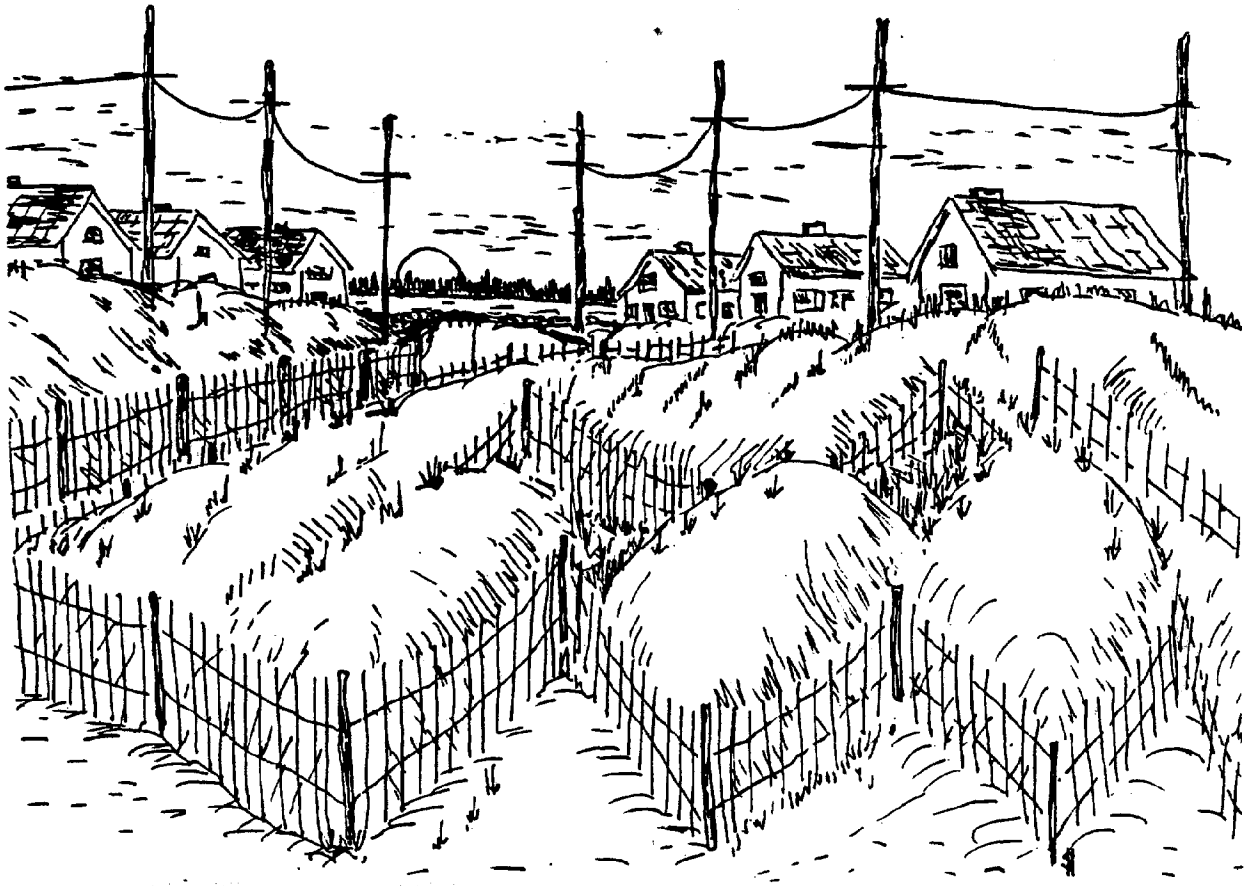
Assessment of Dune and Shore Protection Ordinances in New Jersey

Presented to Governor Thomas H. Kean and the Members of the New Jersey Legislature



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New Jersey Department of Environmental Protection - Division of Coastal Resources

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by
Department of Environmental Protection
Division of Coastal Resources

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Executive Summary

This report is the Department of Environmental Protection's response to a provision of the first appropriations bill enacted under the Shore Protection Bond Act of 1983. The Legislature requested an assessment of dune protection in New Jersey, in response to observations made after the March 28-29, 1984 storm which indicated that shorefront areas behind sand dunes seemed to experience significantly less damage then other shorefront areas.

The New Jersey shore has been lucky. The 1984 storm, like storms in 1978 and 1980, was only one or two high tides away from causing damage as severe as was experienced in the last major coastal storm in 1962. While the damage from the March 1984 storm is still visible in some areas, it did not have an appreciable effect on coastal tourism this past summer.

This report describes the state, federal and municipal laws and the natural shorefront processes that affect the ocean shorefront. Since dune protection in New Jersey is almost entirely a municipal responsibility, the second major section of the report analyzes the language and effectiveness of the current municipal dune ordinances. The report then offers conclusions and recommendations.

In brief, the report concludes that State expenditures for shore protection will be most cost effective if they coincide with active programs to sensitively protect, and where necessary, create dunes. The report further concludes that most current dune ordinances are inadequate to this task. As a result, the report recommends that future shore protection expenditures by the State be conditioned upon municipal adoption and enforcement of an effective dune management program. The report also recommends that the Legislature develop a long term stable source of funding for shore protection.

Lastly, the report includes a dune ordinance adopted by the Borough of Mantoloking which can serve as a good model for other municipalities.

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BACKGROUND

New Jersey's ocean shoreline is frequently cited as the best (or worst) example of an "over-engineered" coastline. It certainly embodies the classic confrontation between a migrating shoreline and a fixed line of development. The intensity of this development has not, however, erased all signs of a natural shoreline. All four coastal counties (Monmouth, Ocean, Atlantic and Cape May) have communities in which dunes and some dune fields can be found. Although these dunes are, without exception, "man-modified" (i.e. they no longer have the width, profile and energy absorbing capacity of natural dunes), they do offer varying degrees of protection from coastal storms.

As a result of the March 28-29, 1984 northeast storm, the beaches and dunes along the New Jersey Coast were severely eroded. This erosion, combined with serious flooding in North Jersey, resulted in a Presidential Disaster Declaration on April 12, 1984. Consideration by the Legislature of the first appropriation under the Shore Protection Bond Act of 1983 led to passage of an amendment requiring the Department of Environmental Protection (DEP) to submit a report to the Legislature and the Governor detailing

> ...the adequacy of existing municipal dune and shorefront protection ordinances and the pattern of enforcement of those ordinances. This report shall also include an assessment of the degree to which these ordinances succeeded in minimizing the damages suffered due to the storm of March 29, 1984 and recommendations for administration and legislative actions necessary to minimize public expenditure for storm damage.

This report is the DEP's response to that legislative charge.

Legislative History

The regulation and protection of sand dunes is a matter of local regulation in New Jersey unless a development is large enough to require a permit from the State's Department of Environmental Protection under the Coastal Area Facility Review Act (CAFRA) (N.J.S.A. 13:19-1 et seq.).[1] Most construction in or near dunes does not require a CAFRA permit, since oceanfront development usually consists of single homes or small multi-unit residences.

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[1] A CAFRA permit is required for residential developments of 25 or more dwelling units, and for some industrial, commercial and public facility development.

Most local dune ordinances were first passed by coastal communities after the devastating March 1962 northeast storm destroyed almost every dune in New Jersey. Federal, state and local governments spent weeks and months rebuilding dunes, and protective ordinances were passed to preserve these newly created features. Presently, about 20 towns have special dune ordinances (see Table 1 page 9). Some communities have passed subsequent ordinances strengthening their initial ordinances, while others have not. An assessment of the provisions of these ordinances is presented beginning on page 9.

In addition to dune ordinances, most coastal communities have also adopted ordinances which are designed to meet the minimum land management criteria of the National Flood Insurance Program (NFIP). The NFIP allows property owners in flood-prone areas to purchase federally-subsidized flood insurance. This insurance was generally unavailable prior to passage of the National Flood Insurance Act in 1968 (P.L. 90-448). Eligibility for the purchase of federally-subsidized insurance is determined on a community-wide basis, and as part of its application, a community must demonstrate that it has adopted floodplain management regulations which satisfy the minimum land use criteria set forth in the Federal Emergency Management Agency's (FEMA) regulations (44 CFR 60.3, "Criteria for Land Management and Use").

These Federal criteria were substantially revised in December, 1976, and participating communities were given until February 1, 1978 to bring their floodplain ordinances into compliance. The amended regulations included a new provision, 44 CFR 60.3(e)(8), which required that communities:

> prohibit man-made alteration of sand dunes...[within the coastal high hazard area] which would increase potential flood damage.

Most coastal communities responded by adopting almost verbatim a model ordinance recommend by FEMA (U.S. HUD, 1978). Both the model ordinance and the adopted local versions incorporated the exact language of Section 60.3(e)(8).

Subsequent to the passage and adoptions of the initial NFIP regulations in 1978 and in response to the trio of damaging northeast storms during the 1977-1978 winter, FEMA began revising their Flood Insurance Rate Maps (FIRM) to include results of wave height studies. Initially, FIRMs were produced showing only the still water storm surge elevation and FEMA considered these minimum elevations. Since there was a pronounced tendency for buildings to be constructed only to meet these minimum standards without regard to additional hazards due to storm wave height, FEMA adopted recommendations developed by the National Academy of Sciences (1977) that included prediction of wave heights. This methodology enabled estimated wave crest elevations to be substituted as the minimum base flood elevations on the revised FIRMS. Currently, 59 New Jersey coastal communities have had their FIRMS revised to include the results of wave height analysis.

Besides the more recent regulatory jurisdiction under CAFRA, since 1940, DEP has had the authority to engage in shore protection work. N.J.S.A. 12:6A-1 passed in 1940, authorized the Department to:

> ...repair, reconstruct, or construct bulkheads, seawalls, breakwaters, groins, jetties, beachfills, dunes and any or all appurtenant structures and work, on any and every shore front along the Atlantic Ocean, in the State of New Jersey, or any shore front along the Delaware Bay and Delaware River, Raritan Bay, Barnegat Bay, Sandy Hook Bay, Shrewsbury River including Navesink River, Shark River, and the coastal inland waterways extending southerly from Manasquan Inlet to Cape May Harbor, or at any inlet, estuary or tributary waterway along the shores of the State of New Jersey, to prevent or repair damage caused by erosion and storm, or to prevent erosion of the shores and to stabilize the inlets or estuaries and to undertake any and all actions and work essential to the execution of this authorization and the powers granted hereby.

With the passage of the Beaches and Harbor Bond Act of 1977 that made available $20 million for shore protection, the Department authorized the development and publication of the New Jersey Shore Protection Master Plan (1981). This Plan was intended to represent a more cohesive, comprehensive and cost beneficial approach to the problem of shore protection for use by not only the State, but also other levels of government. An important aspect of the Plan is its encouragement of as many non-structural approaches to shore protection as possible. Therefore, beachfills with attendant dune creation have been stressed over the construction of groins, revetments, and seawalls. To date, of the six highest priority major projects of the Plan, three are either presently underway or completed and three are in active planning stages for implementation in the next two years.

Partially as a result of the severe winter of 1977 and 1978, particularly the severe damage from the northeast storm of February 5-8, 1978 which led then Governor Byrne to request approximately $15 million in federal disaster relief, attention was focused on the desirability of dune preservation. This led DEP to prepare an option and background paper on the rationale for dune management (Kinsey and Wiener, 1979), and to commission a report from the Rutger's Center for Coastal and Environmental Studies, entitled Coastal Dunes: Their Function, Delineation and Management by Gares et al. (1979). These studies culminated in the introduction of Assembly Bill 1825 in June, 1980 entitled the "Dune and Shorefront Protection Act". This bill was withdrawn a short time later mainly due to controversy regarding a provision that would have both prohibited the reconstruction of buildings more than 50 percent destroyed by a storm without compensation to the land owner (Sec. 7.6.). Several less far reaching dune protection bills have been introduced since then (A-2228, Nov. 1980; A-2262, Dec. 1980; and A-47, April, 1984), but they have to date attracted little legislative or public interest.

Definitions and Processes

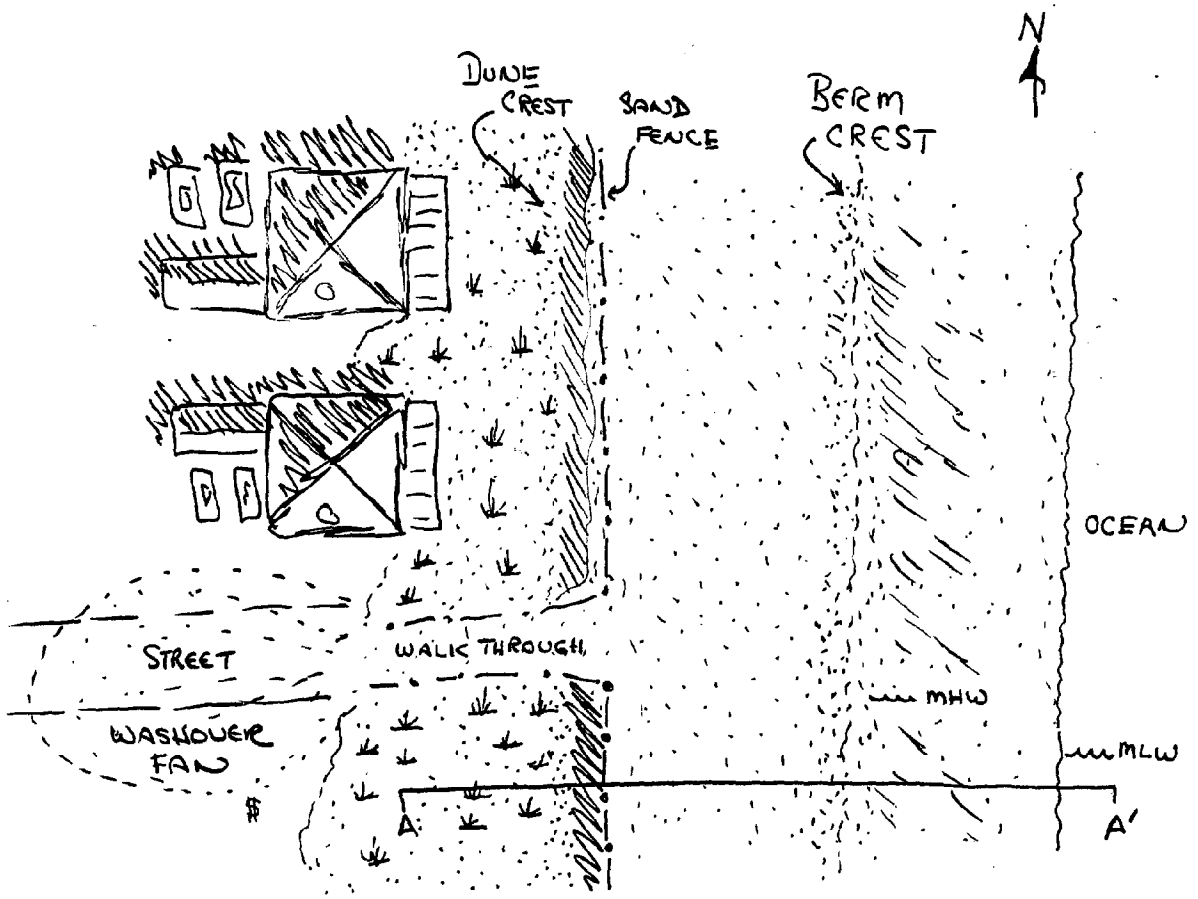
The DEP has adopted a definition of a dune which is included in the Coastal Resource and Development Policies (N.J.A.C. 7:7E-1.1 et seq.) used to administer CAFRA and the Shore Protection Program:

> A dune is a wind or wave deposited or man-made formation of vegetated or drifting wind blown sand, that lies generally parallel to, and landward of the beach, and between the upland limit of the beach and the foot of the most inland dune slope. "Dune" includes the foredune, secondary and tertiary dune ridges, as well as man-made dikes, where they exist. Formations of sand immediately adjacent to beaches that are stabilized by retaining structures, and or snow fences, planted vegetation, and other measures are considered to be dunes regardless of the degree of modification of the dune by wind or wave action or disturbance by development. A small mound of loose, wind blown sand found in a street or on a part of a structure as a result of storm activity is not considered to be a "dune". (Figure 1).

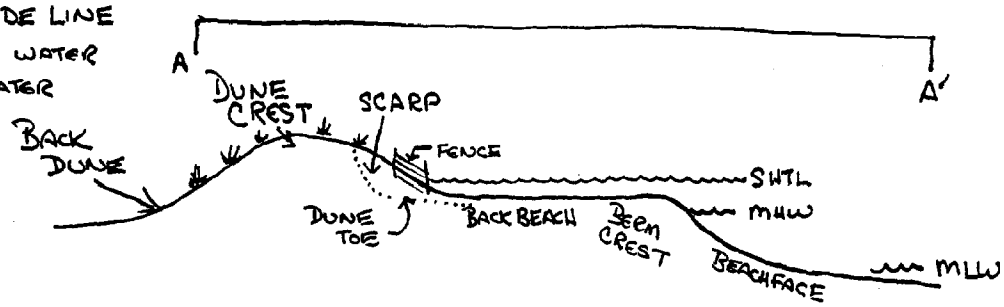
The underlined phrases above are clarifying amendments now under consideration by DEP to include emergency gravel core dunes in the definition to insure their continued protection as a regulated feature. After the 1962 storm, the Army Corps of Engineers constructed "dunes" in some areas that were particularly heavily eroded and were in danger of subsequent damage if other storms had come.

The sentence that included the phrases "formations of sand...that are stabilized by retaining structures, or snow fences, planted vegetation, and other measures are considered to be dunes regardless of the degree of modification of the dune by wind or wave action or disturbance by development"..was included to acknowledge the degree of migration and change that the dune form can undergo through time. This also includes the realization that most unregulated development along the coast has not respected the presence of the whole dune form, not only the secondary or tertiary dune lines where they existed, but also the landward sloping backside of the primary dune. This latter area has been heavily encroached upon all along the coast.

There are many reasons that dunes are such important natural features worthy of protection. The main reason is their presence as natural functioning flood protection devices during storms. A feature that grows, with either little or no human encouragement, or at no or very little expense, to provide an extraordinary level of flood protection is something that should be understood, appreciated, and nurtured by the coastal population. Associated with this built-in flood protection, dunes are storage areas of sand that can be naturally released during storms to insure the rebuilding of post-storm beaches and dunes. Essentially, dunes function similarly in the natural setting as car bumpers do on an automobile, absorbing the initial shock of a collision (storm), thus protecting the vehicle (coast) from more extensive damage. Other benefits of dunes are their aesthetic qualities and the provision of wildlife habitat.



SHTL = STORM HIGH TIDE LINE
MHW = MEAN HIGH WATER
MLW = MEAN LOW WATER



FEATURES AND CROSS SECTION OF A TYPICAL NEW JERSEY BEACH-DUNE SYSTEM SHOWING IMPROPER ORIENTATION OF STREET END WALK THROUGH (SEE FIGURE 4)

FIGURE 1.

In undeveloped areas, dunes will grow, become vegetated, and migrate in response to winds, storms, various climatic factors, and sea level fluctuations. The naturally functioning beach and dune system maintains an equilibrium with its surrounding environment as conditions change with time. The rhythm of this naturally functioning equilibrium is not critical to most people since they are not affected by it.

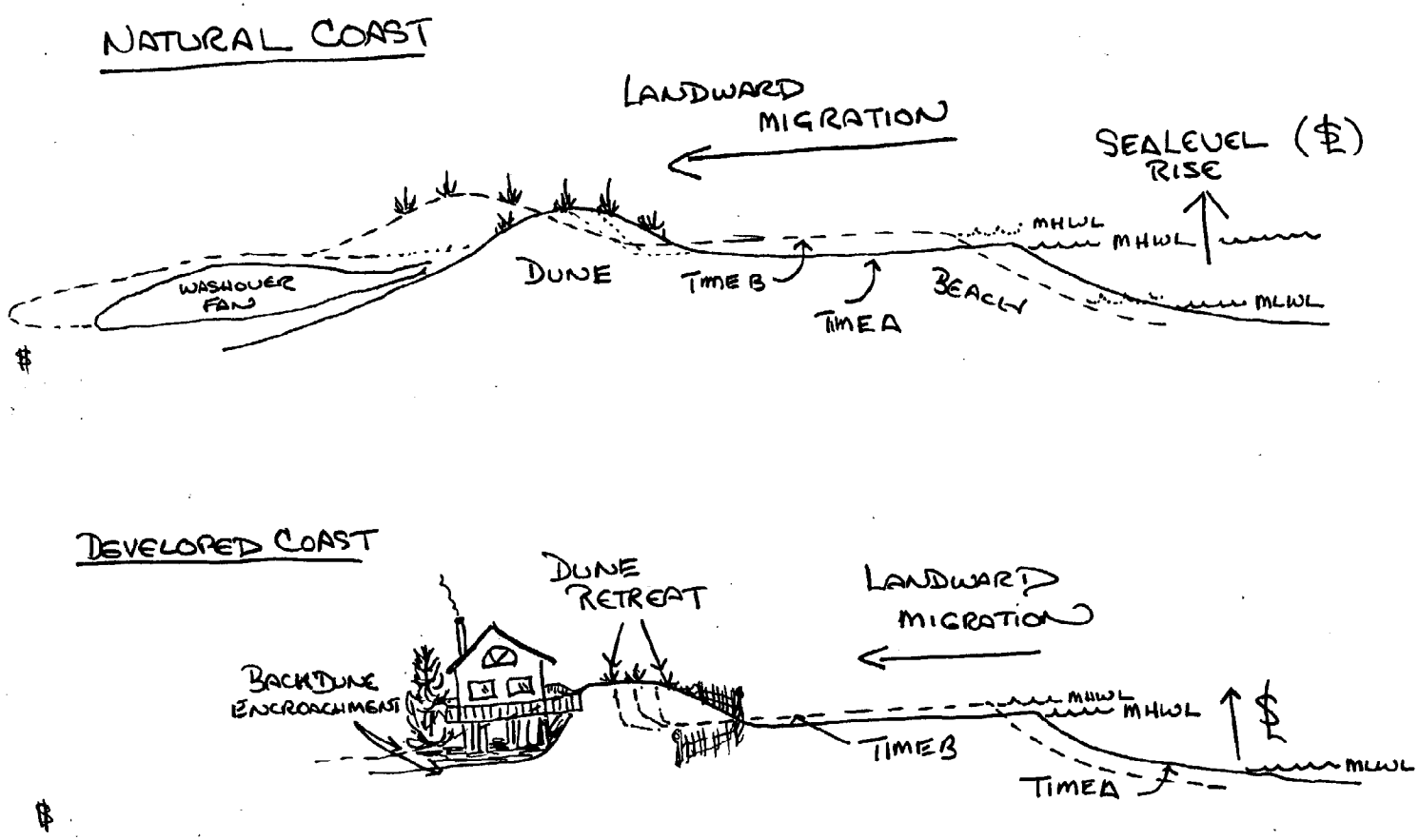
In developed areas, however, with homes and other fixed structures close by, storm damage and its repair can be finitely watched and measured. When there is a loss of beach and dune due to a storm, there is a great rush to "repair" these features. Often money is quickly spent to return the beach and dune profile to its previous outline from the top down without allowing the natural processes to repair the damage from the bottom up. This essentially cosmetic approach to storm repair ultimately leads to a further weakening of the system and consequent increased erosion.

The four necessary ingredients for dune growth and migration are: 1) space for dune and beach development, 2) sediment source, 3) wind and 4) proper vegetation. Much technical literature is available for in-depth analysis of each of these factors and for the design of dune protection programs. A short discussion of each follows that includes only those salient features necessary to explain various provisions of the dune ordinance analysis.

Dunes will only form landward of the spring high tide line of a beach. Spring high tides occur twice a month at the time of full and new moon, and are the highest tides of the month. However, on most New Jersey beaches where there are dunes, they will be found landward of the storm high tide level, due to the fact that 1) the state's coastline is undergoing steady erosion and 2) our storm frequency is high enough to keep eroding the seaward side of the dune. New Jersey's erosion problem is caused by the lack of new sediment entering the system due to past and continuing sea level rise, armoring the would-be source of beach sediment by bulkheads and seawalls along the coast, and numerous jetties and groins that force sediment offshore into deeper water and out of the beach-dune system.

Because New Jersey has so much development close to the ocean, as sea level rises and erosion continues, beaches continue to narrow. In natural areas, by contrast, the winds and waves would move the beach and dune system landward and upwards as the sea level rises. Therefore, the beach and dune system would keep its same width and depth, but its whole position would be translated landward (Figure 2).

Obviously, a narrowing beach-dune system adjacent to development does not provide enough space for dunes to grow and function as a protective feature. Eventually the dune as well as the beach will disappear under these circumstances. The Sea Bright-Monmouth Beach seawalled area is the most extreme example of this scenario, with the ocean waves often slopping over the seawall onto the adjacent State Highway. Parts of Cape May, Ocean City, and Sea Isle City are examples of narrowing beaches with no dunes. Acknowledging the space requirement for effective dunes, the U.S. Soil



RESPONSE OF NATURAL & DEVELOPED COASTS TO LANDWARD MIGRATION OF THE BEACH-DUNE SYSTEM

FIGURE 2.

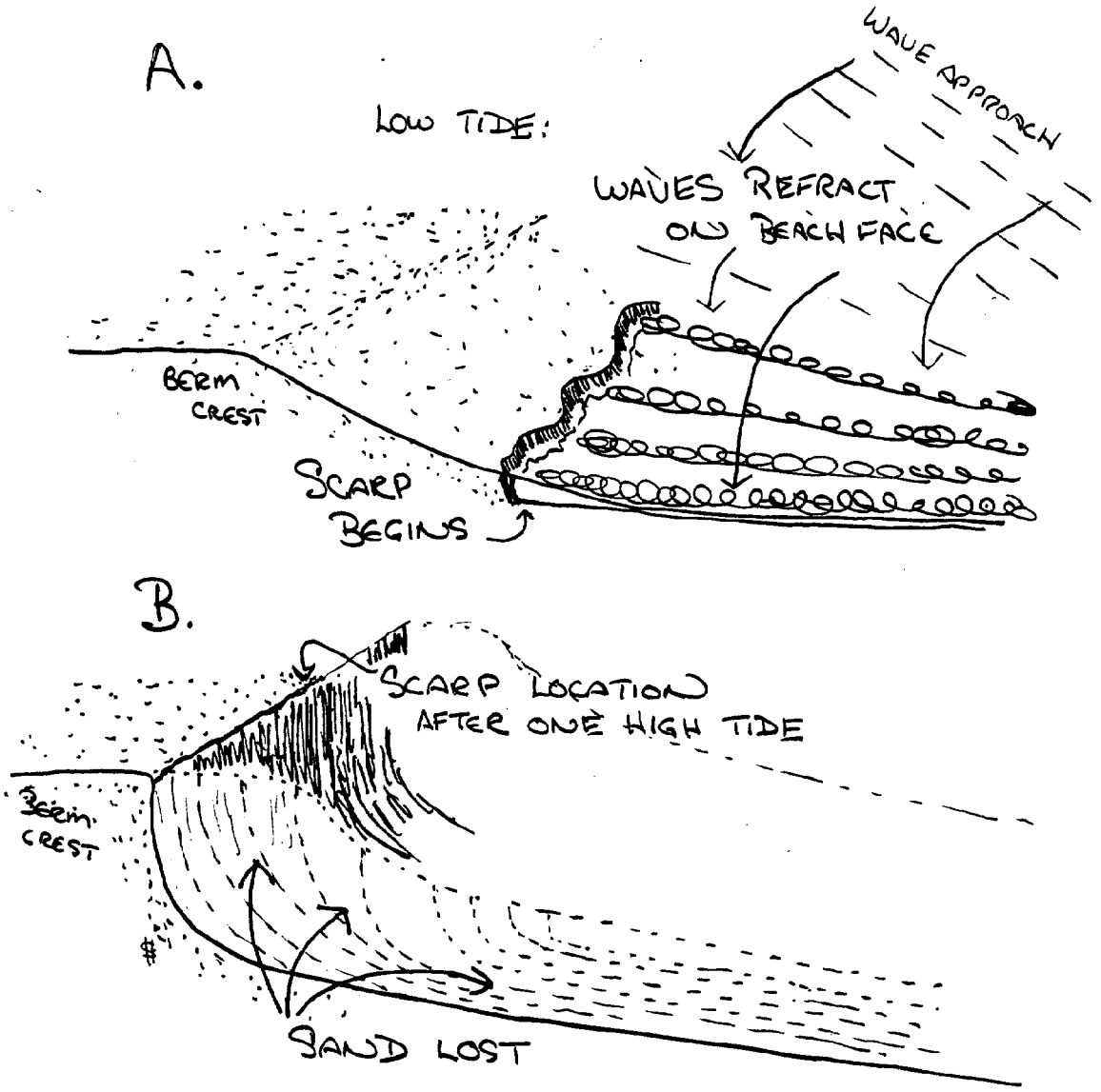
Conservation Service has indicated that they will not participate in any dune building programs unless the beach is at least 100 feet wide from the mean high water line to the seaward side of the dune (USDA-SCS, 1978).

One of the most destructive processes to beaches and dunes, particularly on developed coasts, is called "grazing-swash undercutting" or GSU (Baumgaertner, 1975). This process, occurring during significant northeast storms, is responsible for major beach and dune erosion by the creation of scarps (cliffs). This was the process responsible for the major beach and dune erosion from the March 1984 storm as well as the storms of December 1980, December 1977-February 1978, and December 1974. The dune scarps caused by the 1977-1978 winter storms are still visible in many places along the coast, evidence of the inadequacy of many municipalities' dune building practices. The March 1984 storm, in some places, cut landward of the 1978 scarps.

The process of scarping occurs when the storm waves begin to refract (bend) on the forebeach and run parallel down the beach thus forming a small scarp (Figure 3A). When this process begins on a rising tide, the scarping process continues landward until the highest point of the tide is reached (Figure 3B). As the tide ebbs, the process is arrested. If the storm continues through another tidal cycle, the scarping process resumes and continues further landward, consuming as much of the remaining beach and dunes as time allows. In South Carolina, for example, approximately 5 cubic yards/foot of beach was lost in one 6-hour period (Kana, 1976). This was the scenario of the March 28-29, 1984 storm in New Jersey. The second high tide eroded not only the entire beach but also an average of 10-20 feet of dunes throughout the coast. Fortunately, the storm surge passed before the third high tide started preventing more serious breaching of dunes and destruction of infrastructure and homes. Thus, three times in the last seven years (1978, 1980, 1984), the New Jersey coast was one or two tides away from destruction potentially as severe as the 1962 storm which lasted for five high tides.

The reason this scarping process is particularly serious when it occurs on a developed coast is not only because the backdune is prevented from widening as discussed previously, but also because the vertical scarp is so difficult to repair, either naturally or artificially, because of the large volume of sand that was removed. This is in contrast to the post-storm beach building process which is quite rapid. Therefore, a zone of erosion vulnerability remains in the backbeach - dune area until the scarp is healed. Additional natural dune building landward of the scarp is also suspended until a sufficient ramped dune toe returns that allows sand to travel up through the dune. Over time as the beach continues to narrow, scarping becomes more frequent and the dune is continually narrowed.

On developed coasts, municipalities and private individuals often attempt to rebuild dunes using a variety of methods with varying success (Halsey, 1981). Often these methods are carried out too far seaward on the beach in an attempt to mitigate for destruction of a natural dune where a



FORMATION AND GROWTH OF SCARP BY GRAZING – SWASH UNDERCUTTING

A.) INITIAL SCARP FORMATION

B.) GROWTH OF SCARP

FIGURE 3.

house was constructed. Recent data suggest that this practice may throw the dune system out of equilibrium with the beach, thus increasing the dune's vulnerability to scarping by storm activity (Gares, 1983).

The second requirement for dune growth and migration is adequate source of sediment. If there is sufficient sand in the backbeach area of the beach above the fair weather high tide line, dunes can grow. However, as beach width decreases, this source decreases.

In undeveloped beach-dune systems, there is an auxiliary source of sediment for the growth of the backsides of dunes. During storms, if overwash occurs through dunes (Figure 1), offshore winds can act on this loose sand blowing it seaward up onto the backside of the dune, thus adding to the dune's growth. However, in developed areas, where structures and development prevent overwash, except down streets where it is summarily returned to the beach area by bulldozers, offshore winds do not have this source upon which to act. Instead, strong offshore winds that blow seaward around buildings or down streets lift sediment off dune crests or from pathways, causing dune lowering instead of growth.

The third requirement for dune growth and migration is wind. Generally, sand is transported by wind when the velocity exceeds 10 miles per hour. The duration and direction of the wind are important components in dune building. High wind speeds over a fairly long time (hours to days) are necessary to move significant amounts of sand into or out of dunes. Since New Jersey's coast is generally oriented north-south, the best dune building winds are from the east quadrants: northeast, east or southeast. Northeast storm winds are capable of moving sand into dunes if the beach or dunes are not being destroyed by waves, or the associated rain or snow is sufficiently intermittent to dry out the sand between periods of precipitation to allow movement. The best winds for building dunes in New Jersey are "dry", high velocity northeasters or southeasters (Halsey, 1981).

One of the reasons that sand (or snow) fencing is used so extensively along New Jersey's coast is to "train" or entrap sand in the places where sand is wanted. Since the sand fencing has a 50 percent porosity, sand hitting the slats is temporarily stopped in its journey. This entrapment has both good and bad aspects (Halsey, 1981). If fences are placed correctly, dunes or scarps can be formed or healed quite quickly, and sand, headed offshore from dune crests, can often be intercepted before it is lost. If the fences are placed incorrectly, however, dunes are formed more seaward than they should be, and scarps are not healed sufficiently to allow continued dune growth.

The importance of proper vegetation in dune building is becoming more widely understood. The main dune building plant in New Jersey is the American beachgrass Cape variety (*Ammophila breviligulata*). This plant grows best where new sand is regularly added to the dune (Godfrey et al.,

1979). This important relationship is not yet understood by many municipalities and environmental groups who plant Ammophila everywhere on the dune including the lee side or in areas that are shielded from new sand growth by multiple layers of sand fencing.

The best method to form a new dune is to plant dune grass on the low mound, in order that the dune and plants growup together and the roots knit the entire dune together. Dunes with beachgrass roots that extend down to the base of the dunes were observed to have been eroded less during the March, 1984 storm (Halsey, pers. comm.). This is not to suggest that dunes with new or replacement grass plants on top are totally ineffective, because vegetation does help to capture windblown sand and stabilize the dune form.

One of the only drawbacks of Ammophila is its almost total intolerance to human activity, particularly off-road vehicles (ORV's) and pedestrians (Leatherman and Godfrey, 1979; Leatherman and Steimer, 1979). Even the pressure of foot traffic will quickly cause breakage and churning up of the roots, destabilization of the sand, and consequent weakening of the dune. This is why DEP now recommends that public accessways, including street end walk throughs, be constructed of elevated wooden walkways above dunes to avoid this damage (Halsey, 1981).

ASSESSMENT OF DUNE AND SHOREFRONT PROTECTION ORDINANCES

Table 1 lists those shorefront municipalities below the Manasquan River that are included in this report. In general, the Monmouth County municipalities have so little sand on their beaches, they presently have few dunes. However, if enough beach nourishment were placed on the beaches to allow dune growth, dune ordinances would then be warranted. Those towns below the Manasquan that responded to the Division's inquiry are listed definitively, while others where information was not available in time for this report are listed with a question mark. Since all the municipalities are members of the National Flood Insurance Program, they have passed the required federal land use provisions which also include minimal provisions for protection of sand dunes in the V-Zone.

When these ordinances are read, the first impression is that they all contain very similar, specific restrictions about building in the legal dune area, and are generally quite sound. Most of them, however, share a major problem. The ordinances describe a fixed and static legally defined line, such as a building line or dune area, that does not recognize future beach erosion or past processes that may have caused the dunes to migrate landward past the building line since the ordinance was adopted. The consequence is that the ordinance does not prevent building in natural dune areas which are landward of the building line. A second problem is that municipalities often grant variances to their dune ordinances and allow building in dune areas out of fear that they would otherwise have to buy the lot.

Table 1

	Member NFIP	Additional Dune Ordinance
Ocean County		
Pt. Pleasant Beach	Y	Y
Bay Head	Y	N
Mantoloking	Y	Y
Brick Twp.	Y	?
Dover Twp. (Normandy/Ortley)	Y	Y
Lavallette	Y	Y*
Seaside Heights	Y	?
Seaside Park	Y	?
Berkeley Twp. (S. Seaside Park)	Y	Y
Barnegat Light	Y	Y
Harvey Cedars	Y	Y

Table 1 (Con't)

Long Beach Twp. (4 sections)	Y	Y
Surf City	Y	Y
Ship Bottom	Y	Y
Beach Haven	Y	Y
Atlantic County		
Brigantine	Y	Y
Atlantic City	Y	N
Ventnor	Y	N
Margate	Y	N
Longport	Y	N
Cape May County		
Ocean City	Y	Y
Upper Twp. (Strathmere)	Y	Y
Sea Isle City	Y	Y
Avalon	Y	Y
Stone Harbor	Y	Y
North Wildwood	Y	Y
Wildwood	Y	?
Wildwood Crest	Y	N
Cape May City	Y	N
Lower Twp.	Y	Y
Cape May Point	Y	Y

Key: Y=Yes; N=No
*=First reading of ordinance has passed
?=Information unavailable

One of the most interesting cases arising from municipal failure to revise building and dune lines is the Borough of Beach Haven, where as a consequence of Spiegle vs. Beach Haven[2], the Borough's ordinances were upheld in three of the four lots under litigation but the Borough was forced to buy the fourth lot. Within the Borough's ordinance, however, are two sections that acknowledge the mobility and migration of the dune (at 38.2-Legislative findings and declarations):

> C. The immediate dune and beach area is not capable of rigid definition or delineation, or of completely firm stabilization, so that particular sites, at one time free of dunes, may as the result of natural forces, become part of the dune area necessary for the continuation of the protection above outlined, and persons purchasing or owning such property do so subject to the public interest therein.

and then 2) for the remapping of this dune as it changes (at 38.5-Administration):

> A. The Borough Engineer shall by such surveys and calculations as he finds necessary locate the beach and dune areas as defined in this Article and plot the same on a plan of the borough, which plotting, or a copy thereof, shall be on a file in the office of the Borough Clerk and available for inspection. He shall from time to time make any corrections in his findings and plottings that changes in the natural or artificial features of the terrain may justify or require.

However, this remapping has never been done by the Borough and cases similar to the Spiegle case have continued to plague the borough.

A consequence of dune migration and a fixed building line is heavy encroachment and usually removal of the back dune slope, because dunes landward of the building line lose their legal definition. Landward of the building line, dune sand, in effect, becomes so much "soil" and the community is powerless to prevent development. The effect of this encroachment is the significant narrowing of the dune from the landward side. This activity combined with the continuing narrowing of the dunes from the seaward side has in some areas reduced the dune to a narrow dike-like feature (Figure 2).

There are only a few ordinances that acknowledge the migration of dunes and provide a more scientifically defined setback line. Mantoloking, and now Point Pleasant Beach (recently derived from Mantoloking's ordinance),

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[2] See Spiegle v. Borough of Beach Haven, 116 N.J. Super. 148 (1971).

prescribe a case by case review for the placement of new or renovated residences to keep development a safe distance from the sea and landward of the backdune.

Long Beach Township's ordinance, attempts to define a 150' wide beach-dune area district by stating at 13.3:

> Beach Dune Area: The District set off by this Chapter to include all areas bounded on the Southeast side by the Atlantic Ocean and on the northwest side by a line parallel with and 150 feet northwestwardly from the oceanfront building line.....

However, the next clause states "or by the nearest north south street, whichever is the lesser distance". This last clause has allowed houses to be built on top of dunes as long as they are twenty feet behind the bulkhead line and the dune is sixteen feet high at the ocean front building line.

This clause has also allowed a critical situation to develop in the Brant Beach section of Long Beach Township where significant beach and dune retreat by scarping has been continuing for many years. During the March, 1984 storm, the scarp progressed far enough landward to expose the pilings of the houses built eastward of Ocean Ave. Some of these houses have been only recently completed. This critical erosion and the vulnerability of the homes precipitated a request from Long Beach Township for $100,000 of State Aid from the first shore protection appropriation for emergency repair of dunes. However, as discussed in the process section of this report, dunes will only remain in areas that have sufficiently wide beaches. Thus, the expenditure of $100,000 for bulldozing of sand up from already depleted beach areas would not correct this critical situation, but would only temporarily provide some sand until the next series of storms removed it. The Federal Interagency Hazard Mitigation Team called together after the March, 1984 storm suggested to the Mayor of Long Beach Township that no further building be allowed seaward of Ocean Ave. until further studies can be conducted in this area to determine the cause of erosion and steps to mitigate it.

Other sections of municipal dune ordinances were found to be deficient to prevent dune damage or to provide clear guidance for homeowners and others to build new dunes, repair damaged dunes or to improve existing dunes. However, this is not entirely the fault of the ordinances, but is due to the lack of specific knowledge of dune dynamics until a few years ago.

One of the best dune ordinances in New Jersey is the Mantoloking ordinance that has been continuously amended to strengthen it. This strengthening is due to the hiring of a private dune consultant and the interest of a group of homeowners who aggressively maintain and study their dunes. A copy of Mantoloking's latest ordinance is presented in Appendix A. As a result of the ordinance and its enforcement, and despite the heavy scarping of their dunes in the March storm, so little damage was sustained

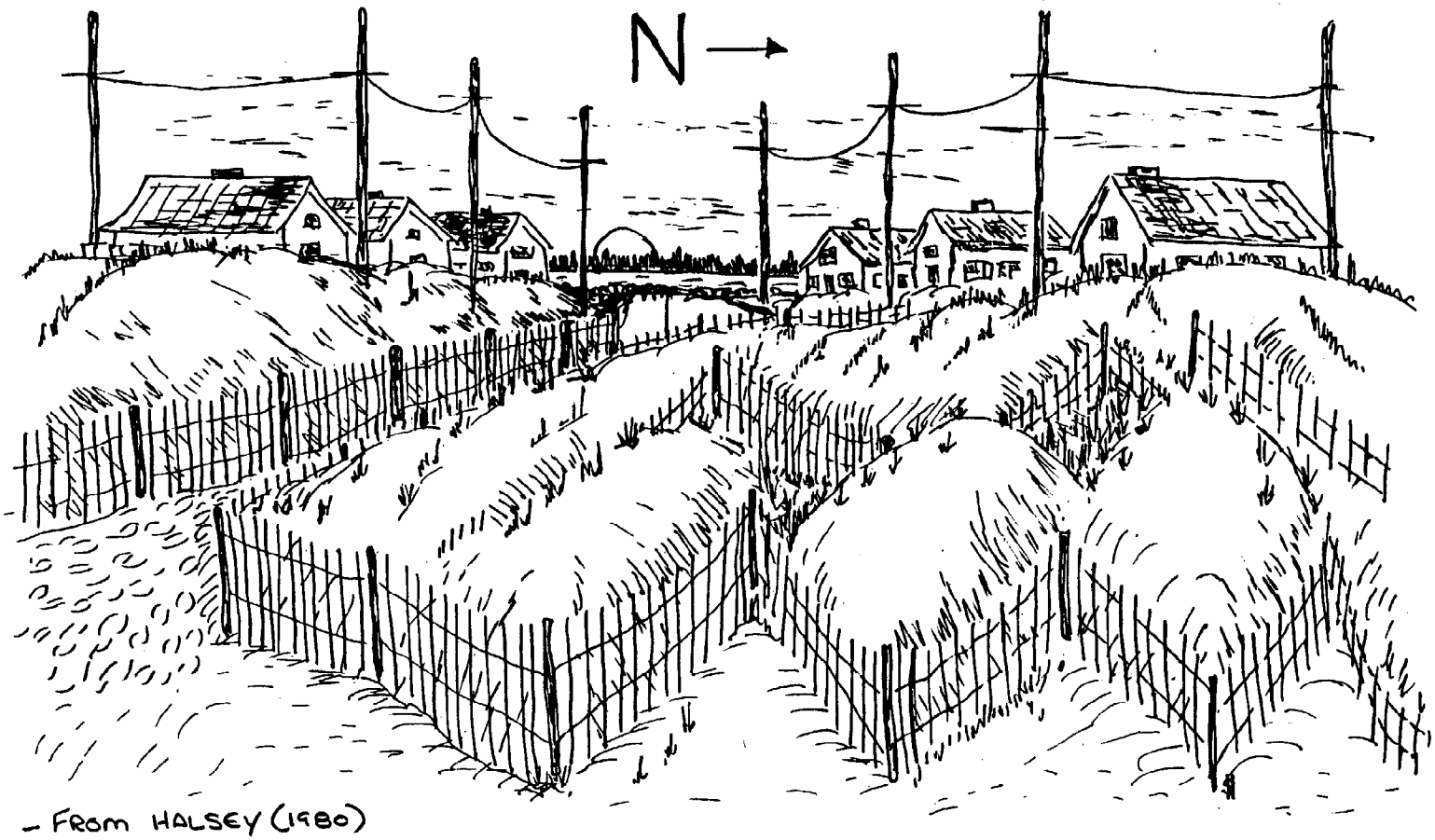
in Mantoloking that the municipality did not need to apply for post-storm disaster assistance.

One of the strongest provisions of Mantoloking's ordinance is the recently added provision that all walkways to the beach, both public at street ends and private, be elevated wooden walkways over the dunes. Since there is a direct correlation between low streetend walkthroughs and overwash, this provision had also been recommended by DEP to other municipalities as they have requested technical assistance for their dunes. If the municipality considered wooden walkways too expensive, DEP has suggested a lower cost substitute in the form of an angled path with protective dunes in the front (Figure 4). Had either of these protective street end suggestions been instituted throughout the shore prior to the storm, at least $450,000 could have been saved during the 1984 storm just for removal of sand and other debris from local streets.

Although most, if not all, the dune ordinances forbid the destruction of vegetation and sand fencing, thus acknowledging their roll in the maintenance and growth of dunes, few ordinances give clear guidance to either the municipalities or private owners particularly in matters of vegetative plantings. Only the ordinances of Mantoloking, Point Pleasant Beach, Dover and Berkeley Townships mandate the specifications for dunegrass plantings, the latter two of which apply only to dune areas that have been disturbed by construction activities. The Long Beach Island family of ordinances also mandates mitigative planting specifications around dune platforms.

Sand fencing specifications get slightly more attention in ordinances but the guidance is not always clear. Although Mantoloking has adopted accompanying resolutions to their ordinances that include minimum standards for fencing, other municipalities have language that suggest fences "perpendicular to prevailing winds". It is doubtful that municipalities or the general public have such detailed wind knowledge, and in any case, recent data suggests that dunes are built by dominant wind events not by prevailing winds, as discussed earlier. In the absence of clear guidance, the municipalities and homeowners have been doing whatever they think best. The most common practice is the use of dune-beach parallel fencing placed slightly seaward of the previous year's fencing and turning up perpendicular to the ocean at streetend walkthroughs. The most beneficial effect of this fencing is to act as a "people" fence, keeping people out of the dunes, off fragile dunegrass, and confined to designated walkways. However, recent data plus on going research by DEP has shown that while this type of fencing technique does retard trespassing, it is not an effective technique to repair scarps, increase total dune growth, or prevent overwash at street ends (Halsey, 1980, 1981, Halsey et al., 1981).

An ancillary practice to the use of parallel fencing is the use of brush piling, commonly recycled Christmas trees, at the landward base of the fencing to further baffle moving sand. Many of the ordinances include provisions such as the following in their section on sand fencing:



- FROM HALSEY (1980)

RECOMMENDED PROTECTIVE ANGLED STREETEND PATHWAY

FIGURE 4.

SAND FENCE -- This shall include the term "snow fence" and may mean either of two (2) types of barricade established in a line or a pattern to accumulate sand and aid in the formation of a dune.

A. BRUSH TYPE -- This consists of dead bushes, trees, reeds or similar debris collected in bundles and fixed by stakes or similar means.

B. PICKET TYPE -- This shall be the commercial variety of light wooden fence, held together by wire and secured by posts.

Although the ordinances read "either" the brush type or picket type, many municipalities use both in an attempt to trap more sand. However, recently this brush piling activity has increased to the point where in many localities, the dune toe-fence area has become the dumping ground for municipal pruning or clearing activities. Besides being unsightly, this activity is injurious to dune growth and particularly the growth of beach grass by blocking light, rain water and windblown nutrients. Brush, taking the place of a vegetatively knit dune, is easily removed during storms. This once buried brush with tree trunks become further storm litter and possible lethal air and waterborne missiles.

The first municipality besides Mantoloking to react to correct this well meaning but injurious activity is Avalon which recently passed at Chapter VII.7-3.4 the following:

> Refuse and Debris. It shall be unlawful to throw, place, deposit or leave any shrubs or shrub cuttings, trees, bottles, glass, crockery sharp or pointed article or thing, paper, refuse, or debris of any kind on beach area, dunes or approaches thereto, except in the proper receptacles provided therefore on the Boardwalk or the Beach. (Amended 12/29/84 by Ordinance 139-83).

DEP concurs with this amendment because the aforementioned data suggest that the proper use of snow fence and the planting of Ammophila builds the dune quickly and thoroughly. The addition of brush does not at all further this growth.

Another technique of sand fencing has been practiced in some northern Ocean County municipalities for many years. This is the placement in the fall of parallel rows of fencing oriented from northwest to southeast along the backbeach area of the beach but seaward of the boardwalk, natural dune or homes. This fencing traps large quantities of sand before it reaches the area which would be occupied by natural dunes, if they existed. In Ocean County, this is usually the boardwalk area. In the late spring this fencing is removed, and the natural beach plus the mounds of sand are redistributed and graded flat by bulldozer. Often this requires that some of this beach sand be actually pushed into the ocean. Various rationales for this practice have been offered: 1) The tourists prefer a graded beach; 2) Pulling sand away from and under the boardwalk prevents rotting of the wood and ORV's from gaining ready access to and from the beach from the boardwalk;

and 3) Grading prevents dunes from growing up and blocking the views of the oceanfront homeowners.

As a result of this practice and their lack of dunes, the northern Ocean County municipalities from Normandy Beach to Seaside Park experienced a great deal of damage from the March 1984 storm. Lavallette again lost almost its entire boardwalk, and they and the rest of the communities were extensively overwashed by voluminous quantities of sand down streets. This waterborne sand was augmented by significant windblown sand from these unvegetated "dune" mounds. Dover Township estimated that in the Ortley Beach section of their community dump trucks moved 39,000 cubic yards of sand from the streets back to the beach (FEMA, 1984). Seaside Park formed huge piles of sand at every street end in order to transport the sand back to the beach over the boardwalk. There was an average of two to four feet of sand with six-eight foot drifts on the boardwalk and streets. Seaside Heights reported that each street took an average of six hours to clean and that a new dune area six feet high and 50-70 feet wide accumulated against the boardwalk with three to four feet of sand over the boardwalk itself. Front end loaders, bulldozers and dumptrucks were borrowed and rented as far away as Stafford and Lakewood Township to help in this cleanup effort.

Most of this production and expense could have been avoided by the creation of permanent dunes and the suspension of this fencing and grading program. As a result of this suggestion by the Interagency Hazard Mitigation Team (FEMA, 1984) and offers of technical and financial assistance by DEP, Lavallette has suspended the seasonal fencing/grading practice, and erected fences to create a new permanent dunefield just seaward of their boardwalk with angled pathways to the beach. This new dune will be planted with beach grass in the spring and a Citizen's Environmental Dune Committee will help the Mayor and Council to administer the dune program. A new dune ordinance has been drafted for the protection of these new dunes.

Dover Township is now planning to create dunes on municipally owned sections of their beach in the Ortley Section while their ordinance which permits this "maintenance program" is under review. Although there are many privately owned sections of beach throughout Dover Township, each homeowners association must apply for a beach maintenance permit through Dover Township and conform to other provisions of the dune ordinance.

Conclusions

The main conclusions of this study are:

1. Those municipalities with good ordinances that have avoided granting variances and have encouraged good dune building practices over the years, particularly Mantoloking, Barnegat Light, and Avalon, had the least damage to homes and infrastructure, and requested the least amount of post storm cleanup money after the March 1984 storm. Throughout the shore, areas behind natural or well designed dunes experienced significantly less damage than the rest of the shore.

2. While most of the municipal dune ordinances in New Jersey are well meaning in their intent, they are substantially out of date. Drawn up as a result of the March 1962 northeast storm, these ordinances either do not recognize the actual landward migration of the dunes out of a legally defined area, or the areas they address have never been remapped to respond to migration subsequent to their passage. As a result, the back slopes of dunes have been allowed to be removed and homes have been built too close to the ocean. This has resulted in past, and will continue to require in the future, costly shore protection projects to be designed to protect these homes and infrastructure.

3. While generally recognizing the role of wind and vegetation to build dunes, most municipal ordinances lack clear guidelines for proper fencing or vegetative techniques. The destructive role of scarping is neither addressed nor are there guidelines for repair of dunes after its occurrence.

4. Most municipalities permit low pathways through dunes which have allowed extensive flooding and overwash to occur during storms. Only Mantoloking, Point Pleasant, and Avalon mandate and provide guidance for the construction of elevated wooden walkways over dune protected street ends or protective walkways through other dunes.

RECOMMENDATIONS

The Legislature requested administrative and legislative recommendations. DEP believes the suggestions below would help minimize future public expenditures for storm damage by taking maximum advantage of the ability of well constructed and vegetated sand dunes to function as effective low cost flood protective features.

Administrative

1. DEP shall offer technical assistance to help those municipalities draft, or update, and implement dune ordinances. The Department offers the ordinance adopted by Mantoloking (See Appendix A) as a good working model, but will help each municipality tailor the provisions to meet specific community needs.

   Issues such as the role of scarping and its mitigation, effective fencing techniques, vegetative plantings, and elevated walkway or protective street end pathways will be addressed. DEP shall also recommend that remapping be done every five years or after major storms, whichever is less.

2. DEP will make all future shore protection grants from state or federal funding contingent upon municipal adoption of a satisfactory dune ordinance recognizing migration and the issues discussed above. The Department recognizes that shore protection projects

may be appropriate in limited beach areas that are too narrow to support dunes, even with additional sand.

3. DEP will offer public information meetings in cooperation with any municipality or citizen group to explain the rationale and best practices for continued dune protection.

4. DEP will discuss with communities certain practices such as future setback possibilities, mitigation techniques of backdune encroachment such as zoning requirement relaxation, and practices to encourage migration of dunes such as indigenous plantings and dune growth instead of lawns.

5. DEP will offer funds from Shore Protection Bond Issue appropriations and from the Federal Coastal Zone Management Act to fund municipal and county dune enhancement programs. This includes monitoring to test fencing or vegetative plantings for their effectiveness.

Legislative

Dune creation and protection is the most cost effective form of shore protection, but it does entail costs, and it is not sufficient to provide good safe beaches in New Jersey. There will be a continuing need for beachfills and other shore protection projects.

DEP recommends that the Legislature should develop a long term stable source of funding for shore protection to finance projects consistent with the New Jersey Shore Protection Master Plan and the administrative recommendations made above.

DEP also offers to work with the legislature to explore long term possibilities for acquisition of severely eroded areas after major storms.

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This report was prepared under the direction of John R. Weingart, Acting Director of the Division of Coastal Resources by Susan D. Halsey, Ph.D. Technical assistance was provided by Neil Yoskin, Esq. formerly of DEP.

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APPENDIX A

ORDINANCE #226

AN ORDINANCE TO REGULATE, PRESERVE AND PROTECT THE BEACHES AND DUNES WITHIN THE BOROUGH OF MANTOLOKING, OCEAN COUNTY, NEW JERSEY: PROVIDING PENALTIES FOR THE VIOLATION THEREOF; AND REVOKING ORDINANCE #198.

BE IT ORDAINED BY THE MAYOR AND COUNCIL OF THE BOROUGH OF MANTOLOKING, IN THE COUNTY OF OCEAN AND STATE OF NEW JERSEY, AS FOLLOWS:

ARTICLE I. FINDINGS, DECLARATION AND PURPOSE.

1-1. Although there may be no long term defense for fixed oceanfront structures against a constantly rising ocean level, effective protection of the oceanfront and adjacent coastal areas in the intermediate term against high tides and flooding and against damage by the ocean under storm conditions requires sufficient elevation and breadth in the beach and Dune Areas, hereinafter defined, to dissipate the force of the waves. The dunes should provide an uninterrupted barrier and a source of sand to mitigate the effect of storm waves for the benefit of the entire Borough - interior lands as well as oceanfront premesis - and a beach for the recreational purposes of all. Accordingly, the Borough has a vital interest in the continued maintenance and protection of the beach and Dune Areas and in the right to cause their restoration in the event of damage or destruction.

1-2. Dune areas are vulnerable to erosion by wind, water, the absence of good husbandry by those responsible for their maintenance and preservation, and by indiscriminate trespass, construction or other acts which might destroy or damage them.

A proven and available means of protecting Dune Areas against erosion is by preventing indiscriminate trespassing, construction or other acts which might destroy or damage them, and through the aggressive use of native plantings supplemented, when necessary, by sand fencing and other protective devices, or combinations thereof, designed to prevent the erosion of Dune Areas and to promote the root accumulations, normal contours and other features found in natural dune systems.

1-3. The Beach Area and Dune Area are dynamic and are not capable of rigid definition or delineation, or of completely firm stabilization. They can and do migrate, so that particular sites, at one time free of dunes may, as the result of natural forces, become a part of the Dune Area declared to be in the interest of the Borough to protect. Persons owning, using or purchasing such property do so subject to the public interest therein.

1-4. It is a purpose of this ordinance to define the areas so affected and to establish regulations to assure their continued effectiveness.

1-5. This ordinance does not attempt to define and regulate all parameters of dune delineation, function or management and the Borough Council declares its intent to review and update this Ordinance periodically to reflect appropriately new and beneficial knowledge treating of such things as, but not limited to, Upper Driftline, elevated walkways and building Setback requirements.

1-6. This ordinance is declared to be an exercise of the police power in the interest of safety and welfare for the protection of persons and property.

ARTICLE II. DEFINITIONS.

For the purposes of this Ordinance, the following words shall have the meaning given herein.

2-1. **Beach Area** is that area between the mean high water line of the Atlantic Ocean, in reference to the 1929 Sea Level Datum as established by the U.S. Coast and Geodetic Survey and the Seaward Edge of the Dune as hereinafter defined.

2-2. **Seaward Edge of the Dune** is the intersection line of the foreslope of the dune and the gradient of the Beach Area, or the contour line at an elevation of 12 feet above mean high water, or the Vegetation Line, or the Upper Driftline, whichever is the more easterly, except when the Borough Engineer may have caused stakes to be driven to mark the Seaward Edge of the Dune, in which case it is the line between such stakes.

2-2. **Upper Driftline** is that line produced by the winter spring tides (highest tides of the year) which contains oceanic debris (flotsam such as seaweed, etc.) and the seeds, rhizomes, or detached plants which can germinate and/or grow to produce a zone of new dune vegetation.

2-3. **Landward Edge of the Dune** is the intersection line of the backslope of the dune and the grade of the land extending from the east boundary of New Jersey Route 35 eastwardly, or the line joining the average Landward Edge of the Dune of the adjoining oceanfront properties, or a line parallel to and 60 feet west of the Seaward Edge of the Dune, whichever is the more westerly.

2-4. **Vegetation Line** is that line connecting the most seaward naturally occurring perennial plants with other such plants.

2-5. **Dune Area** is that area between the Seaward Edge of the Dune and the Landward Edge of the Dune.

2-6. **Dune Reference Line** is that line designated as such on the revised tax map of the Borough of Mantoloking.

2-7. **Setback Line** is that line parallel to the Dune Reference Line and located westwardly therefrom by the setback distances variously specified in Borough Ordinance #184, or any subsequent modification thereof.

2-8. **Natural Vegetation** shall include the terms "native vegetation" or "indigenous vegetation". Specifically, it shall include such plants as beachgrass (**Ammophila breviligulata**), dusty miller (**Artemisia stelleriana**), sea rocket (**Cakile edentula**), seaside goldenrod (**Solidago sempervirens**), bayberry (**Myrica pensylvanica**), beach pea (**Lathyrus japonicus**), salt spray rose (**Rosa rugosa**), or seaside spurge (**Euphorbia polygonifolia**), which normally grow or may be planted on the slopes of dunes or behind them, no distinction being made as to how such plants are introduced into their location.

2-9. **Walkway** is a constructed means of crossing the Dune Area in accordance with drawings approved by Borough Council and on file with the Borough Engineer.

2-10. **Sand Fence** shall include the term "snow fence" of a barricade type established in a line or a pattern to accumulate sand and aid in the formation of a dune, such as:

a. Picket type consisting of light wooden fence held together by wire and secured by posts; or

b. Such other material as may be designed and approved for the purpose.

2-11. **Dune Consultant** shall mean an expert on dunes and their care retained by the Borough. In any periods during which no such expert is regularly retained, it shall mean such other person designated by Borough Council.

2-12. **Dune Inspector** shall mean that person designated by Borough Council.

ARTICLE III. BEACH AND DUNE AREAS: REGULATIONS.

3-1. Construction east of the Setback Line is prohibited, except as provided in 3-3. Construction in the Dune Area west of the Setback Line is prohibited, except as specifically allowed herein or by the present Land Use regulations of the Borough and in accordance with the present Flood Plain regulations of the Borough. Any allowed structure shall be built upon suitable piling and shall be and remain open and unenclosed between the piling at least from grade to the bottom of the first floor joists, as to dwellings; other allowed structures shall be designed, constructed and maintained so as to facilitate the natural migration of sand on or across the premesis.

3-2. The first floor of any new or rebuilt residence structure built east of New Jersey Route 35 from the southerly borough line to Lyman Street, or east of East Avenue from Lyman Street to the northerly borough line, shall be at an elevation at least as great as that specified in Ordinance #174, or any subsequent modification thereof.

3-3. No person shall be in the Dune Area unless:

(a) upon an approved pathway, Walkway or dune platform; or

(b) in the performance of such activities as may be reasonably and necessarily required to construct or maintain the dune or allowed structures with the permission of the owner; or

(c) for purposes of enforcement of this Ordinance.

Only one pathway or Walkway across the Dune Area is permitted for each residence. It shall run, generally, the shortest practical course between the residence and the Seaward Edge of the Dune, and shall not exceed three feet in width. At street ends, wider pathways may be delineated by the Borough Engineer. In the event that any pathway or Walkway shall be or become, in the opinion of the Dune Consultant, a substantial detriment to the development and maintenance of the continuous protective dune sought to be achieved by this Ordinance, the owner of the premesis shall be subject to the provisions of Sub-Article 3-9 of this Ordinance.

In addition to the pathway or Walkway, each oceanfront lot shall be allowed a "dune platform" not to exceed 200 square feet, situated within the Dune Area and specifically located and delineated by the owner of the premesis. The dune platform shall, in all events, be maintained in the same fashion and subject to the same regulations as may govern use of pathways and Walkways. Dune platforms shall comply with such specifications as may hereafter be adopted by resolution of the Borough Council governing such structures.

3-4. The removal, cutting, burning, or destruction of Natural Vegetation, Sand Fence or such other types of dune protection devices as may be approved by the Borough Council in the Dune Area is prohibited, except as necessary for construction authorized pursuant to subsections 3-1 and 3-3.

3-5. The removal of sand from the beach or Dune Area is prohibited.

3-6. Sand which is transported upon lands by action of wind, tides, storms or any combination thereof shall not be removed from the lot upon which it is deposited by such action. To the extent practicable, considering the utilization of the premesis, such sand as may be affirmatively relocated by the owner upon the lot shall be moved eastwardly. Sand deposited upon any improved street ends shall be restored into the beach and Dune Area.

3-7. One of the purposes of this Ordinance is to achieve the maintenance of sand dunes at the highest practical height. To this end, no dune shall be directly or indirectly lowered or reduced in height by the action or inaction of any owner or his agent. However, if any dune shall be or become lower than the elevation deemed materially significant by the Dune Consultant, applying recognized criteria, with due regard to the intent of this Ordinance and reasonable use of the premesis, the owner thereof shall be obliged to install such Sand Fence and plantings as may be prescribed by the Dune Consultant. The owner shall have an obligation to maintain and replace,if necessary, these fences and plantings but shall not be obligated to take any other affirmative action, except as may be specified elsewhere in this Ordinance. If the dune is lowered or caused to be lowered by the direct or indirect action of any owner, then the dune shall, upon due notice to the owner, be restored to its immediately pre-existing elevation by the owner or at his expense. The restored dune shall be planted and sand fenced in accordance with specifications promulgated under this ordinance.

3-8. In order to provide for effective protection and/or restoration of the Dune Area, each owner shall plant or cause to be planted in the Dune Area adjoining his property suitable vegetation and erect, or cause to be erected, suitable sand fencing all in accordance with such standards as may be recommended by the Dune Consultant and adopted by resolution of the Borough Council.

3-9. The Borough dune inspector, and in his absence, the Chief of Police and in all events the Borough Council shall enforce the affirmative duty of each oceanfront owner, as set forth in this Ordinance, by service of a written notice, certified mail return receipt requested, upon the record owner at his last known address as set forth in the Borough tax rolls, requesting specific compliance with these obligations concerning dune protection and/or restoration. The notice shall also advise that unless the owner shall take appropriate corrective action and complete the same within 30 days from the day of mailing said notice, the Borough may perform such acts of protection and/or restoration at the expense of the owner. Such expenditures by the Borough, if any, shall be due and payable upon demand. In the event that any such owner shall fail to pay, then the sum together with interest at the highest legal rate thereon shall become a lien upon the property and be collected in the same manner as deliquent real property taxes.

In addition to the action described above, the owner may, at the election of the enforcement officials or the Borough Council, be prosecuted for violation of this Ordinance in accordance with Article IV.

3-10. No person shall operate a motor vehicle (as defined in Borough Ordinance #138) across or upon any Dune Area except as may be necessitated for allowed construction or for dune maintenance.

3-11. Administration. A copy of this Ordinance shall be furnished to all oceanfront property owners and to each applicant for a building permit for any construction east of Ocean Avenue south of Lyman Street and east of East Avenue, north of Lyman Street. Compliance with this sub-article shall not be a jurisdictional prerequisite in any enforcement proceeding.

ARTICLE IV. PENALTIES.

4-1. For any and every violation of this Ordinance, the owner of lands abutting the beach or Dune Area where such violation has been committed, or the trespasser if the violation is of subsection 3-3, or any violator, shall for each and every violation be subject to a fine of not more than five hundred dollars or ninety days in detention at the discretion of the Court. Each and every day that such violation continues shall be considered a spearate violation of this Ordinance.

ARTICLE V. EFFECT OF ORDINANCE.

5-1. Effect of Ordinance. If any part or parts of this Ordinance are for any reason held to be invalid, such adjudication shall not affect the validity of the remaining portions of this Ordinance.

5-2. Repeal. All Ordinances of parts of Ordinances in conflict with or inconsistent with the provisions of this Ordinance are hereby repealed except that this repeal shall not affect or prevent the prosecution or punishment of any person for any act done or committed in violation of any Ordinance hereby repealed prior to the effective date of this Ordinance.

5-3. Effective Date of Ordinance. This Ordinance shall take effect upon its final adoption.

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