Absecon Island Coastal Storm Risk Reduction Project

Planning Behind the Project

Most residents of Atlantic City, Ventnor, Margate and Longport are familiar with the beach replenishment project ongoing for Absecon Island and other projects elsewhere along the New Jersey shoreline.

The Federal Sponsor of the Absecon Island 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 the project plan for Absecon Island come about? What other alternatives were considered and what made the U.S. Army Corps of Engineers — who planned and designed the project — choose this one?

The U.S. Army Corps of Engineers Philadelphia District pumps sand onto the northern end of Atlantic City in 2012 as part of the first full scale renourishment of the project.

BACKGROUND

The Absecon Island Coastal Storm Risk Management project grew out of a larger U.S. Army Corps of Engineers' feasibility study that was authorized by Congress which 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. The project has moved forward with at the request and with support from the local, State and Federal representatives for Absecon Island; and through the joint efforts of the U.S. Army Corps of Engineers Philadelphia District (the Federal sponsor) and the New Jersey Department of Environmental Protection (the non-Federal sponsor). The project was ultimately authorized for Construction by Congress in the Water Resources Development Act of 1996 (WRDA 1996).

The Project Cooperation Agreement (PCA) was signed July 31, 2003. This document defines the relationship between USACE and NJDEP in constructing this project and performing periodic nourishment over the 50-year project life. (The four municipalities on Absecon Island—Atlantic City, Ventnor, Margate and Longport—enter into a State-Aid Agreement with NJDEP that delineates the roles of the state and respective local governments in meeting project requirements of the non-federal sponsor). The initial construction of the Atlantic City and Ventnor portions of the project was completed in 2004

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 creating low profile beaches that were little defense against coastal storms; Hence the construction over the years of a network of bulkheads and seawalls along the shoreline in an attempt to create coastal protection. The ocean shoreline of Absecon Island, though low in profile, has experienced relatively stable shoreline locations in between the Atlantic City and Longport areas 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. If sand had not been placed on Atlantic City's beaches in the past, prior to the start of the Federal project, it is very likely that the other communities on Absecon Island would have experienced more serious erosion and storm damages than they actually had over the past several decades

PLANNING BEHIND PROJECT

For study purposes, Absecon Island was further broken down into two areas: ***(1) the Absecon Inlet frontage and (2) the oceanfront, which is the focus of this pamphlet.***

With respect to the oceanfront, Absecon Island historically has been one of the hardest hit of all the New Jersey barrier islands during coastal storms, especially nor'easters like the 1962 Ash Wednesday storm. Under state and local funding, Atlantic City has already seen several large beachfill efforts to maintain a beach along the northern end, and a series of groins is in place to help stabilize the shoreline.

The communities of Ventnor and Margate have historically low-elevation beaches that are prone to ocean side flooding despite the presence of bulkheads. Longport generally has a narrow beach; shore protection takes the form of a curved-face concrete seawall and timber bulkhead. Past bulkhead failures have resulted in significant property damage.

PLANNING PARAMETERS

Specific objectives for the Absecon Island study included the following:

- Reduce storm flooding and wave damage along both ocean and inlet frontages
- Reduce the impacts of long-term beach erosion along the oceanfront
- Improve the retention of beachfill on the ends of the project in Atlantic City and Longport
- Improve the stability and longevity of beaches and shore protection structures in general
- Reduce maintenance of existing "hardened" shore protection structures (bulkheads, seawalls) along the shoreline
- Preserve and maintain the environmental character of the areas affected

In evaluating alternatives and selecting a plan that would meet these objectives, the Corps' project team was constrained by a principal guideline: *The economic benefits of the project must exceed its cost.*

The Absecon Island project is a Coastal Storm Risk Management project and is based on an analysis of reduced damages versus costs. Corps regulations required us to recommend the plan to Congress for authorization that has a benefit to cost ratio greater than 1.0, which has the highest annual net benefits in the form of reduced damages over the 50 year period of economic analysis. This is considered the National Economic Development, (NED), plan. This was the plan ultimately supported by the local municipalities, the non-federal cost sharing partner, NJDEP, and authorized by Congress for construction by the Water Resources Development Act of 1996.

For more information please see our web page at: www.nap.usace.army.mil/coastal
or contact the Public Affairs Office, Philadelphia District, U.S. Army Corps of Engineers at (215) 656-6515.

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 WAS REJECTED OR SELECTED)

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.

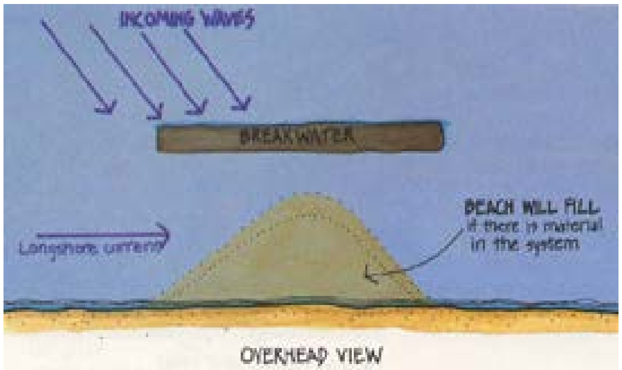
2. **Evacuation from Areas Subject to Erosion and Storm Damage**. Permanent evacuation of existing developed areas that are prone to flooding involves not only acquiring lands and structures, but also demolishing or relocating commercial and industrial developments and residential property to another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

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

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

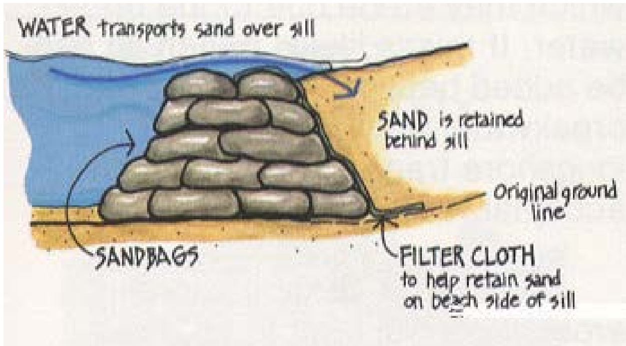
WHY REJECTED: Would have little impact because virtually all the oceanfront is already developed.

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 it does not protect against storm surge or flooding, it usually must be accompanied by an initial beachfill.



WHY REJECTED: This alternative is cost prohibitive. All stone must be brought in on barges with the resulting additional difficulty of working in an open ocean environment. It would not provide sufficient protection to densely developed ocean fronts. 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 eliminate 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 not usually designed for high-wave-energy open ocean coastlines like Absecon Island. Ocean waves would scour in front of and behind the offshore structure, driving up maintenance costs; sand trapped by the perched beach can cause erosion down the coast, even if only temporarily; and the submerged structure could pose a safety hazard to swimmers and bathers. The structure would not reduce damages significantly during the most coastal storm events as the storm surge would allow storm waves over and impact the shoreline. Costs of construction would be prohibitively high in comparison to the damages prevented.

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: Similar to the perched beach, this approach would not offer significant protection from storm surge. Costs of construction would be prohibitively high in comparison to the damages prevented.

7. **Offshore Submerged Feeder Berm**. In some areas these near shore 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. And they afford virtually no protection from the largest coastal storms.

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, so there is less erosion because of the vertical downward flow of water. 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. It would not provide sufficient protection to densely developed ocean fronts.

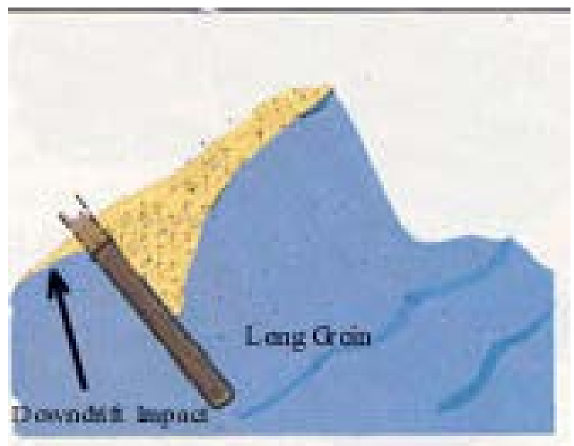
9. **Seawall**. While it would not add any recreational beach area, construction of either a curved face seawall or a massive stone seawall would provide storm damage protection by deflecting or dissipating wave energy.

WHY REJECTED: Costs of construction would be prohibitively high in comparison to the damages prevented. 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.

Stage 2

The alternatives listed below did not proceed to Stage 3.

10. **Extend the Longport Terminal Groin**. 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 down drift 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.

· *Beach Berm ("Towel Area") Elevation:* Based on historical surveys of the beaches along Absecon Island the natural berm crest elevations averages at approximately +7.25 feet above the North American Vertical Datum,1988, (NAVD), and was selected as the design berm elevation for the project.

· *Beachfill Slope:* Based on historical profiles the average slope from the beach berm to MLW was selected as the design slope for the project. Beyond that point the slope follows that of the existing profile to where the design berm meets the existing profile.

· *Beach Berm Width:* 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.)

· *Dune Heights:* For economic evaluation, design heights ranging from +11.25 feet (the minimum to provide significant added storm damage protection) to +16.75 feet NAVD were selected.

· *Dune Shape:* 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.

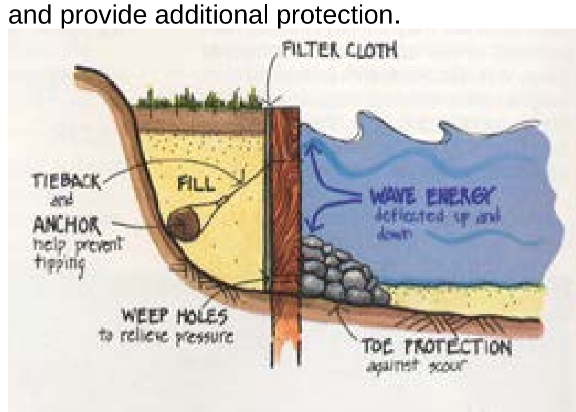
· *Dune Alignment:* In Atlantic City the proposed dune alignment follows the existing dunes. In Ventnor, Margate and Longport the proposed dunes will be as far landward on the beach berm as practical to both maximize "towel area" as well as provide a uniform alignment.

· *Design Beachfill Quantities:* Quantities for each alternative were calculated by comparing the proposed design cross section with existing beach survey data. This quantity will be updated and the design adjusted accordingly just before construction of each reach of the project.

· *Renourishment Volumes:* 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.

· *Storm Drain Outfalls:* 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.



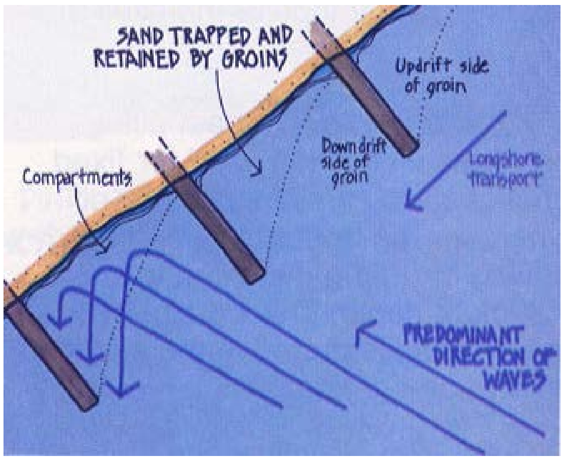
Since about 60 percent of the Absecon Island ocean frontage has existing timber or concrete bulkheads and seawalls parallel to the ocean front, this alternative examined extending the timber bulkhead walls along the entire length of the study area. This would require 12,700 feet of new bulkhead to provide 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 +8.25 NAVD or that are in poor condition.

WHY REJECTED: A simple matter of economics; the bulkhead offers little more protection than a more natural dune but costs much more. Even if constructed beachfill would also be necessary to limit erosion in front of the bulkhead which would drive up the costs even further above the beachfill options.

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 up drift side—closest to the sand supply—while minimizing corresponding erosion of sand on its down drift 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. Without adding a dune or bulkhead the plan would not significantly reduce damages from the more extreme storms enough to justify the significantly higher costs.

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
12.75-foot dune, 150-foot-wide berm +$669,806
12.75-foot dune, 200-foot-wide berm +$592,056
14.75-foot dune, 150-foot-wide berm +$832,011
14.75-foot dune, 200-foot-wide berm +$957,298
14.75-foot dune, 250-foot-wide berm +$648,388
16.75-foot dune, 200-foot-wide berm +$932,573

Ventnor, Margate and Longport
No dune, 150-foot-wide berm –$2,196,501
11.25-foot dune, 75-foot-wide berm +$206,370
12.75-foot dune, 100-foot-wide berm +$592,352
12.75-foot dune, 150-foot-wide berm –$138,283
12.75-foot dune, 200-foot-wide berm –$674,614
14.75-foot dune, 150-foot-wide berm +$296,102
14.75-foot dune, 200-foot-wide berm –$272,181

FINAL PLAN FORMULATION

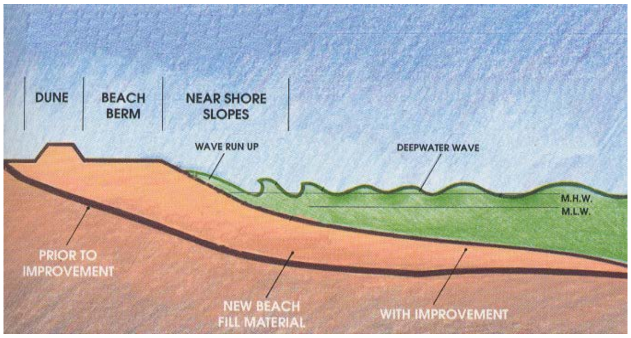
After extensive analysis and screening, the field was narrowed down to two alternatives: beachfill only and beachfill with dunes.

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.



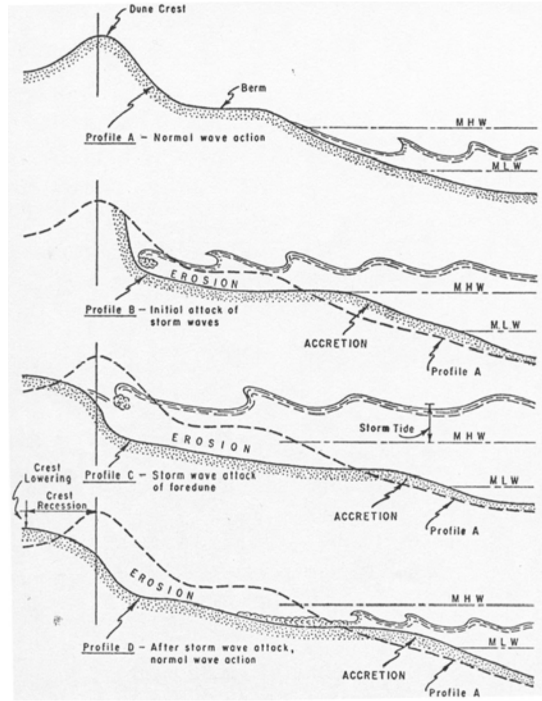
They not only reduce flooding in low interior areas by blocking the movement of storm tides and waves into the land area behind the beach, but also serve as stockpiles to feed the beach. That is because sand accumulation on the seaward slope of a dune will either build or extend the dune toward the shoreline; 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, then waves can overtop the dune, lowering the dune crest.

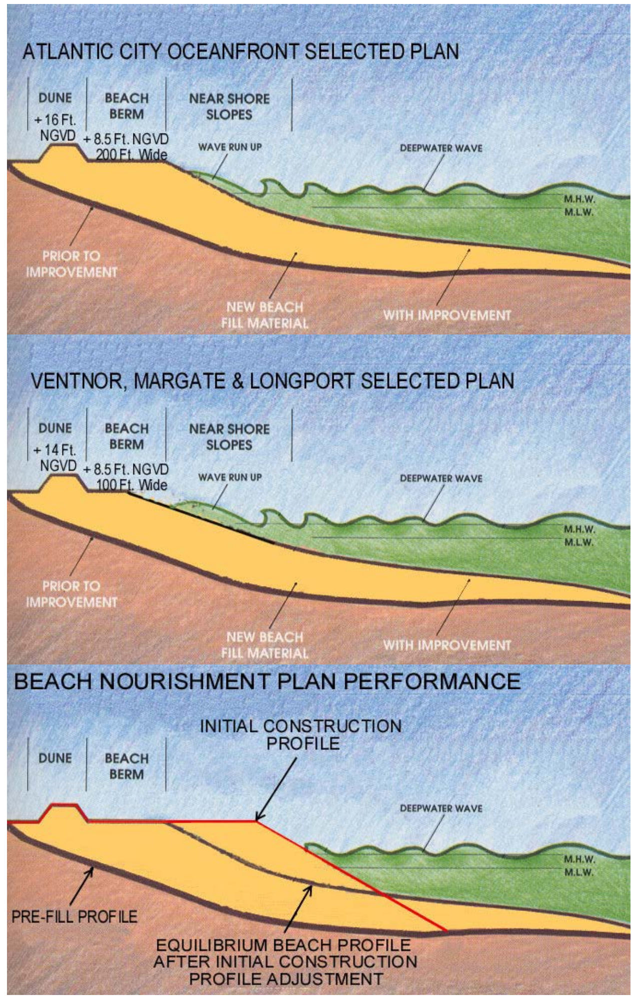
Much of the sand eroded from the berm and dune is then transported directly offshore and deposited in a bar formation. This process helps to dissipate wave energy during a storm. Offshore sand deposits are then normally transported back to the beach by waves after the storm. Onshore winds transport the sand from the beach toward the dune area, and another natural cycle of dune building proceeds. The goal 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	+7.25NAVD (+8.5NGVD)	+7.25NAVD (+8.5NGVD)
Dune	Top Elevation	+14.75NAVD (+16 NGVD)	+12.75NAVD (+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 about 1 foot above the boardwalk, in Margate it will be on average 2.75 feet above the bulkhead and in Longport it will be approximately 2.5 feet above the seawall.

Other key plan elements are as follows:

- The initial beachfill for the oceanfront will require over 7 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.