Absecon Island Shore Protection

The planning behind the project

Most residents of Atlantic City, Ventnor, Margate and Longport are now aware of upcoming plans to protect their common coastline with a beachfill and dune system that will run the length of Absecon Island. The Federal Sponsor of this project is the U.S. Army Corps of Engineers, Philadelphia District and the Non-Federal Sponsor is the State of New Jersey, Department of Environmental Protection (NJDEP).

But how did these plans come about? What other alternatives were considered, and what made the U.S. Army Corps of Engineers—who planned, designed and will eventually build the project—choose this one?

PROJECT BACKGROUND

The Absecon Island Shore Protection project grew out of a larger Corps and NJDEP feasibility study that looked at ways to *reduce storm damage due to flooding and wave attack* and *minimize shoreline erosion* between Brigantine Inlet and Great Egg Harbor Inlet. Under the management of the Corps' Philadelphia District, the project is now nearing completion of the design phase. Construction could begin as early as spring 2002, pending execution of a cost-sharing agreement between the Army Corps and NJDEP.

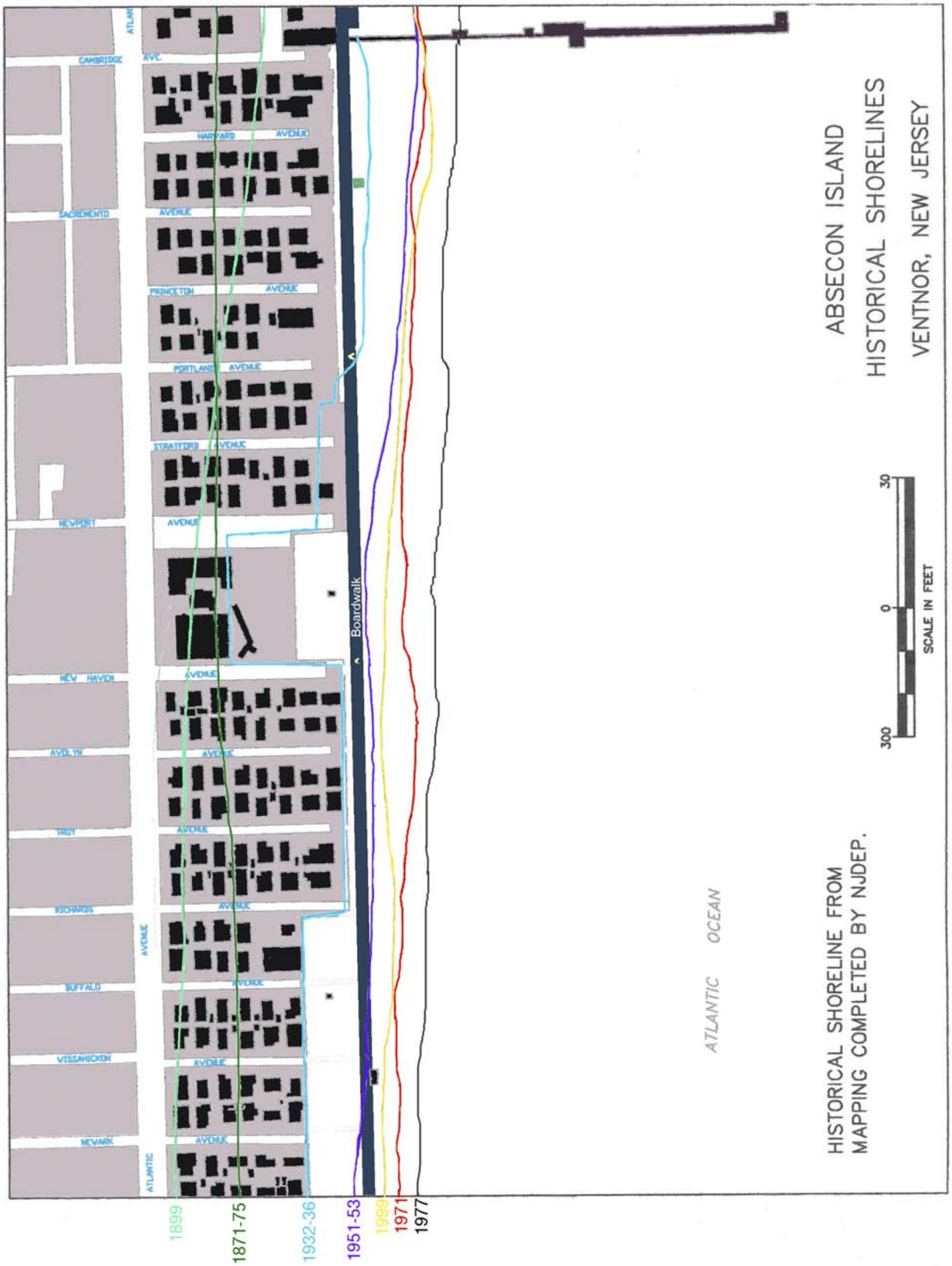
For study purposes, Absecon Island was divided (or grouped) into two areas: (1) the Absecon Inlet frontage and (2) the oceanfront. The second area is the focus of this pamphlet.

The northeast-facing orientation of Atlantic City's inlet frontage increases its vulnerability to storm damage. Extensive damage to the boardwalk, bulkheads, buildings and roads during storms in 1991 and 1992 emphasized the need to evaluate potential shore protection measures.

The oceanfront of Absecon Island has historically been one of the hardest hit of all the New Jersey barrier islands during coastal storms, especially nor'easters. Atlantic City has already had several large beachfills to maintain a beach along its northern end, and has had a series of groins installed to help stabilize the shoreline.

The communities of Ventnor and Margate have low-elevation beaches that are prone to oceanside flooding despite the presence of bulkheads. Longport has virtually no beach in many sections of the Borough; shore protection is provided by a curved-face concrete seawall and timber bulkhead. Past bulkhead failures have resulted in significant property damage.

The map on page 2 shows historical shorelines for a portion of Absecon Island. As can be seen in the figure, the 1870's shoreline was half a block landward and consisted of naturally occurring dunes and dune grasses. After development of the area later in the century, these dunes were flattened and the beach was extended. The ocean shoreline of Absecon Island - especially in Ventnor, Margate, and Longport - has experienced relatively stable shoreline locations in comparison with the ends of the island adjacent to Absecon and Great Egg Inlets. This stability is due to the periodic placement of millions of cubic yards of sand ("beachfill," "beach nourishment," etc.) onto the beach in Atlantic City over the past half-century. Along Absecon Island, the predominant transport of sand by waves is to the southwest, so that, sand initially placed in Atlantic City is naturally transported, over periods of years to decades, to the beaches of Ventnor, Margate and Longport. If sand had not been placed on Atlantic City's beach in the past, it is very likely that the other three communities on Absecon Island would have experienced more serious erosion and storm damages than they actually had over the past several decades.


ABSECON ISLAND
HISTORICAL SHORELINES
VENTNOR, NEW JERSEY
SCALE IN FEET
HISTORICAL SHORELINE FROM
MAPPING COMPLETED BY NJDEP.
ATLANTIC OCEAN
Boardwalk
CAMBRIDGE AVE.
HARVARD AVENUE
SACRAMENTO AVENUE
PRINCETON AVENUE
PORTLAND AVENUE
STRATFORD AVENUE
NEWPORT AVENUE
NEW HAVEN AVENUE
AVOLYN AVENUE
TROY AVENUE
RICHARDS AVENUE
BUFFALO AVENUE
WISSAHICKON AVENUE
NEWARK AVENUE
ATLANTIC AVENUE
1899
1871-75
1932-36
1951-53
1999
1971
1977

PLANNING PARAMETERS

Specific objectives for the Absecon Island study included the following:

- Reduce the impacts of long-term beach erosion along the oceanfront
- Improve the stability and longevity of beaches and shore protection structures in general
- Reduce storm flooding and wave damage along both ocean and inlet frontages
- Reduce maintenance of existing “hardened” shore protection structures (bulkheads, seawalls) along the shoreline
- Preserve recreational and commercial boating opportunities through Absecon and Great Egg Harbor Inlets
- Enhance recreational opportunities along Absecon Island
- Preserve, restore and maintain the environmental character of the areas affected

In the evaluation of alternatives and plan selection process, economic justification is a requirement for final recommendation. *The economic benefits of the project must exceed its cost.* Stated differently, the benefit-to-cost ratio has to be greater than 1.0.

THE PLANNING PROCESS

The process of screening many alternatives to identify the best plan that is technically effective, environmentally sound and economically most beneficial consists of three stages or cycles:

Stage 1. Identify various shoreline protection measures that may satisfy the problem and need. Eliminate from consideration those that obviously would not provide the minimum acceptable shore protection at a reasonable cost.

Stage 2. For the remaining alternatives, evaluate shore protection benefits, construction costs and environmental impact in detail. Make a preliminary comparison between the cost of each alternative and the damages that would occur—storm-induced erosion, wave attack and inundation—without it. Eliminate those for which the benefits (damages prevented) do not exceed the costs. Benefits and costs are expressed on an average annual basis. Net benefits for a proposed plan are measured by subtracting average annual costs from average annual benefits.

Stage 3. Develop the designs and calculate damage projections to produce the optimal plan with the greatest net benefits.

Alternatives Considered (and why each one was rejected or selected)

The original list of alternatives is shown below. Each method will be explained in further detail later.

Nonstructural Methods:

- No action
- Evacuation from the areas subject to erosion and storm damage
- Regulation of future development

Structural Methods:

- Offshore Detached Breakwater
- Submerged Reef
- Offshore Submerged Feeder Berm
- Beach Dewatering
- Lengthen the Longport Terminal Groin
- Seawall
- Beachfill with Bulkheads
- Beachfill with Groins
- Beachfill with Dunes
- Relocation of the Boardwalk
- Beachfill only
- Lengthen the Brigantine Jetty
- Realign the Absecon Inlet channel

Stage 1

The alternatives listed below did not proceed to Stage 2.

1. **No Action**. In other words, maintain status quo—no measures to provide erosion control, recreational beach or storm damage protection to beachfront property.

   WHY REJECTED: Does not meet any of the project’s objectives.

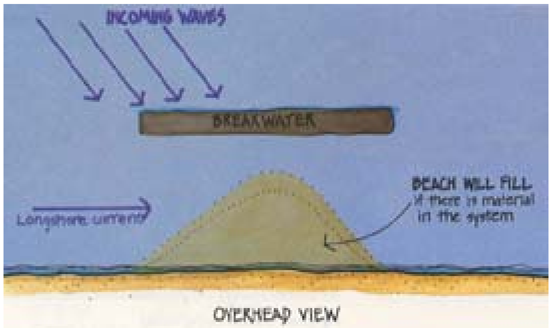
2. **Evacuation From Areas Subject to Erosion and Storm Damage**. Permanent evacuation of existing developed areas that are prone to flooding involves not only acquiring lands and structures, but also demolishing or relocating commercial and industrial developments and residential property to another site.

   WHY REJECTED: The level of development in the problem areas under study would make this measure prohibitively expensive.

3. **Regulation of Future Development**. Regulation could be enacted to minimize the impact of erosion on lands which could be developed in the future.

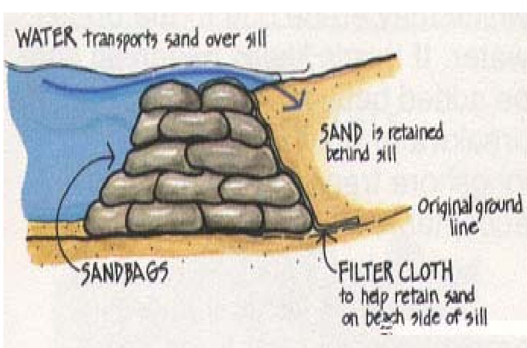
   WHY REJECTED: Would have little impact because virtually all of the shoreline is already developed.

4. **Offshore Detached Breakwaters**. Typically a series of stone structures that are visible from the beach during low tide periods; an offshore detached breakwater acts as a buffer against erosion by reducing wave energy on the beaches behind it. Since a breakwater does not protect against storm surge or flooding, an initial beachfill must usually accompany it.



   WHY REJECTED: Because construction takes place from the water, this method would be cost prohibitive. All stone must be brought in on barges with the resulting additional difficulty of working in an open ocean environment. Would not provide sufficient protection to densely developed oceanfronts. There are also aesthetics and safety concerns.

5. **Perched Beach**. In combination with initial beachfill, this alternative involves the addition of an underwater structure to support the offshore end of the placed beachfill and thus eliminates the need to place additional sand to meet the ocean bottom. As a result, the actual amount of sand to be placed is less than in a typical beachfill. The underwater structure would act in the same way as a natural sandbar formed offshore during storm events.



   WHY REJECTED: Perched beaches are at high risk at locations with high-wave-energy such as Absecon Island. Ocean waves would scour in front of and behind the offshore structure, driving up maintenance costs; sand trapped by the perched beach will cause erosion down the coast, even if only temporarily. Since the offshore structure is submerged, it would not offer protection from storm surge; the submerged structure would also pose a safety hazard to swimmers and bathers.

6. **Submerged Reef**. Interlocking concrete units form an offshore reef that is designed both to reduce incident wave energy during storms and to prevent outgoing currents from carrying sand to deeper water.

   WHY REJECTED: This method is still in the exploratory stage and may be at high risk in the Absecon environment. Like the perched beach, this approach would not offer protection from storm surge. One installation off Avalon has had some of the erosion problems associated with the perched beach concept.

7. **Offshore Submerged Feeder Berm**. In some areas these nearshore berms can supply sand and reduce wave damage for about half the cost of onshore beach placement.

   WHY REJECTED: Experience with these berms is limited, with mixed results to date. The success of offshore submerged feeder berms is affected by such variables as wave conditions, long-term sand transport trends, and proximity to inlets of jetties. So despite their lower cost, their benefits are much less certain than traditional beachfill.

8. **Beach Dewatering**. This concept of draining the beach face to increase stability—using onsite dewatering equipment—has been tried in both Florida and Denmark. Sand in the wet beach area is typically in a buoyant state. When the groundwater is drained, the dewatered sand absorbs the sediment-laden swash, creating a deposit of new sand on the foreshore slope.

   WHY REJECTED: This technology is unpredictable for the Absecon environment. Erosion during a storm would likely expose and damage the dewatering equipment buried in the beach. Routine maintenance would also be required for the pump system.

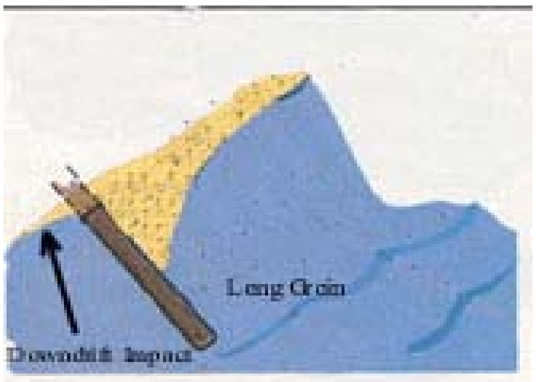
9. **Seawall**. While it would not add any recreational beach area, construction of either a curved face seawall or a massive stone seawall would provide storm damage protection by deflecting or dissipating wave energy.

   WHY REJECTED: Costs of construction would be prohibitively high. Also, because seawalls protect only the land immediately behind them, widening and long-term maintenance of the adjacent beach would be necessary to reduce scour and preserve the shoreline for recreational use. Wave runup or overtopping could occur, damaging land immediately behind the seawall.

Stage 2

The alternative listed below did not proceed to Stage 3.

10. **<u>Extend the Longport Terminal Groin</u>**. The Corps developed a cost estimate for extending the Longport Terminal Groin—marking the south end of the Absecon Island oceanfront—from 500 to 1000 feet. The result showed positive net benefits because of reduced periodic nourishment requirements.



WHY REJECTED: The downdrift erosion typical of groins in general has been especially pronounced for those placed at the southern end of New Jersey's barrier islands.

More specifically, extending the Longport Terminal Groin seaward of the breaker zone could force sand to flow too far offshore to be returned to the Great Egg Harbor Inlet ebb shoal. That in turn would decrease the sand supply to both the Longport borrow area identified for this project and the borrow area currently being used for the Corps' ongoing Ocean City beachfill project. These potential negative impacts outweigh the benefits mentioned above.

SELECTING A SHORE PROTECTION PLAN

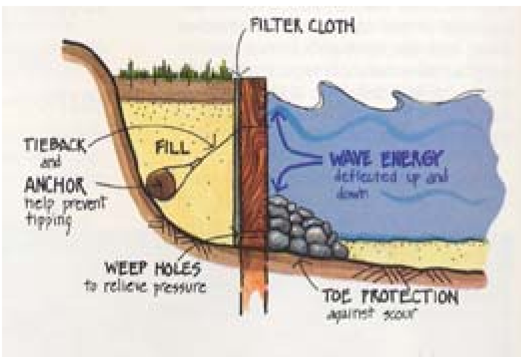
Only four alternatives remained at the start of the third stage of the planning process: beachfill with bulkheads, beachfill with groins, beachfill as a standalone option, and beachfill with dunes. Since all four methods include a beachfill, the next step was to establish the required beach parameters.

- *<u>Beach Berm ("Towel Area") Elevation</u>:* Based on natural berm crest elevations between +7.5 and +9.0 feet NGVD (as determined by tides, waves and beach slope), a design elevation of +8.5 feet NGVD was selected.
- *<u>Beachfill Slope</u>:* Based on historical profiles and the average slope of the beach berm, both onshore and offshore, a design slope of 1-to-30 was selected. Beyond that point the slope follows that of the existing profile to where the design berm meets the existing profile.
- *<u>Beach Berm Width</u>:* For economic evaluation, design widths ranging from 75 feet (the minimum to support a small dune) to 250 feet (beyond which the beachfill construction costs clearly increase faster than the benefits) were selected. (SEE COMPARISON OF NET BENEFITS BELOW.)
- *<u>Dune Heights</u>:* For economic evaluation, design heights ranging from +12.5 feet (the minimum to provide significant added storm damage protection) to +18 feet NGVD were selected.
- *<u>Dune Shape</u>:* The dune top width for all alternatives was 25 feet except for those alternatives with a 75-foot berm width, in which case the dune top width was 15 feet. Side slopes were set at 1 vertical to 5 horizontal.
- *<u>Dune Alignment</u>:* In Atlantic City the proposed dune alignment follows the existing dunes. In Ventnor, Margate and Longport the proposed dunes will be as far landward on the beach berm as practical to both maximize "towel area" as well as provide a uniform alignment.
- *<u>Design Beachfill Quantities</u>:* Quantities for each alternative were calculated by comparing the proposed design cross section with existing beach survey data.
- *<u>Renourishment Volumes</u>:* The initial quantity of sand was intended to provide for maintenance of the design beach. Then an additional "sacrificial" amount was factored in to account for erosion between initial construction and the first renourishment. This way, by the end of the first renourishment cycle—about three years—the beach will be at its design profile.
- *<u>Storm Drain Outfalls</u>:* In Atlantic City, all outfalls are intact out to approximately the mean low water line; however, several of the existing outfall pipes have broken off at pipe sections located in the surf zone. Several outfalls in Ventnor, Margate and Longport have also suffered damage, and in some cases have sheared off completely at the bulkhead. Since these outfalls are now not long enough to ensure unhindered drainage for beachfill alternatives with a berm width of 200 feet or greater, the analysis included the cost of extending them.

Using these parameters, the project team narrowed the options down to 14 combinations of berm widths and dune heights for the final analysis via computer modeling—seven for Atlantic City and seven for the other three communities. Two alternatives were rejected at this point as stated in the following paragraphs.

11. **Beachfill With Bulkhead**. A bulkhead protects shoreline areas from erosion and storm damage, including flooding, but since it does not extend into the surf area, it does not reduce the flow of sand along the shoreline. Therefore beachfill would also be necessary to limit erosion in front of the bulkhead and provide additional protection.

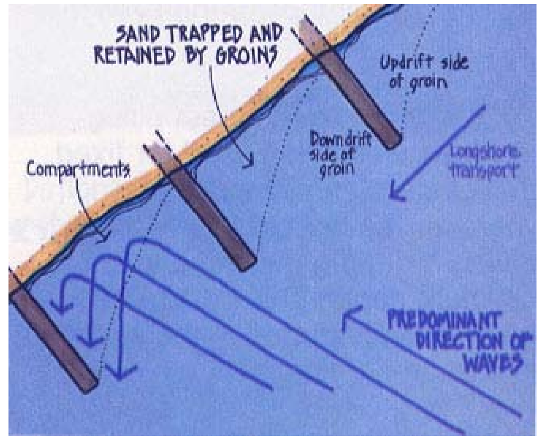
    Since about 60 percent of the Absecon Island ocean frontage has existing timber or concrete bulkheads and seawalls parallel to the ocean front, this alternative examined extending the timber bulkhead walls along the entire length of the study area. This would require 12,700 feet of new bulkhead to provide a continuous line of storm protection for Atlantic City.



    About 1,400 feet would be needed in Ventnor, Margate and Longport—primarily at street ends—to replace bulkhead sections that have top elevations below +9.5 NGVD or that are in poor condition.

    WHY REJECTED: For Atlantic City, a simple matter of economics; the bulkhead offers little more protection than a more natural dune but costs much more. The option of raising bulkheads in Ventnor, Margate and Longport was dropped because (1) the present bulkhead system is a mix of designs and heights, making it very difficult to tie into and (2) many of the structures are on private lands, so added real estate costs would make rehabilitation too expensive. As it stands, all three communities have begun pursuing this option on their own as funding allows.

12. **Beachfill With Groins**. Groins are structures built perpendicular to the shoreline that extend from the upper beach face into the surf zone to trap some of the sand moving along the shoreline. When used in combination with a beachfill, a groin field can reduce both long-term erosion and the required frequency of periodic renourishment.



    For such a system to work, an adequate quantity of sand must be moving along the shoreline and the groins must be designed properly—otherwise, groin compartments at the downward end of the sand supply may not fill properly and may require periodic addition of sand. An optimally designed groin will maximize the amount of sand trapped on its updrift side—closest to the sand supply—while minimizing corresponding erosion of sand on its downdrift side.

    To supplement numerous groins already in place along the Absecon Island coastline, the Corps considered adding two groins about 1,200 feet apart in Atlantic City (southwest of the Ocean One Pier) to stabilize beachfill, and six groins in Longport that would also increase the natural beach width.

    WHY REJECTED: The one-time cost of groin construction turns out to be significantly higher than the cost of coming back and adding sand every three years. Also, the saw-tooth shaped profile of a groin-protected beach, together with the presence of the groins themselves, are aesthetically less pleasing to most people than an open shoreline.

DETERMINATION OF BENEFITS

Damages from hurricanes and coastal storms fall generally into three categories: storm-induced erosion, wave attack and inundation (flooding).

Using a computer model that simulated storm events from five- to 500-year frequency, both with and without each of the alternative solutions in place, the project team was able to project monetary damages stemming from all three categories, subtracting "with-project" damages from "without-project" damages to calculate damages prevented. Both construction (initial beachfill) and long-term maintenance (renourishment) costs for each alternative were then developed and subtracted from the average yearly damages prevented to determine the net benefits.

Note that the "no dune" options yielded negative net benefits; in other words, the damages prevented would not be enough to recover the costs of construction and maintenance.

COMPARISON OF NET BENEFITS

Atlantic City

No dune, 150-foot-wide berm	–$984,344
14-foot-high dune, 150-foot-wide berm	+$669,806
14-foot-high dune, 200-foot-wide berm	+$592,056
16-foot-high dune, 150-foot-wide berm	+$832,011
16-foot-high dune, 200-foot-wide berm	**+$957,298**
16-foot-high dune, 250-foot-wide berm	+$648,388
18-foot-high dune, 200-foot-wide berm	+$932,573

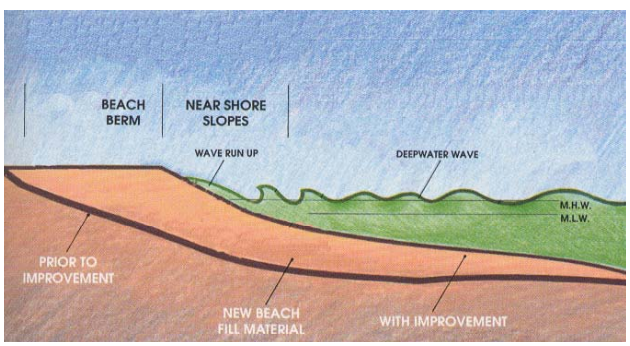
Ventnor, Margate and Longport

No dune, 150-foot-wide berm	–$2,196,501
12.5-foot-high dune, 75-foot-wide berm	+$206,370
14-foot-high dune, 100-foot-wide berm	**+$592,352**
14-foot-high dune, 150-foot-wide berm	–$138,283
14-foot-high dune, 200-foot-wide berm	–$674,614
16-foot-high dune, 150-foot-wide berm	+$296,102
16-foot-high dune, 200-foot-wide berm	–$272,181

FINAL PLAN FORMULATION

After extensive analysis and screening, the field was narrowed down to two alternatives: beachfill only and beachfill with dunes.

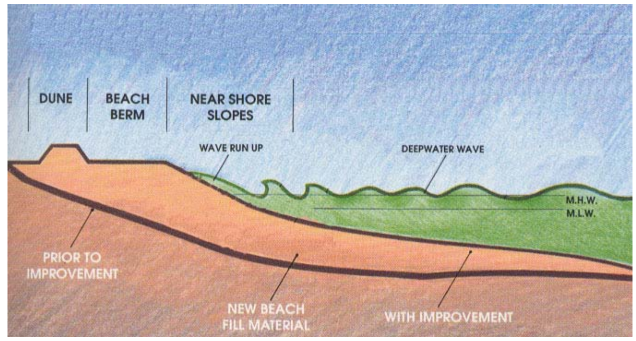
13. **Beachfill Only**. This alternative involves the placement of sand from an offshore borrow source, directly onto the beach to widen the existing beach. Restoring the beach without sand dunes could possibly provide some storm protection by adding significantly more sand to the beach to create a much wider beach berm (the “towel area” or main part of the beach). However, the addition of a dune would provide a much greater level of storm protection.



The widened beach is graded to a certain design elevation and width to provide the desired level of storm protection. After the initial widening, the beach will require additional sand on a periodic basis to keep the design beach width and elevation.

WHY REJECTED: This plan was not selected because it is not cost-effective. See comparison of benefits above.

14. **Beachfill With Dunes**. The beach-restoration-with-dune alternative provides the same beach restoration plan as described above, with additional sand placed to create a dune at a designed elevation and width.

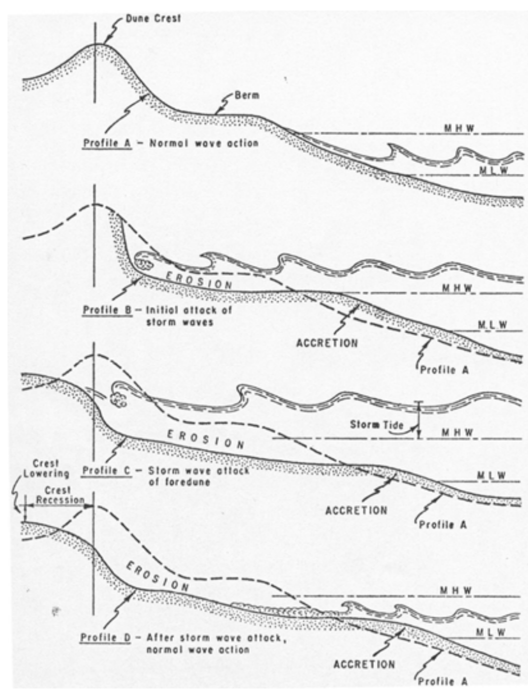


Sand dunes provide additional storm surge protection similar to that of bulkheads, but at much lower cost. They not only reduce flooding in low interior areas by blocking the movement of storm tides and waves into the land area behind the beach, but also serve as stockpiles to feed the beach. That is because sand accumulation on the seaward slope of a dune will either build or extend the dune toward the shoreline; this sand, once in the dune, may be returned to the beach by a severe storm.

WHY SELECTED: Most cost-effective plan, meeting engineering and environmental requirements. See comparison of benefits above.

HOW DUNES AND BEACHFILL WORK TOGETHER

During a coastal storm, the initial wave attack is on the beach berm in front of the dune. Once the berm is eroded, waves work their way up to the dune. If no dune is in place, oceanfront structures are exposed to both wave attack and flooding.



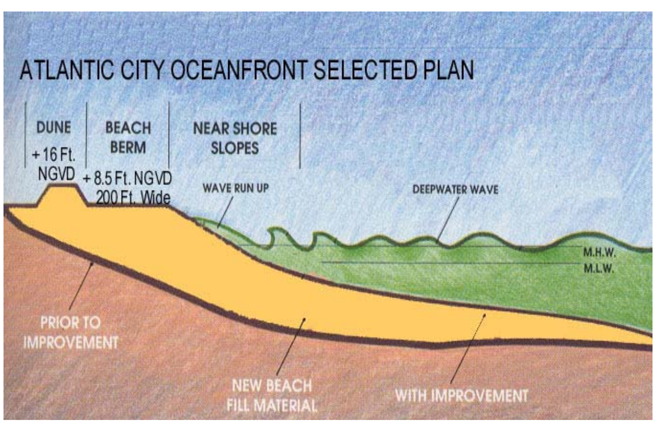
If the attack lasts long enough, the waves can overtop the dune, lowering the dune crest. Much of the sand eroded from the berm and dune is then transported directly offshore and deposited in a bar formation. This process helps to dissipate wave energy during a storm. Offshore sand deposits are then normally transported back to the beach by waves after the storm. Onshore winds transport the sand from the beach toward the dune area, and another natural cycle of dune building proceeds. The "trick" is to have a dune of sufficient size so that it will not completely erode away during a major storm event.

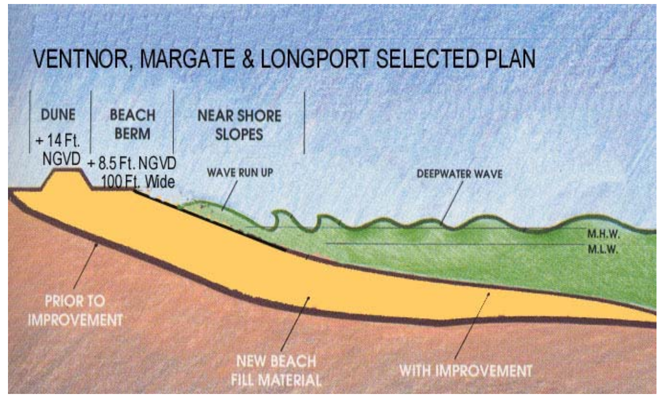
THE SELECTED PLAN

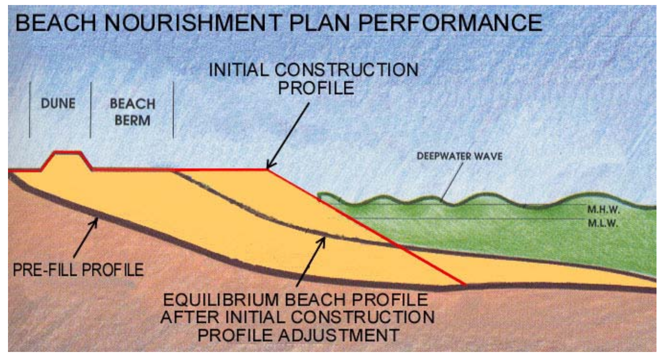
The two options with the highest net benefits (one for Atlantic City and one for Ventnor/Margate/Longport) were completed to come up with the final Absecon Island shore protection plan: Beachfill With Dunes.

ABSECON ISLAND SELECTED PLAN		Atlantic City	Ventnor/ Margate/ Longport
Beachfill	Berm Width	200 feet	100 feet
	Top Elevation	+8.5 NGVD	+8.5 NGVD
Dune	Top Elevation	+16 NGVD	+14 NGVD
	Top Width	25 feet	25 feet
	Side Slopes	1V:5H	1V:5H
	Distance from Boardwalk	25 feet	25 feet

To aid in the visualization of dune heights: in Ventnor the dune will have an elevation 1 foot above the boardwalk, in Margate it will be 2.75 feet above the bulkhead on average and in Lonport it will be 2.5 feet above the seawall.







Other key plan elements are as follows:

- The initial beachfill for the oceanfront will require over 6 million cubic yards of sand to be placed over a total shoreline length of approximately 43,000 feet, followed by periodic renourishment of about 1.7 million cubic yards every three years. The beach profile will taper from a 200-foot to 100-foot berm between Atlantic City and Ventnor over a distance of 1000 feet.
- Beach access will include natural beach walkover paths bordered by sand fencing up and over the dunes, and handicapped access at required intervals. These walkovers will be placed at most street ends or other traffic areas. Access for maintenance and emergency vehicles will be provided at specific locations in each community.
- Approximately 90 acres of dune grass will be planted and about 64,000 feet of sand fence will be erected to protect the dunes.

For more information please see our web page at: www.nap.usace.army.mil/cenap-dp/projects/absecon/absecon.htm

or contact the Public Affairs Office, Philadelphia District, U.S. Army Corps of Engineers at (215) 656-6515.