

Definition of Beach

The term "beach" means different things to different people. To the scientist, the term beach would include all land forms associated with littoral processes. This area would encompass the barrier beach from the shoreline to the back barrier marshes. Others would confine the term beach to the areas available for water related recreation, i.e. the dry sand beach.

The term beach can also connote the general area associated with coastal resorts and tourism and it has no specific boundary. On the other hand the legislature, in the Beach Preservation Act, has defined "beach" as "that portion of the shoreline of any body of water which extends from the mean high water mark inland one thousand feet, or to a roadway for automobiles whichever is closer."

Since the primary purpose of this planning element is to provide access to public "beaches" for recreational pursuits, the term beach shall be defined to include only the wet and dry sand area from the low water mark inland to the line of vegetation. This is the primary attraction of the coastal areas and, therefore, access to the publicly owned portions of this zone must be assured.

II. SIGNIFICANCE AND VALUE OF BEACHES AND SHORELINES

Delaware's Atlantic barrier beach is the State's most important and heavily utilized recreational resource. There are 24.5 miles of sandy beach bordering the Atlantic Ocean from the mouth of Delaware Bay to the Maryland border. This coastal recreation area also includes Rehoboth, Little Assawoman and Indian River Bays which lie landward of the barrier. This extensive beach area lies within a day's drive of over 21 million people. There are 2.5 million annual visits to the coastal area. The State's travel industry nets about \$202,000,000 a year, a significant portion of which is generated in the Sussex County coastal area.

There are two state parks, Cape Henlopen and Delaware Seashores, which attract large numbers of visitors each year for swimming, surf fishing, nature study and boating. Of the 24.5 miles of ocean beach, 12 miles are contained within these parks.

The barrier beaches on the Delaware Bay are significantly less important to the tourist industry. With exception of the Lewes area, the amenities that attract tourists are not present at these locations. The extensive marshes that back these very narrow beaches prevent significant development. In addition, there is no surf to speak of and most areas are characterized by muddy substrates offshore and very turbid waters, which are not conducive to water contact recreation.

Use of these beaches by the general public is limited and recreation benefits accrue primarily to owners and their guests.

The quality and proximity of Delaware's beaches to the Washington, Baltimore and Philadelphia metropolitan areas, coupled with the fact that on an average summer weekend 70% of the visitors to the Sussex County coastal areas are from out-of-state, make these shores a resource of national significance in addition to being important to the State's residents and economy.

It is difficult to predict future demand for outdoor recreational facilities. State park visitation from 1965 to 1969 increased tenfold, underscoring the potential for substantial increased participation over a short period of time. This potential, combined with the dynamics of more leisure time, increased mobility, etc. would seem to indicate that future demand might be great. On the other hand, park attendance has been relatively constant since 1969 -- although the seashore has been increasingly popular.

Many of the most popular recreational areas, of course, are not State parks. The summer weekend population in the Sussex Coastal area has been projected at between 178,330 and 190,324 for the year 1980; between 189,107 and 201,831 for 1985; between 200,615 and 214,117 for 1990; and 214,084 and 228,531 for 1995. Most of the present summer population is concentrated in the Rehoboth Beach, Bethany Beach and Fenwick Island areas although there are increasing pressures for resort developments around the inland bays and along an undeveloped stretch of beach between Bethany Beach and Indian River Inlet.

While the public sector provides most of the areas, facilities and services for outdoor recreation, the private sector provides lodging, restaurants, shops and evening entertainment that is such an integral part of the resort atmosphere. It also provides summer jobs for students, contributes to the economy and produces tax revenue.

Aesthetics are also important attributes of Delaware's beaches.

The State is fortunate to own three large undeveloped tracts of oceanfront property which mitigate the visual intrusion of continuous resort development characteristic of the Mid-Atlantic region from Maryland to New York. Delaware Seashore State Park (two tracts) provides extensive views of rolling coastal dunes, inland water bodies and back barrier marshes. Cape Henlopen State Park features upland pine forests, extensive marshes along the Lewes-Rehoboth Canal, large "walking dunes" (the largest north of Nags Head, North Carolina) and the Cape itself.

The tributaries and extensive marsh lands along Delaware Bay are also important assets of the coastal area. The State is located along the Atlantic Flyway and its marshes and coastal waters provide important stop-over points for migrating waterfowl. The State and Federal governments between them own roughly 44,000 acres of coastal wetlands and associated

uplands. These wildlife areas are especially attractive to hunters, fishermen, nature lovers, and sightseers. They are most heavily used during the spring and fall and represent a significant "off-season" tourist attraction. Delaware's wetlands, particularly Bombay Hook National Wildlife Refuge and Little Creek Wildlife Areas, are nationally significant and ornithologists from all over the country visit these areas annually. As a matter of fact, it has been estimated that naturalists and sightseers outnumber all other users of the State and Federal wildlife areas by 20 to 1.

SPECIAL SIGNIFICANCE OF CRITICAL NATURAL AREAS

Natural areas are usually of aesthetic value - places of beauty. They may include the habitat for rare or endangered plants or animals, or they may be cherished by geologists or archaeologists as irreplaceable evidence of Earth's development and past civilizations.

Such areas are irreplaceable as laboratories for scientific research; as reservoirs of natural materials (not all the uses of which are known); as habitats for plant and animal species and biotic communities whose diversity enriches the meaning and enjoyment of human life; as living museums where people may observe natural biotic and environmental systems of the earth and the interdependence of all forms of life; and as reminders of the vital dependence of the health of the human community upon the health of the natural communities of which it is an inseparable part.

Thus, if these areas are maintained in their natural state, Delawareans will retain the opportunity to maintain close contact with such living communities and environmental systems of the earth and to benefit from the scientific, educational, aesthetic, recreational, and cultural values possessed by such areas.

The significance and value of Delaware natural areas has received increased attention recently. New Castle County, in recognition of the value of natural areas, sponsored the first natural area study (New Castle County Natural Areas Study) in 1975. Since the completion of that study, the County Council had adopted a resolution calling for the preservation of natural areas. Also various County agencies are developing ordinances to preserve remaining natural areas and are working with landowners to try to preserve natural areas through various means. For its part during program development, the CMP supported the completion of the Delaware Natural Areas Study performed by the Delaware Nature Education Society and encouraged legislative efforts, as well as other actions, to protect these areas.

III. PROBLEMS AND ISSUES -
ACCESS, RECREATION AND
DEVELOPMENT OF THE SHORELINE

Although recreation and tourism, particularly in the coastal area, are important to the economy of Delaware and important to those who benefit from visits or vacations here, recreation development is not without its problems. These may include conflicts between recreation and other competing uses and activities, conflicts between various forms of recreation, and problems associated with the provision of recreation lands and facilities.

The recreation demand for the Coastal Zone is high. In addition, other types of users vie for the small areas available. Many industrial complexes have the potential to render large areas of shoreline unusable for many types of recreation. The air and water pollution that have been evident in the past in the vicinity of such complexes demonstrates this fact. Oil spills have covered beaches, pilings, and boat hulls, rendering the water unfit for boating, swimming, fishing, surfing, diving, or sightseeing. These types of recreation have been incompatible with "heavy" industry throughout the Delaware Estuary.

The concentration of pollution in the Delaware River and the lower reaches of the Brandywine and Christina Rivers makes many recreation activities, such as boating and fishing, less appealing than in areas to the south. All recreation in the coastal area depends on adequate water quality; this is the factor that so often causes conflict between industry and recreation. If industry could be pollution-free, some types of recreation could exist adjacent to it.

The industry does not have to be classified as "heavy" to generate potential conflicts however. Recent proposals to construct an OCS oil support base at Lewes adjacent to Cape Henlopen State Park could create conflicts with recreation activities at the park. For example, park visitors would have to share a two-land access road with a rail crossing and truck traffic. Initial and continuous dredging of the harbor, as well as possible noise problems, could hamper recreation in the western portion of the park.

One of the greatest problems facing Delaware today in recreation is how the public and private sectors can satisfy the demand for recreation and yet not destroy the natural resources of the State. Already the specter of overdevelopment has appeared in the Sussex County resort areas. Significant portions of the Rehoboth and Indian River Bays are closed to the taking of shellfish because of domestic pollution resulting from improper development of the shoreline. The major part of this development has taken place within the last 25 years. Since 1938 the percentage of developed shoreline along these bays increased from 4.5 percent to about 30 percent. Conflicts between urbanization and recreation are many and include increased water pollution from failing septic systems and package treatment plants and other waste discharges, destruction of shoreline and aquatic habitat, and reduced public shoreline access. Moreover, in resort areas the prime development sites are adjacent to water bodies, which means development will be widely scattered with its attendant adverse effects on government expenditures for roads, utilities and other services.

In addition, recreation subdivisions oriented toward boating access, particularly those utilizing dredged lagoons, place additional burdens on State expenditures for access channel dredging and spoil disposal that would otherwise be unnecessary. This form of development, along with private beachfront development benefiting from State beach protection efforts, is the most uneconomic form of development on a cost/revenue basis in Delaware.

Perhaps the most volatile development issue in the resort area is one concerning high-rise condominium development along the oceanfront. This issue is largely one of aesthetics and overcrowding, although water pollution and natural area destruction are also raised. Proponents of this type of recreation development point to construction jobs, high land prices, market demand, local property tax revenue (and no school children) and other economic benefits as justification for high-rise construction. Opponents argue such structures disrupt the view of the coast, disturb dunes and barrier habitat, contaminate groundwater, create congestion and traffic problems, and severely restrict public use of the beach.

They point to Ocean City, Maryland and the New Jersey shore as examples of how not to develop the beach. This issue will certainly end up in court before it is resolved.

Conflicts in the use of recreation lands also arise among different types of recreation. For example, boating cannot be permitted in close conjunction with swimming and diving because of the danger to swimmers. Water pollution will occur in an area subjected to high-intensity use. The utilization of any area beyond its capacity creates pollution resulting from sanitary waste. Aesthetic pollution resulting from ugly structures or facilities, litter, and distracting human activities also may occur.

Other conflicts arise between day-use visitors and coastal property owners. The former are competing for access to a limited resource and often encroach onto private beaches, cause noise and litter problems and generally antagonize the seasonal resident. This conflict has led to more and more shoreline property being closed to the general public. Providing public access to the beach is an expensive proposition in terms of acquisition, development and maintenance and, therefore local government has attempted to remedy this situation by requiring public access easements along private beaches as a condition to development approval. The question of who should pay for this access and what, if any, cost-sharing arrangements should be made have yet to be resolved. As can be expected, coastal property owners and recreation seekers stand at opposite ends of the spectrum on this issue.

Resistance to development of recreation facilities stems also from a natural self-interest on the part of local year-round or vacation homeowners who feel threatened by the prospect of sharing recreational space and facilities. Often these are people whose own financial situations are independent of the local recreation and resort industry. Their point of view is not necessarily a matter criticism because it is basically a desire to protect property values and stems from genuine alarm at examples of rapid and uncontrolled development of shore areas in other states and a concern over the impact of tourism on expensive local police, fire, and health services.

The need for parklands has not always been fully recognized and money available to public agencies for land acquisition has seldom been adequate for all needs. In 1939, it was recommended that Delaware acquire additional lands adjacent to the "Indian River Barrier Beach Tract." Estimates of land values were planned at "\$4 per acre on the marsh lands and a maximum of \$30 per acre on the uplands section." This land was not purchased and today its value probably exceeds \$50,000 per acre. The prices per acre for undeveloped coastal lands along the Delaware River and Bay have increased twentyfold from 1954 to 1970.

The escalation of coastal property value illustrates a dilemma faced by public recreation agencies. The great demand for coastal recreation opportunities is, of course, reflected in land prices. As land prices increase, however, public agencies are able to supply less and less of this most desired commodity for use by the general public. Eventually, the State is priced out of the market (despite federal land acquisition grants) and increasing amounts of land are being converted for use by the few at the expense of the many. A case in point is a 1.5 mile stretch of barrier beach north of Bethany. It is the last large tract of privately owned beachfront land between Virginia and New York. Its proximity and accessibility to the eastern metropolitan areas, coupled with increasing demands for public recreational beaches, would suggest this area as a prime candidate for public acquisition. The State's fiscal situation, now and in the foreseeable future, prevents the State from considering this possibility. Since purchase is the only available management alternative to private development, the land will eventually be converted to condominiums and second homes. By the time demands on the existing seashore parks become excessive, the State will have no other option than to turn visitors away.

The most acute, and perhaps insoluble problem relating to shoreline access, involves the lack of boat launching facilities, particularly those with access to the excellent Delaware Bay fishing waters. This problem arises not because of an almost complete lack of fast land sites within a reasonable distance of the Bay and adjacent to deep water. The lower Delaware Bay Coast is characterized by broad marshes adjacent to all of its tidal rivers.

Development of launching facilities would require extensive wetlands filling in order to construct ramps, and parking lots. These activities are contrary to the Wetlands Act. As yet, suitable sites have not been located. However, given the characteristics of the coast there are certainly insufficient possible locations to satisfy present demand.

Most of the preceding discussion dealt with problems associated with developemtn of the shoreline and the associated problems of physical and visual degradation of the resource as well as the closing off of the shoreline to possible future public use and enjoyment. As mentioned previously, however, the provisions of the CZM Act dealing with shoreline access are concerned with the provision of public access to existing public shorelines. This section of the Act was spurred by a situation common to many states, but which is anomalous to Delaware. In most states the lion's share of the coastline is privately owned. This ownership, however, extends only to the high water mark. The beach seaward of this line is publicly owned. In many states, most notably California, private development was literally walling off miles of public beach. Therefore, at a time when public demand for beach access was increasing, the beaches available to the public were decreasing. The Congress felt that rather than embarking on an expensive acquisition program to purchase the dry sand beach and associated uplands, it would be more cost-effective to purchase public access ways and parking facilities at strategic locations. Such a program would be considerably less costly and would still provide access to the public beach.

Delaware, however, is one of the few, so-called "low water" States. In other words, when the fee simple title to shorefront lands is held by individuals, that title extends to the low water mark. The public, therefore, owns no right of access to any portion of those beaches and the public access provisions of the CZMA do not apply to these lands. Delaware is fortunate, however, that 72 percent of the Atlantic beaches is either owned outright by public agencies or the public possesses perpetual easements to them. Access to this public shoreline is not prevented by intervening private development as it is in many states.

Those public beaches backed by private development are characterized by numerous public rights-of-way dead-ending at the dune which provide ample access for the public.

Moreover, access is provided to all other public shorelines and furthermore, the specter of private development restricting access to these shores or the Atlantic beaches does not exist. Nonetheless, the ever-growing popularity of the beaches and other shorelines compels a close watch on the relationship between the demand for the resource and the ability to get to it. The primary means for monitoring the supply and the demand for shoreline access is the State Comprehensive Outdoor Recreation Planning process. (SCORP).

The inventory which follows describes all publicly owned lands and wetlands adjoining the State's tidal waters, as well as those shores where the public has a right of entry. This description includes, as appropriate, the size of the area; parking capacity; launching ramps; sanitary facilities; natural, historic and aesthetic amenities; agency plans for increasing access; and constraints on additional public access.

SPECIAL PROBLEM - "THE PUBLIC LANDS"

The Delaware Coastal Management Program, in its first year of program development, recognized the significance of the crucial issues relating to certain lands along the coast. The lands involved are those properties along the Atlantic Coast between Cape Henlopen and Fenwick Island which have never been transferred from the public domain. They currently include the Cape Henlopen and Delaware Seashore State Park, portions of the Assawoman Wildlife Area, and three small tracts at Fenwick Island, Dewey Beach and Deauville Beach. They are commonly called the "public lands" because a Public Lands Commission established in 1913 was the first State agency to manage them.

The territory which is now Delaware was given to William Penn by the Duke of York (later King) of England. Penn and his heirs made land grants from the territory prior to the American Revolution. Delaware made additional grants after the Colonies achieved Independence.

The State Supreme Court determined that Penn and his heirs owned the land as sovereigns, not as individuals. Therefore, any land not granted by the time the State gained its independence became State property.

Land was plentiful and precise boundaries were of little consequence. Some areas were considered of little value. In many cases, there was a dearth of geographical knowledge of the area conveyed. Land transfers were sometimes made without a writing. Deeds were not routinely recorded and deed descriptions, when they were recorded, used mortal markings, such as "the old white oak." Geological processes altered earlier boundaries.

In 1913, the General Assembly expressed its concern over the State public lands by establishing a Public Lands Commission to ascertain State boundaries. The Commission engaged Thomas B. Pepper to conduct a survey of the public lands from the lighthouse on Fenwick Island to the old lighthouse at Lewes, a stretch encompassing virtually all of the Delaware's ocean front. Mr. Pepper's survey included extensive historical research of the patent records in Delaware and Maryland, as well as physical measurement of the property. The survey was recorded in Georgetown in 1929.

In 1955, the State Highway Department caused the 1929 Pepper boundaries to be resurveyed and reconfirmed. The survey was supervised by Fred Ruyter, still employed by the Highway Department who was assisted by Mr. Pepper himself. The Ruyter survey crews drove steel casings into the ground and implanted concrete markers on top of the casings in order to mark the boundaries.

In 1971, a Delaware Chancery Court ruled that the Pepper plot, as confirmed by Ruyter, constituted a true and accurate survey of the lands portrayed thereon to the extent that State land titles were disputed in the subject case which applied only to the lands between South Bethany and Fenwick Island.

Much of monumenting work accomplished in 1955 was destroyed by the great storm of 1962. Some monuments were removed, perhaps illegally.

The loss of the monuments, the lack of an effective monitoring program, and lingering title disputes inevitably led to encroachment. In one case, a surveyor, who laid out a building project for "an owner" that included several acres of State land, has said that he figured no one would notice and that his client might as well have it as nobody else. In other cases, State land is falsely claimed under bogus deeds. Unpaid taxes lead to a Sheriff's sale and the new "owner" takes under apparent color title.

Finally, in some cases when litigation has offered the promise of restitution of State coastal property, the General Assembly has legislatively relinquished State claims in order to protect private investments. This "solution", of course, would be unnecessary if protection of State coastal lands precluded private development of State lands.

In order to address these issues, a comprehensive survey was undertaken with Coastal Management Program support to establish the location of the public lands and fully monument them. That step completed, it is necessary to prescribe policies to assure that these irreplaceable resources will be managed properly.

SPECIAL PROBLEM - CRITICAL NATURAL AREAS PRESERVATION

Natural areas are frequently lost as a result of public and private actions. These losses may be the result of inadequate information, economic pressures on surrounding lands, carelessness, or indifference. In some cases these areas are extensively developed and hence, more costly.

Private ownership of many of these areas complicates their management, particularly where public ownership is neither desirable nor feasible. Owners must be assured of their individual property rights, yet the public has an interest in seeing that a valuable site is not significantly altered or destroyed.

Public access to a site must be handled carefully since these fragile areas can be damaged by overuse and misuse. Thus, management decisions must reflect a balance between preservation in the purest sense and the public purposes for which special attention was originally warranted.

Finally, there may, on rare occasions, be imperative and unavoidable public necessities for using such areas in a manner inconsistent with maintaining them in their natural state. Thus, a mechanism is needed which will allow such uses but only after extremely careful deliberation.

IV. INVENTORY OF PUBLIC BEACHES AND SHORELINES

Division of Fish and Wildlife

1. Chesapeake and Delaware Canal

The Division owns 679 acres adjacent to the C and D Canal and manages another 5,178 acres for wildlife purposes under license from the U.S. Army Corps of Engineers. A large portion of this land has been used for disposal of spoil from canal maintenance and expansion, but the Division is attempting to reclaim this land and create upland game habitat. The Corps maintains canal bank roads on both sides of the canal which are open to the public. They have also constructed 4 fishing piers. Since the canal is an important spawning area for striped bass, the area is a popular fishing area during the late spring.

The area also contains about 350 acres of brackish marsh and access to this area for fishing, hunting and nature study is provided along Delaware Route 9 and several minor roadways.

Three areas along the canal banks contain unique exposures of marine fossils and each is designated in the New Castle County Natural Areas Study as being worthy of preservation.

2. Augustine Fishing Area

Between Port Penn and Augustine Creek, the Division owns 96 acres which are devoted to fishing and marine access. The area contains two launching ramps and three parking lots with a capacity of about 100 cars and trailers. The area has proven to be popular with fishermen and is crowded seasonally. The Division is planning to construct a bulkhead to protect the river front road as well as a fishing pier and another launching ramp.

3. Augustine Wildlife Area

The Division owns two tracts totalling 1,105 acres, of which about 40 percent is wetland. As with most State Wildlife areas, the land is managed for hunting, fishing and nature study.

There are four small parking areas which can accommodate four to five cars each. Access to the shoreline is also available along Delaware Route 9 and several minor state roads. Stream crossings are popular crabbing locations and also provide for visual access to the marshes.

The wildlife area is part of a larger tract designated by the New Castle County Natural Areas Study as being worthy of preservation, because the marshes are very productive and contain a rare nesting colony of Great Blue Herons. Another area within the refuge, and owned principally by the State, is the Silver Run Marsh. This marsh has escaped drainage and other mosquito control measures and remains essentially undisturbed by man.

4. Woodland Beach Wildlife Area

The Woodland Beach tract consists of 3,791 acres, of which about 90 percent is wetland. The Division maintains one launching ramp on the beach and two more on an inland stream. The area has a capacity for 150 cars and trailers. A fishing pier and wildlife observation tower exist at the site and portable sanitary facilities are available seasonally. Visual access to the marshes exists along Delaware Routes 9 and 6. Physical access to the river shoreline and the town of Woodland Beach is not possible during spring tides due to the subsidence of Route 6.

About one-half of the wildlife area has been designated by the Kent and Sussex Counties Critical Natural Areas Study as worthy of preservation because of its bountiful marshes and tidal flats. A young growth of woods bordering Taylors Gut impoundment provides habitat for the soapwort gentian, a wildflower rare in Delaware.

5. Little Creek Wildlife Area/Port Mahon Access Area

The Little Creek Wildlife Area consists of 3,897 acres, of which about 800 acres are marshlands and 1,200 acres are impounded fresh and brackish ponds. This area contains the most diverse wildlife population in Delaware and is unique for its attraction of numerous migratory and shorebird species.

The area is very popular with naturalists, who typically outnumber other users by at least 20 to 1. The area also contains four, twenty-five car parking lots, and an observation tower. Visual access is also provided along Route 9 and the Port Mahon and Pickering Beach roads.

Port Mahon is a 23 acre tract along the Delaware Bay and Mahon River. Facilities include two double-wide launching ramps, parking for 100 cars and trailers and a fishing pier. The area also serves as a hunter's access point to the Bombay Hook National Wildlife Refuge.

The Bay shoreline at Port Mahon is the most rapidly eroding area in Delaware; averaging in excess of twenty feet per year. The access road, which 25 years ago was protected by 600-800 feet of marshlands, is now at the waters edge. Numerous methods, all of which have proven inadequate, have been used to protect the road. The State now plans to construct a rock revetment along 6,500 feet of the shore to stem the shoreline retreat. Port Mahon not only serves as a public access point, but other facilities in the area include commercial fishing docks, jet fuel unloading port for Dover Air Force Base and the Delaware Marine Police dock.

6. Roberts Tract

This wildlife area was recently acquired from Delaware Wildlands Inc., a private conservation organization. It consists of 175 acres of marsh along the St. Jones River and is accessible only by water. The area will be used for waterfowl hunting. The nearest launching facility is Barker's Landing.

7. Lofland and Buckaloo Tracts

These two tracts were also recently purchased from Delaware Wildlands Inc. They are located on St. Jones Neck between Kitts Hummock and Bowers and consist of 2,218 acres of which about 1,120 acres are wetland. These tracts also contain about two miles of Delaware Bay beach front which are accessible from Kitts Hummock as well as an unpaved road midway between Kitts Hummock and Bowers.

The area is important as migratory waterfowl and shorebird habitat and contains The Old Court House - "Kingston Upon Hull" - which is a late 17th century structure on the National Register of Historic Places. The site also contains the Logan Lane Farm (circa 1800) and about 12 pre-historic and 12 historic archaeological sites. The State Review Board of Historic Preservation has recently nominated the St. Jones Neck area as a National Historic District. The Lofland Tract makes up about half of this district.

The Division plans to lease the tillable acreage and trapping rights to the highest bidder and develop the area for waterfowl and upland game hunting. Parking facilities and access to the beach for fishing and day use activities are also planned.

8. Penuel - Elfreth - Bamberger Tract

This area was also purchased recently from Delaware Wildlands Inc. and consists of 744 acres, approximately 50 percent of which is wetland. The Division plans to develop the area in a manner similar to the Lofland Tract.

9. Bowers Access Area

The Division maintains two boat ramps on 13 acres along the Murderkill River with parking facilities for 350 cars and trailers. The area is one of the most popular access points for Delaware Bay fishing, and as such, it is crowded on weekends throughout the fishing season. Room for additional launching ramps does not exist because the remaining shoreline is occupied by commercial fishing facilities or wetlands.

10. Milford Neck Wildlife Area

Consisting of two tracts totaling 1,376 acres, the Milford Neck Wildlife Area is managed primarily for upland hunting. The area contains about 300 acres of wetlands and limited frontage on the Mispillion River. A narrow, unpaved road provides access to the river. The Division has long range plans to acquire considerable additional acreage along the Mispillion River and Delaware Bay.

Within this area are two sites designated by the Kent and Sussex Counties Critical Natural Areas Study as worthy of preservation. One is the Millman Farm which is an archaeological site that may have been occupied for a period up to 7,000 years. The other is a 675 acre tract of marsh which has been a research site since the 1930's.

11. Cedar Creek Access Area

This site provides easy access to the lower Delaware Bay for fisherman and pleasure boaters and is a very popular launching site. The area consists of 15 acres with eight launching ramps and parking for 325 cars and trailers. Despite the extensive facilities, the area is overcrowded on weekends during fishing season. Unfortunately, there is insufficient space for expansion.

12. Fitzgerald - Anderson/Stokes Tract

This 542 acre tract was also recently acquired from Delaware Wildlands Inc. The area is all wetland, and as such, access can be obtained only by water transportation. There are no plans to provide land access and the area will be managed for waterfowl hunting and wildlife purposes.

13. Primehook Wildlife Area

This 635 acre wildlife area is nestled within the Primehook National Wildlife Refuge. About 585 acres are wetland and it serves primarily as a waterfowl hunting and nature study area. Small boat access with parking for 25 cars is provided and the Division plans another launching facility on Primehook Creek just below Waples Mill Pond.

14. Milton Access Area

The Division owns a perpetual easement from the town of Milton on 0.7 acres and operates a launching ramp with access to the Broadkill River. The area can accommodate 10 cars and trailers. It is not heavily used.

15. Oyster Rocks

The Division has leased this 15 acre wetland site along the Broadkill River and had plans to construct launching facilities there. Since the passage of the Wetlands Act, these plans have been abandoned, because ramp construction would require extensive filling.

16. Lewes Access Area

This area was obtained from Lewes by perpetual easement. Located along the Lewes-Rehoboth Canal, this 1.7 acre site has one double-wide launching ramp and parking for 90 cars and trailers. Its location, relative to prime Delaware Bay fishing waters and the Atlantic coast resorts, results in overcrowding during the fishing season.

17. Love Creek Access Area

This 34 acre site was acquired by the Division to provide much needed public access to Rehoboth Bay. Plans include construction of several boat ramps with parking facilities for 50 cars and trailers initially and eventually expanded to 100. The site is presently undeveloped because of a dispute with a nearby private marina owner who claims the public ramps would interfere with his business.

18. Rosedale Access Area

The Division has a perpetual easement to this site which provides boating access to Indian River Bay. The area consists of a double-wide launching ramp and parking for 300 cars and trailers. The facility is heavily used, but primarily by local seasonal residents.

19. Pepper Creek Access Area

As with Oyster Rocks, this 17.5 acre site is nearly all wetland and will probably never be developed because of restrictions imposed by the Wetlands Act.

20. Assawoman Wildlife Area

This area was originally acquired during the depression by the U.S. Department of Agriculture and used as a Civilian Conservation Corps camp. The property was deeded to the State in 1954 for "public conservation purposes". The 1,451 acre site contains about 400 acres of wetland on the Little Assawoman Bay and its tributaries. A portion of the wildlife area is located on the barrier beach between two tracts of Delaware Seashore State Park. There are three launching areas for small boats, two on the mainland and one on the barrier which provide access to the Bay for waterfowl hunting, fishing and crabbing. Parking is available for a total of about 45 cars and trailers. The area is also used for picnicking, nature study, hiking and other day use activities. An observation tower provides an excellent view of the wetlands, bay and the undeveloped barrier beach to the east. A youth camp operated by the Delaware Association of Chiefs of Police is also located here and it provides recreation opportunities for disadvantaged children.

21. Nanticoke Wildlife Area

The Division administers this 1,850 acre, primarily upland, tract along the Nanticoke River and Broad Creek just west of Laurel. The river is fringed with wooded swamps, freshwater marshes and a large stand of wild rice. Access is provided at Phillips Landing. The Division operates two launching ramps and has provided parking for 100 cars and trailers. The area is heavily used year round for picnicking, hunting, fishing, nature study and water skiing. The banks of both the Nanticoke River and Broad Creek are perhaps the least developed of any major river system in the State. Because of this and the biological diversity of the areas, these rivers have been designated by the Kent and Sussex Counties Critical Natural Area Study as worthy of preservation. A large portion of this designated area is within the wildlife area.

The area also contains an archaeological site and three mature stands of the rare and endangered box huckleberry. Access to Broad Creek is also provided by numerous roads through the area.

Department of Transportation

The Division of Highways owns a small boat launching area at Barkers Landing on St. Jones River. Informal parking exists for about 15 to 20 cars and trailers. The State also owns two acres of land at Fowler Beach and had installed a timber launching ramp there. Rapid beach erosion has reduced this holding somewhat and the ramp is now offshore and unuseable. The Division, however, still maintains the rights-of-way to the shoreline. Other public rights-of-way to otherwise private Delaware Bay beaches also exist at Bennetts Pier, Big Stone Beach and Primehook Beach.

Delaware Route 9 from New Castle to Dover is an exceptionally scenic road through rural Delaware. There are numerous scenic overlooks where the road crosses tidal streams and wetlands.

The Division also owns numerous rights-of-way which dead-end at the waters edge along the Atlantic Coast in the communities of Rehoboth-By-The-Sea, Dewey Beach and Fenwick Island. The Division also owns a right-of-way to Rehoboth Bay at Dagsworthy Street in Dewey Beach which is used to launch small boats. The Division of Soil and Water Conservation of DNREC maintains dune crossings at many of these locations.

Division of Parks and Recreation

1. Fort Delaware State Park

Located on Pea Patch Island in the Delaware River near Delaware City, this fort served as a prison for Confederate POW's. The old fort, designated a National Historic Site, houses a museum of Civil War memorabilia. The northern portion of the island is a site of the State's largest nesting colony of egrets, herons, and ibis. The 161 acre site also provides picnic facilities and a nature trail.

The Fort Delaware Historical Society owns and operates a tour boat to the island and parking for about 80 cars is available in Delaware City. The Division is in the process of redeveloping the urban waterfront. When completed, the project will entail a visitor center, new bulkheading and rebuilt docking facilities, as well as a public launching area. The fort is also accessible by small boat although docking facilities are not provided.

2. Holts Landing State Park

Holts Landing is located on the south shore of Indian River Bay. The park is 33 acres in size of which about 25 percent is wetland. The area is used primarily for swimming, shellfishing and fishing and has parking facilities for 150 cars. Small boats may be launched there although parking for boat trailers is quite limited.

3. Cape Henlopen State Park

Cape Henlopen State Park is a natural area of great diversity. A rapidly accreting spit, a large migrating sand dune (the largest in the Middle Atlantic), and an eroding shoreline combine to create a land form of national interest geologically. Once a sand barrier/lagoonal system, the present physiography of the cape includes salt marshes, "walking" and stabilized dunes, and ancient recurved spit tips. Also within the park are several shell middens of archaeological significance, the location of an early saltworks at Gordons Pond, and a seabird nesting colony which provides habitat for the threatened least tern. These features have led to the designation of a large portion of the park as an area worthy of preservation by the Kent and Sussex Counties Critical Natural Areas Study. The recommended area includes the shore of the Delaware Bay, the spit tip, the ocean front dunes, and most of the area south of the Great Dune to the Lewes and Rehoboth Canal.

The park contains 2,588 acres, 162 camp sites, a bath house, a resident youth camp, a fishing pier, nature trails and the Seaside Nature Center. Activities include picnicking, swimming, surf fishing and related day use activities. The Department of the Army has recently agreed to turn over 176 acres of its 190 acre in-holding to the State. Efforts are also underway to acquire some or perhaps all of the in-holding owned by the Navy.

Pedestrian access to the Delaware Bay shoreline is afforded at the fishing pier and northern watch tower which have parking for 25 and 30 cars respectively. Present plans include reconstruction of the fishing pier and the addition of parking facilities to accommodate 75 more cars. Access is also possible from the bay shore nature trail.

Access to the Atlantic shore is also provided at the northern watch tower. Here there is a fishing vehicle crossover and parking for 50 cars. Just north of the Great Dune are parking for 500 cars and a modern bath house. The Division plans to construct another identical bath house and parking lot to the south of the existing facilities to provide additional access. There is another fishing vehicle crossover in the vicinity of the Great Dune.

Although the intervening federal lands prevent direct access to the southern portion of the park, vehicular access is provided from the Rehoboth area. The entire Bay and Ocean shoreline is open to the public.

At Whiskey Beach, in the southern portion of the park, parking facilities exist for 450 cars and there is a fishing vehicle crossover. The Division eventually plans to construct a bath house here. A hiking trail is also planned which will provide access to Gordons Pond Wildlife Area and the Lewes Creek Marshes. Boating access is, of course, available via the Lewes and Rehoboth Canal.

Recent permission for fishing vehicle access to the tip of the cape has raised a concern over the integrity of the least tern nesting site. These birds nest on the dry sand beach above the high tide line. Vehicular access to the cape during 1978 resulted in complete failure of the nesting colony to produce fledglings. There is no doubt that continued use of the cape by fishing vehicles and intense recreation activities, which until this year were prohibited, will result in abandonment of the site by the terns.

4. Delaware Seashore State Park

Delaware Seashore State Park consists of two separate tracts of Atlantic barrier beach totaling 2,000 acres. The northern-most tract, and the largest and most heavily used, extends from Indian Beach to Cotton Patch Hills. The other tract extends from York Beach to the town of Fenwick Island.

There are three large public access areas within the park at Tower Road, north Indian River Inlet and south Indian River Inlet. The facilities at Tower Road consist of a 500 car parking lot, portable sanitary facilities and several pedestrian crossovers. The area is used primarily for swimming and related activities although fishermen use it in the off-season. The Division plans to construct a much needed bath house here. The lack of adequate sanitary facilities has limited its use in favor of other areas.

At north Indian River Inlet is a 100 car parking lot west of Route 1. Access is available under the inlet bridge. This area is used for surfing and fishing along the jetty. Swimming is not permitted. Between Tower Road and the inlet are four limited-use ocean access areas at Key Box Road, Halfway Road, Conquest Road, and an unnamed area about one mile north of the inlet. These areas provide parking for 35, 35, 75, and 30 cars respectively. Each area provides pedestrian access and the two southern most locations have fishing vehicle crossovers. Surf fishing is the predominant use along this beach.

There are four access areas along the bayside of the barrier. One is used for swimming and picnicking primarily and provides parking for 100 cars. Another area provides parking for about 100 cars and small boat launching along the beach. Shellfishing is the primary activity and swimming is prohibited. The other two areas are near the inlet and have parking capacities of 50 and 10 cars respectively. Picnicking and shellfishing are the main attractions.

The Division operates and maintains a marina near Burtons Island on the north side of the Inlet. Present facilities include a public launching ramp with a capacity of about 50 cars and trailers, a parking area, boat rental and snack bar. The marina is the location of a number of charter and headboats. Slip rental is also available to the public. The Division plans major improvements to this area in the near future. These include dredging the yacht basin, dock reconstruction, bulkheading to stem the erosion of the inlet shore, and construction of a 500 car parking lot. Burtons Island, which is presently inaccessible except by water, will be connected to the barrier by a foot bridge and hiking and nature trails will be developed.

South of Indian River Inlet is the most heavily used, State owned beach. The area has parking for 500 cars and a modern bath house. The parking lot usually reaches capacity before noon on Summer weekends and visitors must be turned away. Planned construction of the bath house at Tower Road and another 500 car parking lot and bath house to the south should alleviate this overcrowding. The beach south of the inlet also has two fishing vehicle crossovers and a small 30 car parking lot for surf fishermen.

On the bayside of the inlet, the Division has 295 campsites. The campground is filled on summer weekends because of excessive demand. Private camping facilities also are available at the South Shore Marina.

The southern tract is largely undeveloped. It contains one 200 car parking lot with pedestrian access to the ocean and portable sanitary facilities.

There are also two fishing vehicle crossovers. There are no plans at present to expand access at this location. There are several private in-holdings east of Route 1 although the beach itself is in State ownership. This is the only area in Delaware where intervening private property prevents direct access to a public beach. Lateral access is available though. As mentioned previously, there is a small boat launching facility on the bay which is part of the Assawoman Wildlife Area holdings on the barrier.

The marsh island complex on the east side of the barrier along Rehoboth Bay has been designated by the Kent and Sussex Counties Critical Natural Areas Study as being worthy of preservation. This area is the location of the most productive osprey nesting colonies in Delaware (16-19 active nests). A portion of this area is privately owned.

Other State Beaches

The State owns four other tracts of beach frontage along the Atlantic coast and Delaware Bay.

1. Deauville Beach

This 21.5 acre tract of State owned beach is located within city limits of Rehoboth Beach and is administered by the City. There are three dune crossings and parking for about 75 cars, but no sanitary facilities.

2. Dewey Beach

The State owns a 10 acre tract between Bellvue and Collins Streets in the unincorporated community of Dewey Beach. The State maintains dune crossings at each street end, but no other facilities are provided. Since public parking space is very limited, this beach is used primarily by renters of summer cottages or motel rooms. Beach use is moderate compared with Rehoboth and Bethany Beaches, because of the parking limitations for day visitors.

3. Fenwick Island

The State owns 7.7 acres of beach frontage in the unincorporated area south of the Fenwick Island

town limits to the Maryland border. There are numerous streets dead-ending at the beach which have been used by the public for access. Street parking is available, but there are no public parking lots.

4. Lewes Beach and Beach Plum Island

These two tracts of Bay frontage are separated by Roosevelt Inlet. Although the area is State owned, the Legislature transferred administrative authority to the City of Lewes. The publicly accessible beach extends from Roosevelt Inlet to the Cape May/Lewes Ferry terminal. It is 12,000 feet in length and consists of 23 acres of dry sand beach and 33 acres of dune lands. Parking for about 200 cars is available in the municipal parking lot at Savannah Road and another 25 cars may be parked at the inlet. Street parking is available throughout the area and public rights-of-way to the beach exist at all street ends. In addition to normal beach use activities, fishing is popular at the inlet as is sailboat launching from the beach. The beach is seldom, if ever, crowded.

Beach Plum Island is a 128 acre washover barrier lying northwest of Roosevelt Inlet. The island is accessible only by water, foot or four wheel drive vehicle from the southern end of Broadkill Beach. There are no roads through the area. The barrier is the only relatively unaltered expanse of beach on the lower Delaware Bay. Because it possesses great beauty and ecological diversity, it has been designated by the Kent and Sussex Counties Critical Natural Areas Study as being worthy of preservation.

Beaches Dedicated to Public Use

With the exception of a one block segment between Jersey and Carolina Streets, the beach frontage, extending south from the Rehoboth Beach city limits to the State lands at Dewey Beach, is dedicated in perpetuity to public use. The tract is approximately 10 acres. This beach is an anomaly along the Delaware coast.

This dedicated beach was created in the early 1900's when the old Public Lands Commission was overseeing the sale of public lands in the Dewey Beach Area. These lands, including the beach, were sold to developers. These developers subsequently subdivided and sold lots to individuals, but dedicated the beach to public use. There is some question as to whether the State or Sussex County is the legal custodian to this beach, although the State offers trash collection and lifeguard services at present. There are no other public services at this location. Public access is available at the ends of each street, but parking is very limited. The area is used primarily by those renting cottages and motel rooms in the vicinity.

Public Use Easements

As part of the State's beach erosion control program, DNREC has acquired (usually by donation) easements to several Delaware Bay beaches. The primary purpose of these easements is to allow beach maintenance equipment on the beach to perform erosion control work on private property when necessary. The easements also provide for public use of these beaches, however, access to the beach is severely restricted, and public parking is either non-existent or very limited. On the other hand, none of these beaches possess the amenities present on the Atlantic coast. It is unlikely that the public would use these beaches extensively, even if additional access and parking were available. In general the public had not benefited in proportion to the amount of tax dollars expended for erosion control at these beaches, which provides the quid pro quo for the public use easements.

1. Pickering Beach

Public use easements exist on 2,600 linear feet of beach, but there are no legal access points. Access can be gained near the road end and at either end of the developed area. These access points are privately owned and could be closed at any time.

2. Kitts Hummock

Public use easements exist along 4,000 feet of beach.

Access is available at a State owned right-of-way which extends to the beach and at the northern end of the developed beach where parking for a few cars exists. The latter access point is privately owned and could be closed at any time.

3. Bowers Beach

Public Use easements exist along 2,800 feet of beach. Access exists at a roadway extending to the beach. Ample parking is available by virtue of the public launching area parking lot located nearby.

4. South Bowers

Public use easements exist along 1,900 feet of beach although no legal access points exist. Most of this beachfront was dedicated by the original owner to public use long before the existence of the beach erosion control program.

5. Slaughter Beach

Public use easements exist along 14,300 feet of beach. Public access is available at some street ends and a public parking area for about 15 cars exists adjacent to the firehall.

6. Broadkill Beach

Public use easements have been obtained along 8,700 feet of beach. There are no parking facilities. Access points exist at some street ends.

U.S. Fish and Wildlife Service

1. Bombay Hook National Wildlife Refuge

The refuge comprises 15,135 acres, of which about 10,500 acres are brackish tidal marsh. The remainder includes 1,200 acres of impounded fresh water pools, brushy and timbered swamps, 1,000 acres of cropland, and timbered and grassy upland. Bombay Hook is primarily a refuge for migrating and wintering ducks and geese, but it also offers a haven for large numbers of land and shore birds.

The recreational uses of the area include nature study, photography, sightseeing and hunting on a limited basis. Observation towers, nature trails, rest rooms, picnic tables and an information booth are also provided. Vehicular access is provided by a road system around Raymond, Shearneck and Bear Swamp pools.

About 6,000 acres of marshland, comprising Bombay Hook, Kent and Kelly Islands have been designated by the Kent and Sussex Counties Critical Natural Areas Study as being worthy of preservation in their natural state. The refuge also contains a nesting site of the Southern Bald Eagle which has been occupied since 1966.

A launching area for small boats is available on the refuge and larger boats may be launched at the State owned facility at Port Mahon.

2. Primehook National Wildlife Refuge

Primehook National Wildlife Refuge was established in 1963 primarily to preserve coastal wetlands that are historically of high value as waterfowl habitat. The refuge is presently 8,750 acres. The Congressionally approved take-line encompasses 10,700 acres. When complete, the area will consist of 7,300 acres of marsh and water, 1,200 acres of timber and brush and cropland 2,100 acres of pasture and cropland.

Permitted public uses include fishing, canoeing, boating, sightseeing, hiking, photography, hunting and similar activities. Vehicular access is gained by several state roads traversing the area and a small internal road network. Observation towers and nature trails are planned.

A 1,200 acre tract within the refuge along Primehook Creek has been designated by the Kent and Sussex Counties Critical Natural Areas Study as being worthy of preservation. The area is ideally suited for a wilderness canoe trail. The distance between Waples Pond and Foord landing is about 5 miles. Private canoe rentals are available at Waples Pond.

U.S. Army Corps of Engineers

See Division of Fish and Wildlife - Chesapeake and Delaware Canal Lands.

Departments of the Army and Navy

The Department of the Army owns a 190 acre oceanfront site within Cape Henlopen State Park. The Army has recently declared all but about 14 acres as surplus and will deed the remainder to the State as an addition to the park. The retained land will continue to be used as a rest and relaxation area for officers.

The Navy owns three separate parcels within Cape Henlopen State Park. A 15 acre oceanfront tract is presently used for Naval Reserve training. The remaining 374 acres are used as a communication center. All military tracts are closed to the public, however, lateral access along the beach is permitted.

Locally Owned Access Areas

1. Fox Point Park

This 171 acre site was purchased from the Penn Central Railroad by the State and subsequently deeded to New Castle County. The parcel is a narrow strip of land along three miles of the Delaware River north of Claymont. There are no access facilities there at present, but the County plans to construct a park road and a hiking and bicycling trail the length of the park. A boat launching ramp and docking facility may also be built if they prove feasible.

2. Battery Park

Owned by the City of New Castle, this 78 acre park is located on the banks of the Delaware River adjacent to the New Castle Historic District. The park includes a fishing pier, small boat launching facility and a river front foot path. This park provides one of the best vantage points to watch the commercial ships plying the Delaware. The park is also the site of the New Castle Sailing Club. The Club owns several sailboats and membership is open to anyone who wants to learn to sail.

3. Ommelanden Park

Owned by the New Castle County Department of Parks and Recreation, this 224 acre park is located on the Delaware River south of New Castle. At present there are no facilities there other than informal hiking trails. Although the shorefront is bordered by about 80 acres of wetland, there is access to the river front. The County intends to develop some of the inland acreage for active recreation. The southern portion, which includes some woodland and most of the wetlands, will be left in its natural state.

4. Coventry Ridge Park

This 85 acre county park is located on the upper Christian River. Developed primarily for active recreation, riverfront access is provided by informal walking trails.

5. Lewden-Green

Also located on the upper Christina River this county owned 89 acre park has not been developed. Access is provided to the river by informal trails. The county may develop a small boat launching facility here.

6. Christiana Park

This 6 acre urban waterfront park is owned by the City of Wilmington and provides physical and visual access to the Christina River just upstream from the Wilmington Marine Terminal.

7. Kirkwood Park

Also owned by the City of Wilmington, this 8 acre park provides access to the tidal portion of the Brandywine Creek. The area is primarily devoted to active recreation.

8. Delaware City Access Area

Delaware City owns a single boat ramp on the C and D Branch Canal and parking is provided for 20 to 30 cars and trailers along the city streets.

9. Little Creek Access Area

The town of Little Creek owns and operates a small boat ramp on 0.2 acres of land on the Little River near Route 9.

10. Millsboro Access Area

The Town of Millsboro owns two launching ramps on 11 acres of land adjacent to the Broadkill River. Other facilities include 5 docks and parking for 40 cars and trailers.

11. Seaford

The City of Seaford owns two acres of land along the Nanticoke River with two boat ramps and pic-nicking facilities.

12. Milford

The Mispillion River flows through downtown Milford and the city owns five parcels of land along the river bank which are being developed as a public park. The area presently contains a boat launching facility and water oriented passive recreation facilities. The park will eventually be further developed for passive recreation such as walking, fishing, and similar activities. The City also owns Goat Island, an 11 acre parcel located in an oxbow of the river. A pedestrian walkway provides access and plans exist to develop a nature trail on the island.

13. Rehoboth Beach

Rehoboth Beach is the most popular beach resort in Delaware. The City owns 33 acres of beach-land which are dedicated to public use and provides lifeguards and sanitary facilities. Continuous access is provided along the boardwalk. The beach is used close to capacity on most summer weekends.

Increased public use is limited, because parking space is at a premium close to the beach. A proposal to acquire a large parcel of land west of the Lewes and Rehoboth Canal to provide, among other things, additional parking and a jitney service to the beach has been discussed, but no decision has yet been made.

14. Bethany Beach

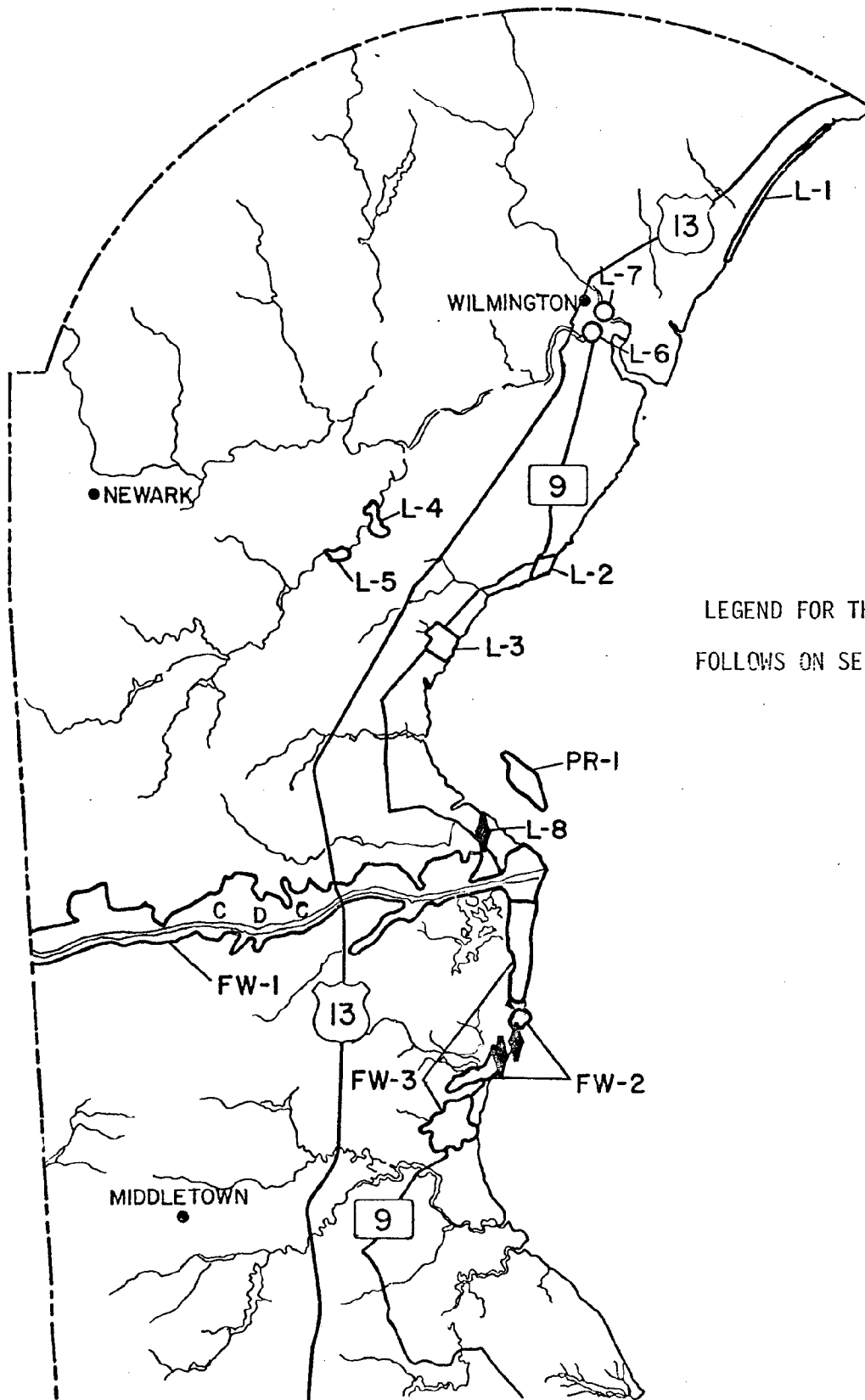
The Town of Bethany Beach owns 26 acres of beachfront which has been dedicated to public use and provides lifeguards and sanitary facilities. Access is continuous along the boardwalk. This area is Delaware's second most heavily used beach and the central section is near capacity during the summer weekends. Parking space presently limits increased useage.

15. Fenwick Island

The Town of Fenwick Island owns about 16 acres of beachfront which are dedicated to public use. The town provides lifeguards but no sanitary facilities. Access is gained at numerous public rights-of-way which extend to the beach. Limited street parking is available, but no public parking lots. The beach is used primarily by residents and those renting cottages or motel rooms.

FIGURE I

PUBLICLY OWNED OR MANAGED LANDS
PROVIDING PUBLIC ACCESS TO TIDAL WATERS



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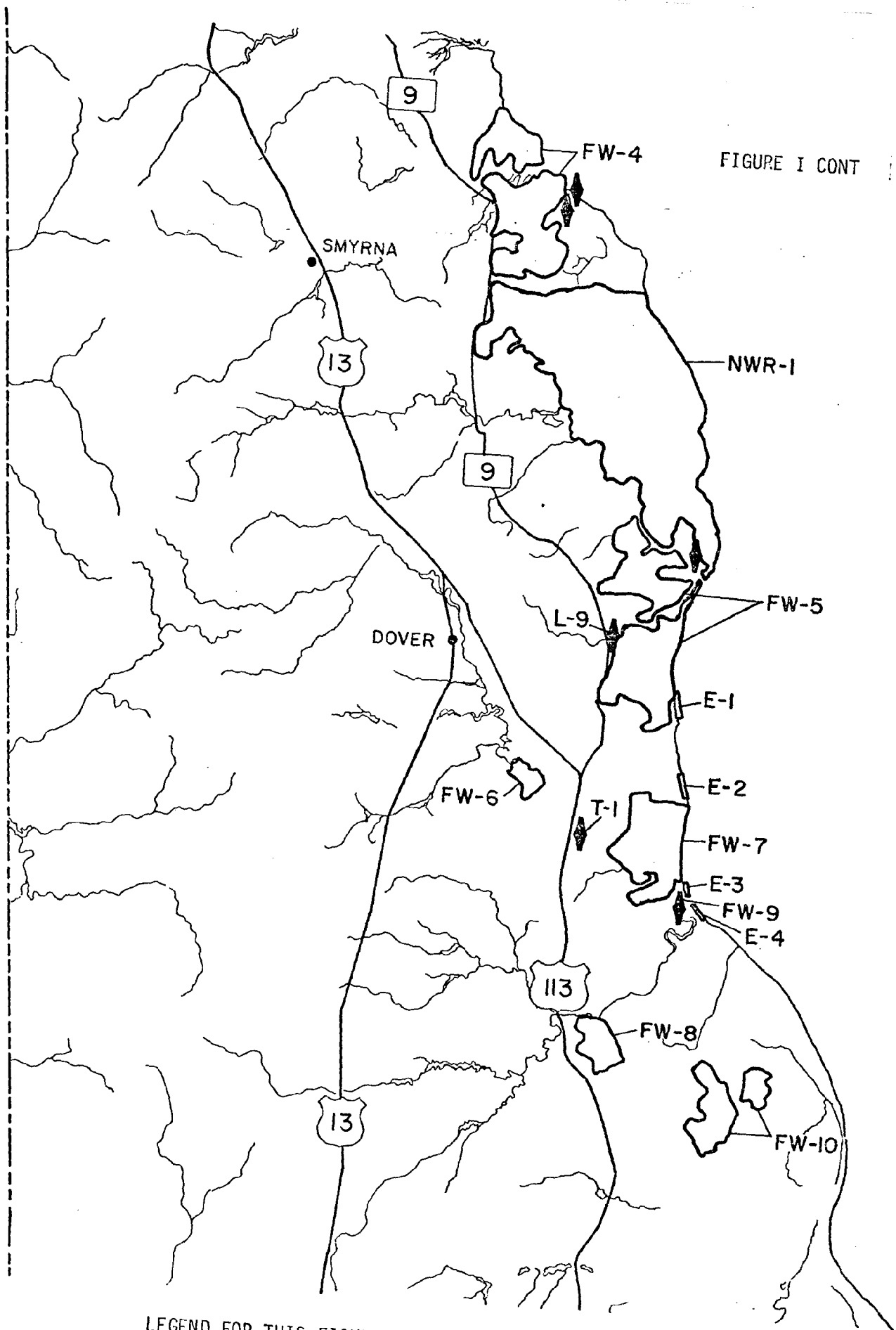
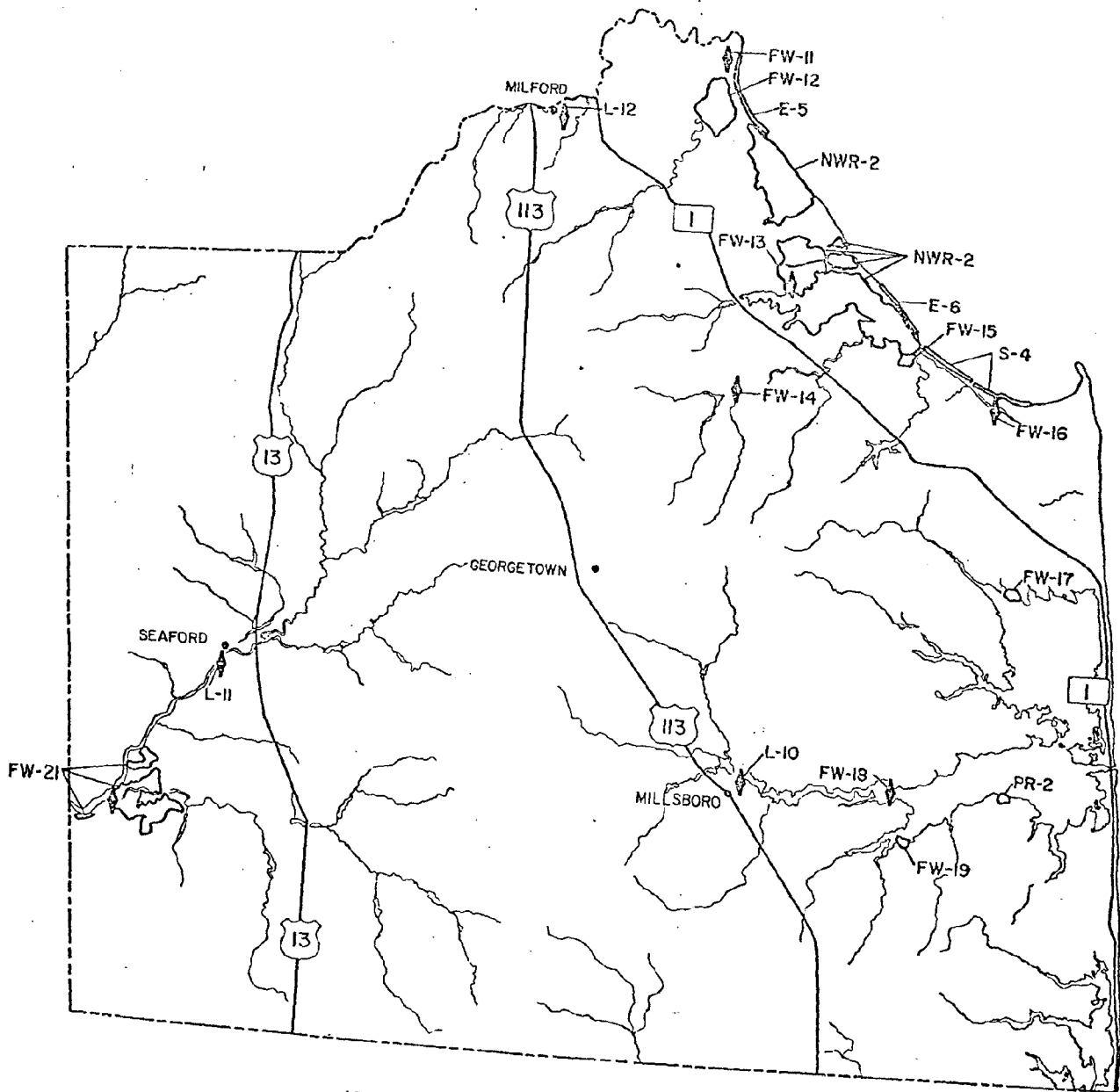


FIGURE I CONT

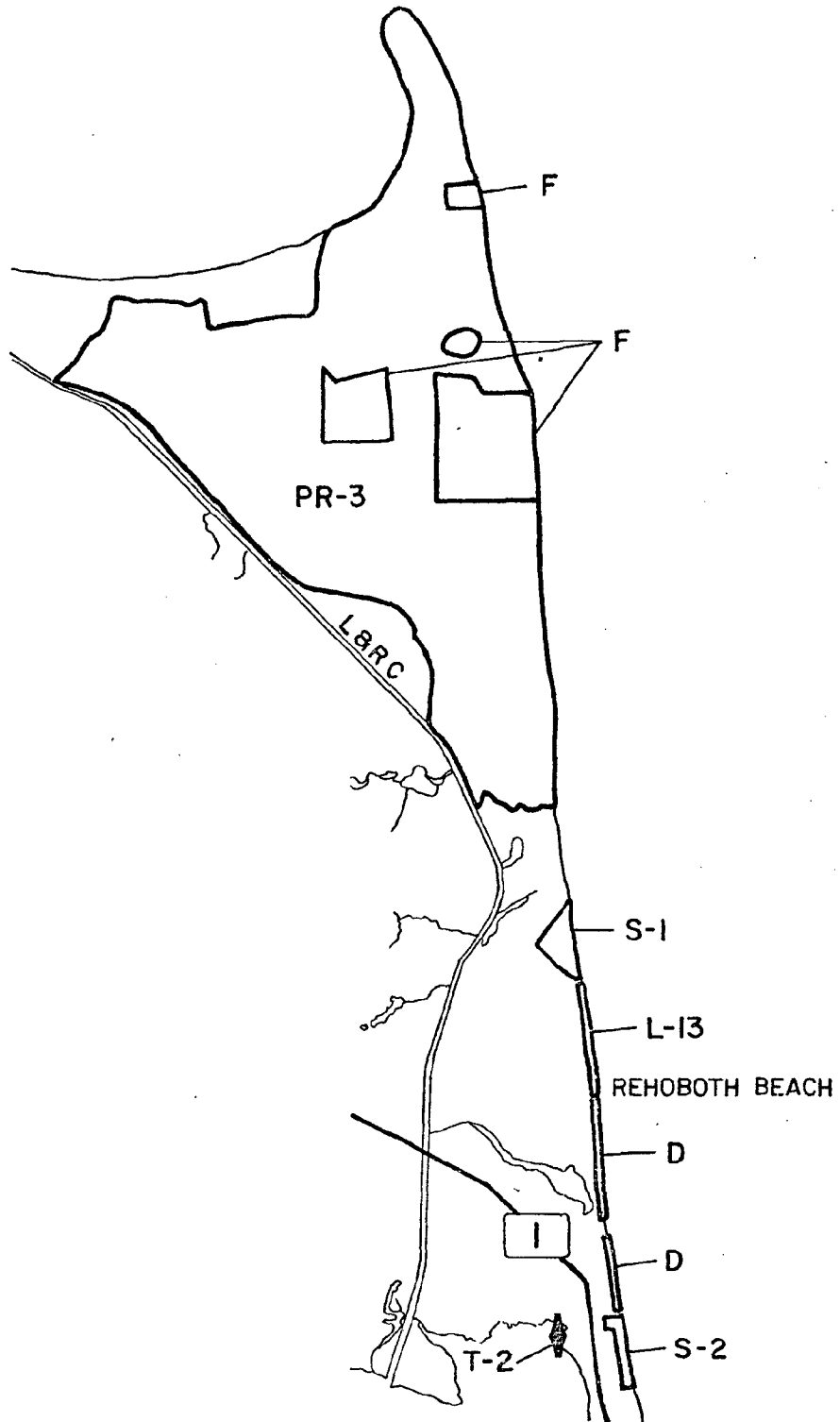
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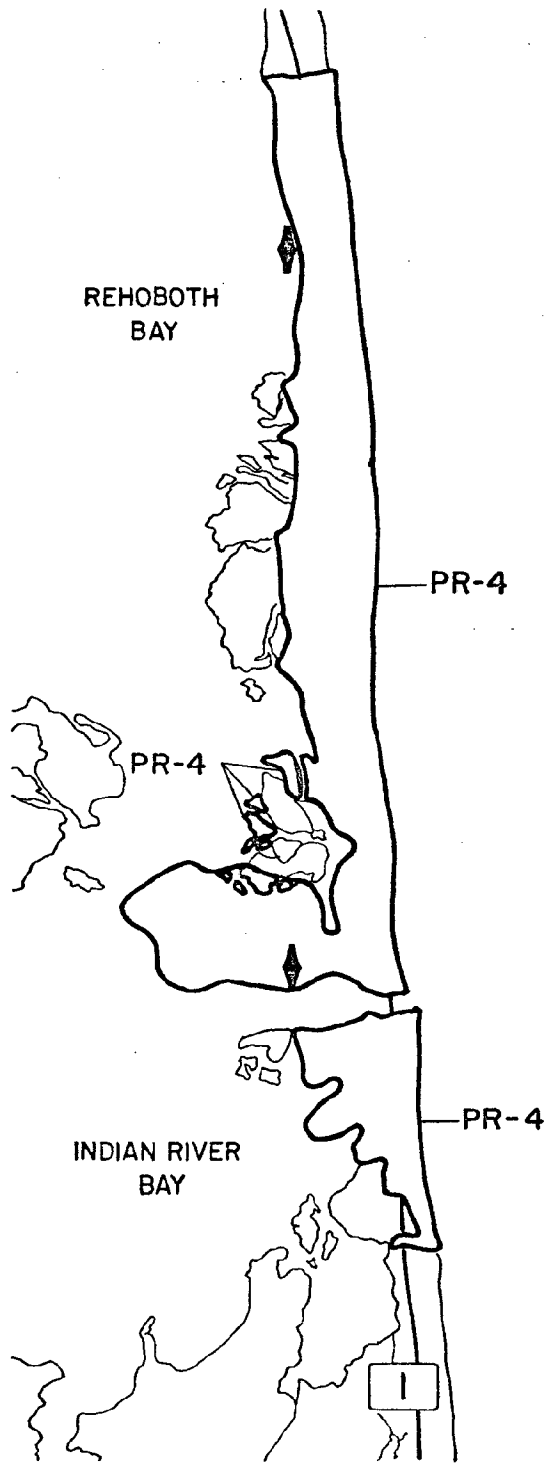
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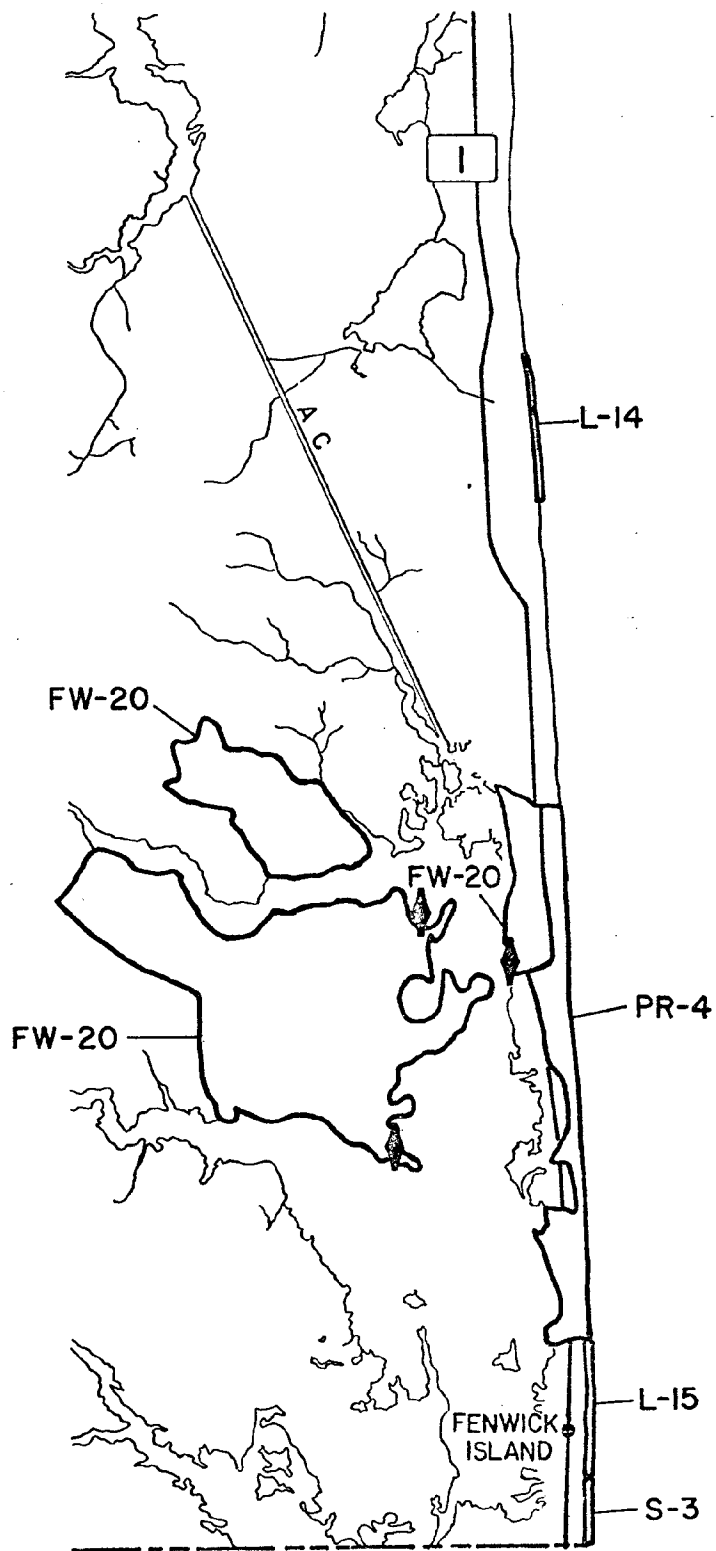
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Legend of Figure # 1

DIVISION OF FISH AND WILDLIFE, DNREC

FW-1 Chesapeake and Delaware Canal
FW-2 Augustine Fishing Area
FW-3 Augustine Wildlife Area
FW-4 Woodland Beach Wildlife Area
FW-5 Little Creek Wildlife Area/ Port Mahon
FW-6 Roberts Tract
FW-7 Lofland and Buckaloo Tracts
FW-8 Penuel - Elfreth Bamberger Tracts
FW-9 Bowers Access Area
FW-10 Milford Neck Wildlife Area
FW-11 Cedar Creek Access Area
FW-12 Fitzgerald - Anderson/ Stokes Tract
FW-13 Primehook Wildlife Area
FW-14 Milton Access Area
FW-15 Oyster Rocks
FW-16 Lewes Access Area
FW-17 Love Creek Access Area
FW-18 Rosedale Access Area
FW-19 Pepper Creek Access Area
FW-20 Assawoman Wildlife Area
FW-21 Nanticoke Wildlife Area

DEPARTMENT OF TRANSPORTATION

T-1 Bakers Landing Access Area
T-2 Dagsworthy Street Access Area

DIVISION OF PARKS AND RECREATION, DNREC

PR-1 Fort Delaware State Park
PR-2 Holts Landing State Park
PR-3 Cape Henlopen State Park
PR-4 Delaware Seashore State Park

OTHER STATE BEACHES

S-1 Deauville Beach
S-2 Dewey Beach
S-3 Fenwick Island
S-4 Lewes Beach and Beach Plum Island

BEACHES DEDICATED TO PUBLIC USE

D Rehoboth/ Dewey Beach

BEACHES WITH PUBLIC USE EASEMENTS

E-1 Pickering Beach
E-2 Kitts Hummock
E-3 Bowers Beach
E-4 South Bowers
E-5 Slaughter Beach
E-6 Broadkill Beach

U.S.FISH AND WILDLIFE SERVICE

NWR-1 Bombay Hook National Wildlife Refuge
NWR-2 Primehook National Wildlife Refuge

DEPARTMENT OF DEFENSE

F- U.S. Military Reservation

LOCAL GOVERNMENT

L-1 Fox Point Park
L-2 Battery Park
L-3 Ommelanden Park
L-4 Coventry Ridge Park
L-5 Lewden Green
L-6 Christina Park
L-7 Kirkwood Park
L-8 Delaware City Access Area
L-9 Little Creek Access Area
L-10 Millsboro Access Area
L-11 Seaford Access Area
L-12 Milford
L-13 Rehoboth Beach
L-14 Bethany Beach
L-15 Fenwick Island

V. STATE MANAGEMENT POLICIES

BEACH AND SHORELINE ACCESS

1. THE SUPPLY AND DEMAND FOR ACCESS TO DELAWARE'S PUBLIC BEACHES AND OTHER SHORELINES SHALL BE STUDIED PERIODICALLY THROUGH THE STATEWIDE COMPREHENSIVE OUTDOOR RECREATION PLANNING PROCESS (SCORP). WHEN THE NEED FOR ADDITIONAL ACCESS FACILITIES TO THESE PUBLIC BEACHES AND SHORELINES, BEYOND THOSE ALREADY PLANNED, IS ESTABLISHED, THE STATE SHALL UNDERTAKE EFFORTS TO PROVIDE SUCH ACCESS AS LONG AS IT CAN BE DONE IN A MANNER CONSISTENT WITH THE PURPOSES FOR WHICH THESE LANDS WERE SET ASIDE.

Delaware is fortunate to own a substantial amount of shore and beach land, particularly along the Atlantic coast, which is readily accessible to the public. There is, at present, plenty of publicly accessible beachfront in Delaware. Growth in public usage of these lands, however, has been increasing yearly and there may come a time when the demand for access facilities, particularly parking and sanitation, will approach the existing and planned supply. The policy recognizes this possibility and provides for continued monitoring of beach and shore use, so that additional access areas can be provided in advance of the need.

"THE PUBLIC LANDS"

2. DNREC SHALL SUPERVISE CONTROL AND CARE FOR DELAWARE'S "PUBLIC LANDS."

DNREC is the logical choice for this responsibility because of its other involvement with the lands.

3. THE STATE SHALL PURSUE ALL NECESSARY AND APPROPRIATE REMEDIES TO ADDRESS ENCROACHMENTS UPON STATE "PUBLIC LANDS" AND TO PROTECT THEIR INTEGRITY FROM CLAIM.
4. ALL PRIVATE DEVELOPMENT ON "PUBLIC LANDS," EXCEPT THAT AUTHORIZED BY DNREC FOR PUBLIC USE, SHALL BE PROHIBITED.

5. THE "PUBLIC LANDS" SHALL REMAIN APPROPRIATELY MARKED WITH PERMANENT MONUMENTS AND THE LOCATION AND COORDINATES OF EACH MONUMENT SHALL BE TIED TO THE STATE PLAN COORDINATE SYSTEM AND RECORDED WITH THE RECORDER OF DEEDS FOR SUSSEX COUNTY. DETAILED DRAWINGS, SURVEY WORK SHEETS AND FIELD NOTES, PERIMETER DESCRIPTIONS, AND OTHER PERTINENT PROPERTY RECORDS SHALL BE LIKEWISE RECORDED.
6. DNREC SHALL MANAGE THESE LANDS FOR PUBLIC RECREATION PURPOSES AND FOR THE CONSERVATION AND PRESERVATION OF THEIR NATURAL RESOURCES AND BEAUTY. A MANAGEMENT PRIORITY SHALL BE THE MAINTENANCE OF PUBLIC ACCESS TO THE BEACH AND OCEAN WHERE SUCH ACCESS CAN BE ACCOMODATED WITHOUT SERIOUS DAMAGE TO THE PRIMARY RESOURCES. THE DEPARTMENT MAY LEASE CERTAIN PORTIONS FOR HIGHWAY AND UTILITY PURPOSES AS IT DEEMS ADVISABLE AND FOR THE PUBLIC GOOD. MANAGEMENT OF THESE LANDS SHALL BE CONSISTENT WITH THE STATE COMPREHENSIVE OUTDOOR RECREATION PLAN (SCORP) AND IN ACCORDANCE WITH SOUND MASTER PLANNING ACTIVITIES.

PRIORITY OF USES FOR THE "PUBLIC LANDS"

The priority of uses for these areas has been established in the master plans for the State Parks, and to some extent, in portions of the CMP document. The master plans, particularly the one for Delaware Seashore State Park, point out that public recreation activities are to be conducted in accordance with the natural capabilities of the landforms involved. The following highlights the priorities for these especially valuable lands:

- a) Beach (ocean edge to foot of the dune) - these areas shall be used for intense recreation activity, such as swimming, sunning, and sport fishing. They shall not be the locations of permanent structures or other facilities which could be damaged by normal erosion and storm events (aids to navigation approved by the U.S. Coast Guard and the State are exceptions). Concentration of intense use is of the highest priority in order to maintain appropriate user services in an efficient and effective manner.

- b) Dunes - these areas should be preserved with human activity on them being restricted. The highest priority use shall be storm buffers with appropriate efforts undertaken to maintain them with beach grass and sand fences. Access across the dunes shall be limited to wooden walkways.
- c) Back dunes and bay marsh (landward toe of the dune westerly to the bay) - primary uses of these areas are passive recreation and limited water contact activities. Access areas, sanitary facilities, and limited recreational services are permissible, provided disturbances to the natural features are minimized.

Lowest priority uses are the location of highways, utilities, and other services unless they are part of the overall park development plan.

NATURAL AREAS PRESERVATION

- 7. THE STATE, ACTING THROUGH DNREC, SHALL ACQUIRE AND HOLD IN TRUST FOR THE BENEFIT OF THE PEOPLE AN ADEQUATE AMOUNT AND QUALITY OF LAND AND WATER FOR THE FOLLOWING USES AND PURPOSES;
 - A. FOR SCIENTIFIC RESEARCH IN SUCH FIELDS AS ECOLOGY, TAXONOMY, GENETICS, FORESTRY, PHARMACOLOGY, AGRICULTURE, SOIL SCIENCE, GEOLOGY, CONSERVATION, ARCHAEOLOGY, AND OTHER SUBJECTS;
 - B. FOR THE TEACHING OF BIOLOGY, NATURAL HISTORY, ECOLOGY, GEOLOGY, CONSERVATION AND OTHER SUBJECTS;
 - C. AS HABITATS FOR PLANT AND ANIMAL SPECIES AND COMMUNITIES AND OTHER NATURAL OBJECTS;
 - D. AS RESERVOIRS OF NATURAL MATERIALS;
 - E. AS PLACES OF NATURAL INTEREST AND BEAUTY;
 - F. AS LIVING ILLUSTRATIONS OF OUR NATURAL HERITAGE WHEREIN ONE MAY OBSERVE AND EXPERIENCE NATURAL BIOTIC AND ENVIRONMENTAL SYSTEMS OF THE EARTH AND THEIR PROCESSES;

- G. TO PROMOTE UNDERSTANDING AND APPRECIATION OF THE SCIENTIFIC, EDUCATIONAL, AESTHETIC, RECREATIONAL AND CULTURAL VALUES OF SUCH AREAS BY THE PEOPLE OF THE STATE OF DEL-AWARE;
- H. FOR THE PRESERVATION AND PROTECTION OF NATURAL AREAS AGAINST MODIFICATION OR ENCROACHMENT RESULTING FROM OCCUPATION, DEVELOPMENT, OR OTHER USE WHICH WOULD DESTROY THEIR NATURAL OR AESTHETIC CONDITIONS.

This policy obviously encourages the maintenance of certain areas in their natural state. The specific policy statements and commentary below provide the mechanics which will implement the general CMP policy.

The key word in this general policy statement is "adequate." The CMP leaves it to DNREC to determine what constitutes an adequate amount and quality of land and water. There are at least two reasons for such discretion. One, the financial burden for acquiring, holding, and preserving lands in their natural state falls primarily on the State. The State's ability to fund a natural areas preservation system will vary considerably over time and according to highly unpredictable events. Unfortunately, there may be times when the State simply cannot afford acquisition because of more pressing priorities. In those cases, the amount and quality of land and water held in its natural state may be deemed "adequate" given the fiscal situation existing at that time. At other times, acquisition will be appropriate. Thus, the policy statement gives DNREC needed administrative flexibility which a more narrowly defined and mandatory acquisition program could not provide. The CMP relies upon this discretionary acquisition program, in part of course, because DNREC is sympathetic to resource protection and will therefore be inclined to use its discretion in a manner which maximizes natural areas preservation.

The second reason for opting against a more rigid natural area acquisition program is that these areas are receiving substantial attention under other programs.

New Castle County, for example, has given natural areas special consideration in its updating of the County Plan, through specific policy resolution of the County Council, and within the context of its water quality management (208) program. Similar consideration has been afforded natural areas in the Coastal Sussex Water Quality (208) Program. Also, of course, the mandatory resource protection programs described in Section 5.A. of the Coastal Management Program protect much of the valuable land and water resources, such as wetlands.

A. Selection of Natural Areas for Acquisition and Preservation

8. DNREC SHALL DEVELOP CRITERIA AND POLICIES FOR SELECTING NATURAL AREAS FOR ACQUISITION AND PRESERVATION. AT A MINIMUM, SUCH CRITERIA SHALL CONSIDER THE USES AND PURPOSES LISTED IN POLICY STATEMENT NUMBER SEVEN, AS WELL AS AREAS OF UNUSUAL NATURAL SIGNIFICANCE. UNTIL SUCH CRITERIA AND POLICIES ARE DEVELOPED, DNREC SHALL, IN ITS SELECTION OF NATURAL AREAS FOR ACQUISITION AND PRESERVATION, CONSIDER POLICY STATEMENT NUMBER SEVEN AND THE UNUSUAL NATURAL SIGNIFICANCE OF AREAS WHICH MAY BE SELECTED.

This policy promotes an acquisition program which is consistent with the general CMP policy on natural areas preservation. It will also ultimately indicate to the general public and governmental agencies what properties are most likely to be selected for acquisition and preservation. The next two policy statements also serve this purpose.

9. DNREC SHALL ESTABLISH AND MAINTAIN A REGISTRY OF NATURAL AREAS OF UNUSUAL SIGNIFICANCE TO ENSURE THAT SUCH AREAS ARE CONSIDERED FOR POSSIBLE ACQUISITION. DNREC IS ALSO ENCOURAGED TO ESTABLISH AND MAINTAIN REGISTRIES OF OTHER NATURAL AREAS FOR THE SAME PURPOSE, AND TO DEVELOP POLICIES FOR THE SELECTION OF NATURAL AREAS FOR REGISTRATION.

This policy establishes a mechanism which ensures that natural areas of unusual significance will be considered for acquisition.

10. DNREC SHALL MAKE WHATEVER SURVEYS IT DEEMS NECESSARY TO ACCOMPLISH THE PURPOSES OF THIS PROGRAM.

It is anticipated that the natural areas surveys completed by New Castle County and the CMP will be utilized by DNREC to select areas for the registries and possible acquisition, thereby obviating the need for additional surveys. The policy statement gives DNREC discretion to conduct another survey or surveys if they are necessary.

11. DNREC MAY ACQUIRE FOR AND ON BEHALF OF THE STATE OF DELAWARE, NATURAL AREAS BY GIFT, DEVISE, PURCHASE, EXCHANGE, OR ANY OTHER METHOD OF ACQUIRING REAL PROPERTY OR ANY ESTATE, INTEREST, OR RIGHT THEREIN PROVIDED THAT ANY INTEREST OWNED BY THE STATE OR BY ANY SUBDIVISION THEREOF MAY BE ACQUIRED ONLY BY VOLUNTARY ACT OF THE AGENCY HAVING JURISDICTION THEREOF. THE DEPARTMENT MAY ACQUIRE THE FEE SIMPLE INTEREST IN NATURAL AREAS OR ANY ONE OR MORE LESSER ESTATES, INTERESTS, AND RIGHTS THEREIN, INCLUDING A LEASEHOLD ESTATE, AND EASEMENT EITHER GRANTING THE STATE SPECIFIED RIGHTS OF USE OR DENYING TO THE GRANTOR SPECIFIED RIGHTS OF USE OR BOTH, A LICENSE, A COVENANT, AND OTHER CONTRACTUAL RIGHTS.

Again DNREC has considerable discretion, this time with respect to how it acquires natural area properties. Condemnation, although a possibility under the policy is expected to be used infrequently, if at all. Rather, the success of the natural areas acquisition program will depend substantially on voluntary participation. The next policies are aimed at encouraging such participation.

12. DNREC SHALL PUBLISH AND DISSEMINATE INFORMATION PERTAINING TO NATURAL AREAS WITHIN THE STATE AS IT DEEMS NECESSARY TO EFFECTUATE THE PURPOSES OF THESE POLICIES.
13. DNREC SHALL, AS IT DEEMS NECESSARY TO EFFECTUATE THE PURPOSES OF THESE POLICIES, ENCOURAGE AND RECOMMEND TO PRIVATE, PUBLIC AND GOVERNMENTAL ENTITIES THAT THEY TRANSFER NATURAL AREAS TO DNREC FOR PRESERVATION PURPOSES.

14. ALL UNITS, DEPARTMENTS, AGENCIES, AND INSTRUMENTALITIES OF THE STATE, INCLUDING COUNTIES, MUNICIPALITIES, SCHOOLS, COLLEGES AND UNIVERSITIES, ARE EMPOWERED AND URGED TO TRANSFER SUITABLE AREAS OR PORTIONS OF AREAS WITHIN THEIR JURISDICTION TO DNREC FOR PRESERVATION PURPOSES.
15. DNREC MAY ACCEPT TRANSFERS OF REAL PROPERTY FOR PRESERVATION PURPOSES WITH THE EXPRESS UNDERSTANDING THAT THE GRANTORS MAY, UNDER SPECIFIED CONDITIONS, RESCIND SUCH TRANSFERS.

This policy, of course, does not require that transfers be made with conditions for rescission. It merely permits such transfers so that DNREC may accept, probably by gift, properties that owners would otherwise be reluctant to transfer.

16. DNREC SHALL ADOPT ADDITIONAL POLICIES FOR THE ACQUISITION OF NATURAL AREAS AS IT DEEMS NECESSARY TO EFFECTUATE THE PURPOSES OF THESE CMP POLICIES.
17. NATURAL AREAS ACQUIRED PURSUANT TO THESE POLICIES SHALL BE ESTABLISHED AS NATURE PRESERVES. PROPERTY SHALL NOT BE ACQUIRED FOR THE ESTABLISHMENT OF NATURE PRESERVES UNLESS THE TERMS OF ACQUISITION RESTRICT THE USE OF THE ACQUIRED AREAS IN A MANNER WHICH ADEQUATELY PROVIDES FOR ITS PRESERVATION AND PROTECTION AGAINST MODIFICATION OR ENCROACHMENT.

This policy, coupled with the next one, guarantees that the property acquired for nature preserves will be protected. Exceptions appear in Policy Number 15 and 19.

18. DNREC SHALL ENFORCE THE TERMS OF ACQUISITION OF PROPERTY ACQUIRED FOR NATURE PRESERVES.
19. NATURE PRESERVES SHALL NOT BE TAKEN FOR ANY USE INCONSISTENT WITH PRESERVATION EXCEPT FOR ANOTHER PUBLIC USE AFTER: (1) A PUBLIC HEARING; (2) A FINDING BY DNREC THAT AN IMPERATIVE AND UNAVOIDABLE PUBLIC NECESSITY FOR SUCH OTHER PUBLIC USE EXISTS; (3) APPROVAL OF THE GOVERNOR AFTER CONSULTATION; WITH THE DELAWARE NATURAL AREAS ADVISORY CONUCIL;

AND (4) A LEGISLATIVE ACT, NOT LESS THAN SIX MONTHS FROM THE DATE OF THE GOVERNOR'S APPROVAL AUTHORIZING SUCH TAKING. THIS POLICY SHALL NOT APPLY, HOWEVER, TO NATURAL AREAS DEDICATED AS NATURE PRESERVES IF THE TERMS OF SUCH DEDICATION PROVIDE OTHERWISE.

This policy makes transfers of nature preserves generally possible but difficult. Thus, such transfers can be made under unusual circumstances, but only after careful deliberation. The policy promotes preservation and encourages transfers by private owners who are inclined to dedicate natural areas for preservation but are fearful that the State might use the property for another purpose.

20. DNREC SHALL FORMULATE ADDITIONAL POLICIES AND RULES FOR THE USE, MANAGEMENT, AND PROTECTION OF NATURE PRESERVES AS IT DEEMS NECESSARY TO EFFECTUATE THE PURPOSES OF THESE CMP POLICIES. AT A MINIMUM, SUCH POLICIES AND RULES SHALL PROVIDE THAT THE EXTENT AND TYPE OF VISITATION AND USE TO BE PERMITTED SHALL BE CONSISTENT WITH THE OBJECTIVES OF POLICY STATEMENT NUMBER SEVEN.

This policy allocates DNREC rule-making authority to manage the nature preserves. Again the CMP is concerned not with the particulars of the management scheme, but rather that the broader preservation objectives are assured.

21. DNREC IS EMPOWERED AND URGED TO FOSTER AND AID IN THE ESTABLISHMENT, RESTORATION, AND PRESERVATION OF NATURAL CONDITIONS WITHIN THE STATE ELSEWHERE THAN IN NATURE PRESERVES, INCLUDING AREAS ON THE REGISTRIES ESTABLISHED PURSUANT TO POLICY NUMBER NINE.

Relatively few natural areas selected for registration are likely to be selected also for acquisition. Nonetheless, such areas may merit special consideration prior to any modification or encroachment. Indeed, one of the primary purposes of establishing and maintaining the registries pursuant to Policy Number Nine is to raise public awareness with respect to important natural areas in the State. It is hoped that local units of government and individuals will then consider more carefully the alternatives to developing such areas.

22. THE DELAWARE OFFICE OF MANAGEMENT, BUDGET, AND PLANNING SHALL CONSIDER AREAS REGISTERED PURSUANT TO POLICY NUMBER NINE DURING ANY PREPARATION OR AMENDMENT OF THE STATEWIDE PLAN DESIGNATING CRITICAL AREAS PURSUANT TO TITLE 29, CHAPTER 92 OF THE DELAWARE CODE.

Actions affecting areas which are designated Critical Areas pursuant to Title 29, Chapter 92 of the Delaware Code are subject to the coordination and review processes in that Chapter. Sections of the CMP itself, most notably Section 5.E. and Appendices E. and F., describe those processes in greater detail. Here it is sufficient to note that once natural areas are designated Critical Areas, decisions by local or State government to allow their alteration are subject to public review by the State Planning Council.

In addition to the Title 29, Chapter 92 review mechanism, careful consideration will precede the alteration of important natural areas which are not protected as nature preserves by virtue of other State and local plans and programs too numerous for mention herein. Among these are the A-95 State review process and the Delaware Statewide Comprehensive Outdoor Recreation Plan.

VI. LEGAL AUTHORITIES

The authority for management of the State owned beaches, parks and wildlife lands is vested primarily in DNREC pursuant to Title 7, Chapters 45 and 47 of the Delaware Code. Section 4504 provides the "The public lands of this State shall be under the supervision and control of the Department of Natural Resources and Environmental Control" Section 4701 (c) provides that DNREC "shall plan, develop, and maintain all areas entrusted to its administration as to preserve in every reasonable degree the scenic, historic, scientific, prehistoric and wildlife values of such areas."

Title 7, Chapter 73 of the Delaware Code, an outgrowth of the CMP, provides most of the authority for the policies governing natural areas preservation. In addition, Executive Order Number 61, which requires State Agencies to implement the policies (within legislatively authorized limits) and Title 29, Chapter 92 of the Delaware Code, the Land Use Planning Act, are relied upon for enforcement purposes.

Additional authority appears in the State Wetlands Act and the Beach Preservation Act. The Authorities Table cites the specific authority for each policy.

AUTHORITIES TABLE

<u>Policy Number</u>	<u>Authority</u>
1.	7 Delaware Code 4701(c); Executive Order Number 61
2.	7 Delaware Code 4504
3.	7 Delaware Code 4504
4.	7 Delaware Code 4504; 7 Delaware Code 4701(c)
5.	7 Delaware Code 4504
6.	7 Delaware Code 4701(c); Executive Order Number 61
7.	7 Delaware Code 7303, 7302(f) and 7306
8.	7 Delaware Code 7307(a) and 7305(a)(3) & (4)
9.	7 Delaware Code 7303, 7307(b) & (f) and 7305(e)(2)
10.	7 Delaware Code 7307(f)
11.	7 Delaware Code 7306(a)
12.	7 Delaware Code 7307(g) & (h)
13.	7 Delaware Code 7307(e)
14.	7 Delaware Code 7311
15.	7 Delaware Code 7306(d)
16.	7 Delaware Code 7307(a)
17.	7 Delaware Code 7306(a) & (c)
18.	7 Delaware Code 7310, 7305(e)(4), 7307(d) & (h), and 7308
19.	7 Delaware Code 7308 and 7309
20.	7 Delaware Code 7307(a), 7308, 7305(e)(4), and 7303
21.	7 Delaware Code 7307(h)
22.	Executive Order Number 61; 29 Delaware Code 9201, 9202(d), 9212

VII. STATE AND FEDERAL PROGRAMS
FOR ACQUISITION AND DEVELOPMENT
OF PUBLIC SHORELINES

LAND AND WATER CONSERVATION FUND

The Land and Water Conservation Fund Program, administered by the Heritage Conservation and Recreation Service, is one of the largest outdoor recreation grant programs. The program provides for the acquisition of lands for federally administered recreation areas. It also provides sizeable matching grants for State recreation planning, as well as State and local land acquisition and development. To be eligible for the grants, the State must develop a Statewide Comprehensive Outdoor Recreation Plan and update it on a continuing basis. The Statewide Comprehensive Outdoor Recreation Plan describes ways in which the State will help satisfy recreation needs at all levels of government. It also identifies capital investment priorities for acquiring, developing, and protecting all types of outdoor recreation resources within the planning area. Finally, the Statewide Comprehensive Outdoor Recreation Plan assures continuing opportunity for local units of government and private citizens to take part in their State's outdoor recreation and environmental planning programs. Recreation facility projects -- such as bicycle trails, campgrounds, boat ramps and swimming pools -- are eligible for funding if they meet the high priority recreation needs identified in the plan.

Monies are made available on 50 percent matching basis. Funds from the LWCF will be utilized for the planned recreation and access facilities described in the Inventory at Cape Henlopen and Delaware Seashore State Parks as well as for local park development projects. Most of Delaware's land acquisition and development projects have been funded through the LWCF.

FEDERAL AID IN SPORT FISH RESTORATION
(DINGELL - JOHNSON PROGRAM) AND FEDERAL AID IN WILDLIFE
RESTORATION (PITTMAN - ROBERTSON PROGRAM)

These two programs are administered by the United States Fish and Wildlife Service.

The Dingell - Johnson Program supports projects designed to restore and manage sport fish populations for the preservation and improvement of sport fishing and related uses of these fisheries resources. The Pittman - Robertson Program supports projects to restore or manage wildlife populations and the provision of public use of these resources. Since Delaware's wetlands support large populations of both fish and wildlife, the funds from these two programs are often used interchangeably. These monies can be used to acquire land, construct boat launching facilities, parking lots, sanitary facilities and access roads, and a myriad of other activities associated with the management and use of fish and wildlife resources including maintenance, and operation of these areas. Up to 75 percent of a project's total cost is eligible for federal funding under either program. Moreover, these programs are considered suitable for joint funding with other closely related Federal aid programs. Dingell - Johnson funds will be used to construct and operate the planned boat launching facilities at Waples Pond and Love Creek.

DISPOSAL OF FEDERAL SURPLUS REAL PROPERTY

Administered by the General Services Administration this program is designed to dispose of surplus Federal real property for a variety of public purposes by sale, exchange or donation. Some of these public purposes include parks, recreation, wildlife conservation and historic monument uses. This program has been used in the past by DNREC to acquire several large tracts of land for parks and wildlife purposes. For example, most of Cape Henlopen State Park and all of the Assawoman Wildlife Areas were obtained through this program. It is also the program through which the State will acquire title to 176 acres of land within Cape Henlopen State Park from the Department of Army. Moreover, it is the program the State would use to acquire the remaining Federal lands within the park should they be declared surplus.

URBAN WATERFRONTS

Various studies have examined portions of the urban waterfronts in the State and proposals for development have been prepared in some cases.

Local and county plans have been prepared to address similar problems in both small and large urban areas, particularly by the City of Wilmington. Redevelopment of deteriorated industrial waterfronts along the Christina and Brandywine Rivers in Wilmington offer new recreational and scenic opportunities for this urban area. At the small scale, a very successful riverfront program is underway in Milford, located along the banks of the Mispillion River. With State and Federal (USDA) help, the City has embarked on a series of park development projects which replace old municipal warehouses, a sewage treatment plant, and the storage yards. The first phase, a Bicentennial Park, has been completed, providing an attractive passive park area in the Town on an area formerly occupied by a dog kennel, storage yard, and city warehouse. Similar programs are in various stages of development in a number of smaller communities, including work recently completed by the City and State along the St. Jones River in Dover.

New Castle County is actively interested in developing waterfront recreational facilities along the Delaware River. A study funded by the County's Department of Parks and Recreation, in cooperation with the Delaware River Shoreline Committee, determined that the public was receptive to developing several types of water-oriented recreational facilities. These include a riverfront park as well as marinas, shoreline bicycle paths and a coastal nature study preserve. The options evaluated in the study are specially attractive in view of their potential to serve high priority urban needs, as well as to reduce congestion in the coastal areas and on north-south highways.

While the State is largely precluded from direct participation in such projects due to a lack of available funding, the State has been actively involved in a number of projects on a technical assistance basis. In one case, direct State participation was possible to assist in the acquisition of a derelict waterfront along the Delaware River, later transferred to New Castle County for future redevelopment as a riverfront park.

It also must be noted that the Delaware Comprehensive Outdoor Recreation Plan of 1976 (SCORP) includes a policy emphasis on acquisition and development of urban serving areas, particularly those involving coastal resources. Clearly urban waterfronts meet that test.

In recognition of the changes in urban waterfront areas and the need for application of resource management techniques to such areas, the Office of Coastal Zone Management (OCZM) of the U.S. Department of Commerce has provided limited funding for demonstration projects as a part of State Coastal Management Program development and implementation efforts.

The Coastal Management Program, with the support of county, city, regional and state agencies has applied for funding. In order to tie the various proposals and plans together and to properly determine the potentials for redevelopment, it is necessary that a careful survey and assessment be made of the entire waterfront area in the urban portion of the State. The effort is designed to assess the potentials for redevelopment and revitalization of Delaware's urban waterfronts, establish criteria by which to rank potential projects, develop a list of redevelopment options with sufficient detail to generally assess costs and feasibility, and demonstrate adaptive reuse and multi-use redevelopment techniques. It is intended to:

- Foster development of deteriorating and underutilized urban waterfronts in Delaware which result in better patterns of land and water uses, as well as, an increase in the supply of available urban land.
- Encourage establishment of water-dependent use along the State's urban waterfronts.
- Provide increased economic activity, private investment opportunity, tax revenues and number of jobs.
- Provide urban amenities in a safer, more attractive environment along urban waterfronts, with particular emphasis on increasing public access.
- Encourage concentrated coastal development in or adjacent to urbanized areas.
- Encourage coordinated planning, management, and public investment for urban waterfront areas.

The project is also intended to identify portions of physically or economically obsolete or underutilized urban waterfront areas which are feasible for reuse and multiple purpose redevelopment and to set priorities for action, including identification of funding sources.

APPENDIX A
FEDERAL REGULATIONS GOVERNING SHORELINE
ACCESS AND PROTECTION PLANNING

§ 923.25 Shorefront Access and Protection Planning

(a) Requirement. In order to meet the requirements of subsection 305(b)(7) of the Act and to coordinate these requirements with those of subsections 305(b)(3) and 306(c)(9), States must develop a planning process that can identify public shorefront areas appropriate for access or protection. This process must include:

(1) A procedure for assessing public areas requiring access or protection;

(2) A definition of the term "beach" and an identification of public areas meeting that definition;

(3) Articulation of enforceable State policies pertaining to shorefront access and protection;

(4) A method for designating shorefront areas (either as a class or site specifically) as areas of particular concern or areas for preservation or restoration, if appropriate; and

(5) An identification of legal authorities, funding programs and other techniques that can be used to meet management needs.

(b) Comment. Statutory Citation Subsection 305(b)(7):

The management program for each coastal state shall include * * * (7) A definition of the term "beach" and a planning process for the protection of, and access to, public beaches, and other public coastal areas of environmental, recreational, historical, esthetic, ecological, or cultural value.

(1) The basic purpose in focusing special planning attention on shorefront access and protection is to express more than local concern with respect to additional access or protection needs for public beaches and other public coastal areas of environmental, recreational, historic, esthetic, ecological or cultural value and to include these areas for special management attention within the purview of the State's management program. If appropriate, this special management attention may be achieved by designation of public shorefront areas requiring additional access or protection as areas of particular concern or areas for preservation or restoration. Since the specific planning requirements called for in this section are closely related to the broader requirements for areas of particular concern and areas for preservation and restoration, many of the requirements called for in paragraph (a) above can be met by completing the work called for in § 923.21 and 923.24.

(c) Comment. In meeting the requirements of (a) (1) above, States should take the following into account:

(1) States should make use of the analyses and considerations of Statewide concern developed to meet the requirements of § 923.21 dealing with areas of particular concern. It also is recommended that information contained in State Outdoor Comprehensive Recreation Plans be considered.

(2) If islands are not considered areas of particular concern, in the context provided by § 923.21, then their protection needs should be addressed through this planning process. Analysis of the need and priority for protection will be useful in establishing eligibility for such funds as may be available for islands acquisition pursuant to subsection 315(2) of the Act.

(3) In developing a procedure for identifying access and protection needs, States should analyze (a) the supply of existing public facilities and areas, (b) the anticipated demand for future use of these facilities, and (c) the capability and suitability of existing areas to support increased access. Based on these and other considerations, as appropriate, the State's planning process shall include a description of appropriate types of access and protection taking into account governmental and public preferences, resource capabilities and priorities.

(4) In determining access requirements, States should consider both physical and visual access. The emphasis, however, should be on the provision of increased physical access. Special attention should be given to recreational needs of urban residents for increased shorefront access. Physical access may include, but need not be limited to, footpaths, bikepaths, boardwalks, jitneys, rickshaws, parking facilities, ferry services and other public transport. Visual access may involve, but need not be limited to, viewpoints, setback lines, building height restrictions, and light requirements.

(5) In determining the needs for protection of public coastal areas, States should consider such factors as (a) environmental, esthetic or ecological preservation (including protection from overuse and mitigation of erosion or natural hazards), (b) protection for public use benefits (including recreational, historic, or cultural uses), (c) preservation of islands, and (d) such other protection as may be necessary to insure the maintenance of environmental, recreational, historic, esthetic, ecological or cultural values of existing public shorefront attractions.

Existing public shorefront attractions may be broadly construed to include, but need not be limited to: public recreation areas, scenic natural areas, threatened or endangered floral or faunal habitat, wetlands, bluffs, historic, cultural or archaeological artifacts, and urban waterfronts.

(d) Comment. With respect to the requirements of (a)(2) above, the purpose of defining the term "beach" is to aid in the identification of those existing public beach areas requiring further access and/or protection as a part of the State's management program. States should define "beach" in terms of characteristic physical elements (e.g. submerged lands, tidelands, foreshore, dry sand areas, line of vegetation, dunes) or in terms of public characteristics (e.g. local, State or Federal ownership, of other demonstrated public interest such as easements, leases, licenses, or traditional and habitual usage). At a minimum, the definition of what constitutes a public beach shall be as broad as that allowed under State law or constitutional provisions. States should take into account special features such as composition (e.g. nonsand beaches), location (e.g. urban or riverine beaches), origin (e.g. manmade beaches), and fragility (e.g. areas of shifting dunes). Where access may be complicated by questions of ownership and use of the foreshore or dry sand beach, States are encouraged to define beach in terms of its component parts, especially at the high tide line, or the ordinary high water mark in the Great Lakes. Finally, in definite the term "beach" States should provide a rationale explaining the relationship between the definition developed and access and protection needs.

(e) Comment. With respect to the requirements of (a)(5) above, States should develop a procedure which will allow for the eventual identification of specific areas for which provision of access through acquisition will be appropriate during program implementation. In developing this procedure, States shall identify local, State or Federal sources for accomplishing particular access proposals. Particular attention should be given to coordination of management objectives with funding programs pursuant to subsection 315 (2) of the Act, and pursuant to the Land and Water Conservation Fund (16 U.S.C. 460 et seq.) and other statutes as may be appropriate.

The access referred to in this subsection is broader than the types of access that may be acquired using subsection 315(2) funds which is limited to the acquisition of lands or interests in lands for purposes of providing access to public shorefront or for the preservation of islands.

(f) Comment. State coastal zone management programs that are submitted and approved prior to October 1, 1978, may submit this planning element as a program amendment by, but no later than, September 30, 1978, or this element may be included as part of the basic program submission submitted and approved prior to October 1, 1978. State coastal zone management programs submitted prior to October 1, 1978, but approved on or after that date, must include this planning element as a part of the basic program submission. State coastal zone management programs submitted for approval after October 1, 1978, must include this element as part of the basic program submission.

APPENDIX B
NATURAL AREAS PRESERVATION ACT
TITLE 7, DELAWARE CODE, CHAPTER 73



DELAWARE STATE SENATE

129TH GENERAL ASSEMBLY

FIRST SESSION - 1977
SENATE BILL NO. 222
AS AMENDED BY
SENATE AMENDMENT NO. 1
AND

FEB 10 1978 61 212

HOUSE AMENDMENT NOS. 1, 2, & 3
AN ACT TO AMEND PART VII, TITLE 7 OF THE DELAWARE CODE RELATING TO CONSERVATION
OF THE STATE'S NATURAL RESOURCES; ESTABLISHING A STATE SYSTEM OF NATURE PRESERVES;
AND PROVIDING FOR THEIR ACQUISITION, CONTROL, USE, MANAGEMENT AND PROTECTION.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF DELAWARE:

1 Section 1. Amend Part VII, Title 7 of the Delaware Code by striking the
2 present title of said Part VII, and substituting in lieu thereof the following:

3 "PART VII. NATURAL RESOURCES"

4 Section 2. Amend Part VII, Title 7 of the Delaware Code by adding thereto
5 a new chapter, designated as Chapter 73, which new Chapter shall read as follows:

6 "CHAPTER 73. NATURAL AREAS PRESERVATION SYSTEM

7 §7301. Statement of Policy

8 Because of the continuing growth of the population and the development
9 of the economy of the State of Delaware, it is necessary and desirable that
10 areas of unusual natural significance be set aside and preserved for the
11 benefit of present and future generations before they have been destroyed,
12 for once destroyed they cannot be wholly restored. Such areas are irre-
13 placeable as laboratories for scientific research, as reservoirs of natural
14 materials — not all of the uses of which are now known, as habitats for
15 plant and animal species and biotic communities whose diversity enriches
16 the meaning and enjoyment of human life, as living museums where people
17 may observe natural biotic and environmental systems of the earth and the
18 interdependence of all forms of life, and as reminders of the vital depen-
19 dence of the health of the human community upon the health of the natural
20 communities of which it is an inseparable part.

1 It is essential to the people of the State of Delaware that they retain
2 the opportunities to maintain close contact with such living communities
3 and environmental systems of the earth and to benefit from the scientific,
4 educational, esthetic, recreational and cultural values they possess. It
5 is therefore the public policy of the State of Delaware that a registry of
6 such areas be established and maintained by the Department of Natural Re-
7 sources and Environmental Control, that such areas be acquired and preserved
8 by the State, and that other agencies, organizations, and individuals, both
9 public and private, be encouraged to set aside such areas for the common
10 benefit of the people of present and future generations.

11 §7302. Definitions

12 The following words, terms and phrases, when used in this Chapter,
13 shall have the meanings ascribed to them except where the context clearly
14 indicates a different meaning:

15 (a) 'Articles of dedication' shall mean the writing by which any estate,
16 interest, or right in an area is formally dedicated as permitted by §7307
17 of this Chapter.

18 (b) 'Council' shall mean the Delaware Natural Areas Advisory Council.

19 (c) 'Dedicate' and 'dedication' shall mean the transfer to the Depart-
20 ment of Natural Resources and Environmental Control, for and on behalf of
21 the State of Delaware, of an estate, interest, or right in an area in any
22 manner permitted by §7306 of this Chapter.

23 (d) 'Department' shall mean the Department of Natural Resources and
24 Environmental Control.

25 (e) 'Natural area' shall mean an area of land or water, or of both land
26 and water, whether in public or private ownership, which either retains or
27 has re-established its natural character (although it need not be undisturbed),
28 or has unusual flora or fauna, or has biotic, geological, scenic, or archae-
29 ological features of scientific or educational value.

30 (f) 'Nature preserve' shall mean a natural area, any estate, interest,
31 or right in which has been formally dedicated under the provisions of this
32 Chapter.

33 (g) 'Secretary' shall mean the Secretary of the Department of Natural
34 Resources and Environmental Control.

1 (h) 'System' shall mean the nature preserves held under the provisions
2 of this Chapter.

3 §7303. Statement of Purpose

4 In order to secure for the people of the State of Delaware of present
5 and future generations the benefits of an enduring resource of areas having
6 one or more of the characteristics referred to in §7302 (e) of this Chapter,
7 the State of Delaware, acting through the Department, shall acquire and hold
8 in trust for the benefit of the people an adequate system of nature pre-
9 serves for the following uses and purposes:

10 (a) for scientific research in such fields as ecology, taxonomy, genetics,
11 forestry, pharmacology, agriculture, soil science, geology, conservation,
12 archaeology, and other subjects;

13 (b) for the teaching of biology, natural history, ecology, geology,
14 conservation, and other subjects;

15 (c) as habitats for plant and animal species and communities and other
16 natural objects;

17 (d) as reservoirs of natural materials;

18 (e) as places of natural interest and beauty;

19 (f) as living illustrations of our natural heritage wherein one may
20 observe and experience natural biotic and environmental systems of the
21 earth and their processes;

22 (g) to promote understanding and appreciation of the scientific, edu-
23 cational, esthetic, recreational and cultural values of such areas by the
24 people of the State of Delaware;

25 (h) for the preservation and protection of nature preserves against
26 modification or encroachment resulting from occupation, development, or
27 other use which would destroy their natural or esthetic conditions.

28 In order to give recognition to natural areas, the Department shall
29 establish and maintain a registry of natural areas of unusual significance,
30 but no area so registered shall be a nature preserve unless and until it
31 shall have been dedicated as provided for in §7306 of this Chapter.

32 §7304. Designation of Office of Nature Preserves

33 There is hereby designated within the Department an Office of Nature
34 Preserves, which shall administer for the Department the provisions of this
35 Chapter.

1 §7305. Provision for Expert Advice and Assistance

2 (a) There is hereby created a Delaware Natural Areas Advisory Council
3 to advise the Secretary of the Department on the administration of nature
4 preserves and the preservation of natural areas.

5 (b) The Council shall have eight members. The Secretary of the Depart-
6 ment of Natural Resources and Environmental Control shall be an ex officio
7 member of the Council, with a voice in its deliberations, but without the
8 power to vote. The other members shall be appointed by the Governor of the
9 State of Delaware, with the advice and consent of the Senate, shall be
10 persons who have been active or have demonstrated an interest in preserving
11 natural areas, and shall include members of public and private educational
12 organizations, conservation organizations, industry leaders active in
13 environmental matters, sport hunting organizations, and sport fishing organizations
14 and shall not include more than four persons who belong to the same political
15 party.

16 (c) The Department shall furnish clerical, technical, legal, and other
17 services required by the Council in the performance of its official duties.

18 (d) Members of the Council shall receive no compensation but may be
19 reimbursed for their actual and necessary expenses incurred in the perfor-
20 mance of their official duties. The Council shall hold at least one regular
21 meeting in each quarter of each calendar year and shall keep a record of its
22 proceedings, which shall be open to the public for inspection.

23 (e) The Council shall:

24 (1) review and make recommendations on the Department's criteria
25 for acquisition and dedication of nature preserves;

26 (2) review and make recommendations regarding inventories and
27 registries of natural areas and nature preserves;

28 (3) review and make recommendations on departmental plans for the
29 selection of particular natural areas for State acquisition;

30 (4) advise the Secretary on policies, rules, and regulations
31 governing the management, protection, and use of nature preserves;

32 (5) recommend the extent and type of visitation and use to be
33 permitted within each nature preserve;

34 (6) advise and consult with the Secretary and Departmental employees
35 on preservation matters;

36 (7) advise and consult regarding any change from dedicated status
37 of a nature preserve.

1 (8) within 10 days of receiving plans from the department for
2 the selection of particular natural areas for State acquisition,
3 issue written notice to adjacent landowners that such areas are
4 being considered for State acquisition.

5 §7306. The Dedication Process

6 (a) The Department is authorized and empowered, for and on behalf of
7 the State of Delaware, to acquire nature preserves by gift, devise, purchase,
8 exchange, or any other method of acquiring real property or any estate, interest
9 or right therein, provided that such acquisition shall not be made through the
10 exercise of the power of eminent domain, and further provided that any interest
11 owned by the State or by any subdivision thereof may be dedicated only by
12 voluntary act of the agency having jurisdiction thereof. The Department may
13 acquire the fee simple interest in an area or any one or more lesser estates,
14 interests, and rights therein, including (without limitation upon the generality
15 of the foregoing by reason of specification) a leasehold estate, an easement
16 either appurtenant or in gross and either granting the State specified rights
17 of use or denying to the grantor specified rights of use or both, a license,
18 a covenant, and other contractual rights. A nature preserve may be acquired
19 voluntarily for such consideration as the Department deems advisable or
20 without consideration.

21 (b) The Secretary of the Department, upon the advice and concurrence
22 of the Council, shall accept natural areas by articles of dedication or
23 gift. A nature preserve is established when articles of dedication have
24 been filed by or at the direction of the owner of land, or a governmental
25 agency having ownership or control thereof, in the office of the County
26 Recorder of the county in which the land is located.

27 (c) Articles of dedication shall be executed by the owner of the land
28 in the same manner and with the same effect as a conveyance of an interest
29 in land and shall be irrevocable except as provided in this section. The
30 County Recorder may not accept articles of dedication for recording unless
31 they contain terms restricting the use of the land which adequately provide
32 for its preservation and protection against modification or encroachment
33 resulting from occupation, development, or other use which would destroy its
34 natural or esthetic conditions for one or more of the uses and purposes set
35 forth in this section.

36 (d) Articles of dedication may contain provisions for the management,
37 custody, and transfer of land, provisions defining the rights of the owner
38 or operating agency and the Department, and such other provisions as may be

1 necessary or advisable to carry out the uses and purposes for which the
2 land is dedicated. They may contain conditions under which the owner and
3 the Department may agree to rescind the articles.

4 (e) The Department may make or accept amendments of any articles of
5 dedication upon terms and conditions that will not destroy the natural or
6 esthetic condition of a preserve. If the fee simple interest in the area
7 is not held by the State, no amendments shall be made without the written
8 consent of the owner. Each amendment shall be recorded in the same manner
9 as the articles of dedication.

10 §7307. Additional Powers and Duties of Department

11 In furtherance of the purposes of this Chapter and in implemen-
12 tation of the powers and duties elsewhere provided in this Chapter, the
13 Department shall have the following additional powers and duties:

14 (a) to formulate policies for the selection, acquisition, use, manage-
15 ment, and protection of nature preserves;

16 (b) to formulate policies for the selection of areas suitable for regis-
17 tration under the provisions of this Chapter:

18 (c) to formulate policies for the dedication of areas as nature pre-
19 serves;

20 (d) to determine, supervise and control the management of nature
21 preserves and to make, publish, and amend from time to time rules and regu-
22 lations necessary or advisable for the use and protection of nature preserves;

23 (e) to encourage and recommend the dedication of areas as nature pre-
24 serves;

25 (f) to make surveys and maintain registries and records of unique natural
26 areas within the State;

27 (g) to carry on interpretive programs and publish and disseminate infor-
28 mation pertaining to nature preserves and other areas within the State; and

29 (h) to promote and assist in the establishment, restoration and pro-
30 tection of, and advise in the management of, natural areas and other areas
31 of educational or scientific value and otherwise to foster and aid in the
32 establishment, restoration and preservation of natural conditions within
33 the State elsewhere than in the system.

1 §7308. Protection Against any Change in Status from that of Dedicated
2 Nature Preserve

3 Nature preserves dedicated under §7306 of this Chapter are to be held
4 in trust, for the uses and purposes set forth for the benefit of the people
5 of the State of present and future generations. They shall be managed and
6 protected in the manner approved by, and subject to the rules and regulations
7 established by the Department. They shall not be taken for any other use
8 except another public use after a finding by the Department of the existence
9 of an imperative and unavoidable public necessity for such other public
10 use and with the approval of the Governor after consultation with the Advisory
11 Council, and by Act of the Legislature not less than six months from the date
12 of the Governor's approval. Except as may otherwise be provided by the
13 articles of dedication, the Department may grant, upon such terms and con-
14 ditions as it may determine, an estate, interest or right in, or dispose of,
15 a nature preserve, but only after a finding by the Department of the exis-
16 tence of an imperative and unavoidable public necessity for such grant of
17 disposition, and with the approval of the Governor after consultation with
18 the Advisory Council, and by Act of the Legislature not less than six months
19 from the date of the Governor's approval.

20 §7309. Public Participation

21 Before the Department makes any finding of the existence of an
22 imperative and unavoidable public necessity, or grants any estate, interest
23 or right in a nature preserve or disposes of a nature preserve or of any
24 estate, interest or right therein, as provided in §7308, it shall give
25 notice of such proposed action and an opportunity for any person to be heard
26 at a public hearing in the county in which the preserve is located.
27 The public hearing shall be published at least once in newspapers with a
28 Statewide circulation and general circulation in the county in which the
29 nature preserve is located. The notice shall set forth the substance of
30 the proposed action and describe, with or without legal description, the
31 nature preserve affected, and shall specify a place and time not less than
32 thirty days after such publication for a public hearing before the Depart-
33 ment on such proposed action. All persons desiring to be heard shall have
34 a reasonable opportunity to be heard prior to action by the Department on such
35 proposal.

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§7310. Enforcement

Enforcement of this Chapter, including enforcement of the articles of dedication, shall be the responsibility of the Department.

§7311. Transfer of Natural Areas

All units, departments, agencies, and instrumentalities of the State, including (without limitation upon the generality of the foregoing by reason of specification) counties, municipalities, schools, colleges and universities, are empowered and urged to dedicate as nature preserves suitable areas or portions of areas within their jurisdiction.

§7312. Additional Protection Unimpaired

Nothing contained in this Chapter shall be construed as interfering with the purposes stated in the establishment of or pertaining to any State or local park, preserve, wildlife refuge or other area or the proper management and development thereof, except that any agency administering an area dedicated as a nature preserve under the provisions of this Chapter shall be responsible for preserving the character of the area in accordance with the articles of dedication and the applicable rules and regulations with respect thereto established by the Department from time to time. Neither the dedication of an area as a nature preserve nor any action taken by the Department under any of the provisions of this Chapter shall void or replace any protective status under law which the area would have were it not a nature preserve, and the protective provisions of this Chapter shall be supplemental thereto."

Section 3. If any provision of this Act or the application thereof to any circumstance is held invalid, such invalidity shall not affect other provisions or applications of this Act which can be given effect without the invalid provision or application, and to this end the provisions of this Act are declared to be severable.

Section 4. All laws and parts of laws in conflict herewith, insofar as such conflicts exist, are hereby repealed.

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