# TOWN OF WESTPORT

## BARRIER BEACH MANAGEMENT PLANNING

## ABOUT

The Town of Westport is developing a Barrier Beach Management Plan for three barrier beaches along the the Town's coast.

This initative will examine past, present, and future management strategies to enhance coastal resilience through comprehensive planning and public outreach.

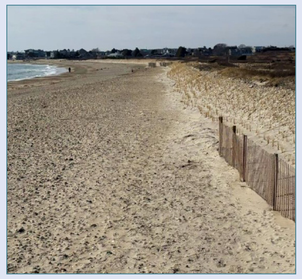
*This work is funded by Massachusetts Office of Coastal Zone Management (CZM) Coastal Resilience Grant Program and the Executive Office of Energy and Environmental Affair's MVP Action Grant.*

## STUDY AREA

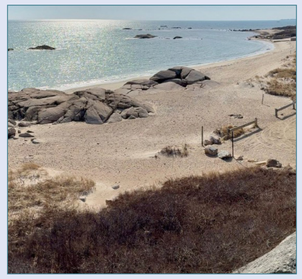
Map of Westport

Study Areas

**ATLANTIC AVE**



**THE KNUBBLE**



**EAST BEACH**

### WHY THESE BEACHES?

Storm activity in recent years has amplified erosion effects in Westport's low-lying areas. The Town is re-evaluating the best way to protect and preserve these barrier beaches, which are home to lifelong Westport residents and play a vital role in Town conservation.

### Map of full study area


## JOIN THE CONVERSATION AT:

# SRPEDD.ORG/WBBMP

- **Take the Survey**
- **Workshop Details**
- **Sign Up for Updates**

### Find us in person this summer! Find details on our website or contact us!

**Summer 2025**

- Coastal Processes 101 Workshop
- All Day Beach Specific Deep Dives
- What is a Beach Management Plan Workshop
- Future Planning Workshop

### PROJECT TEAM

Woods Hole Group
Project Manager

Southeastern Regional Planning & Economic Development District
Outreach Lead

Town of Westport
Project Lead

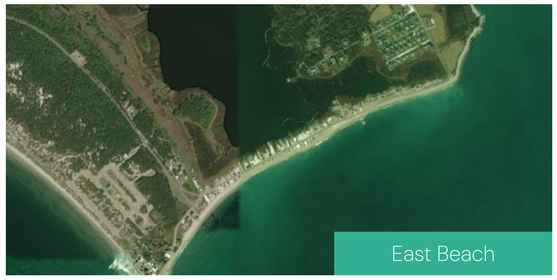
Contact
Michael Burris, Town Planner
burrism@westport-ma.gov

## WHAT ARE BARRIER BEACHES?

# A NATURAL LAYER OF PROTECTION

A **barrier beach** is a narrow strip of sand that is separated from the mainland by a marsh, bay, river, or any other water body.

Atantic Ave and Knubble



East Beach

East Beach

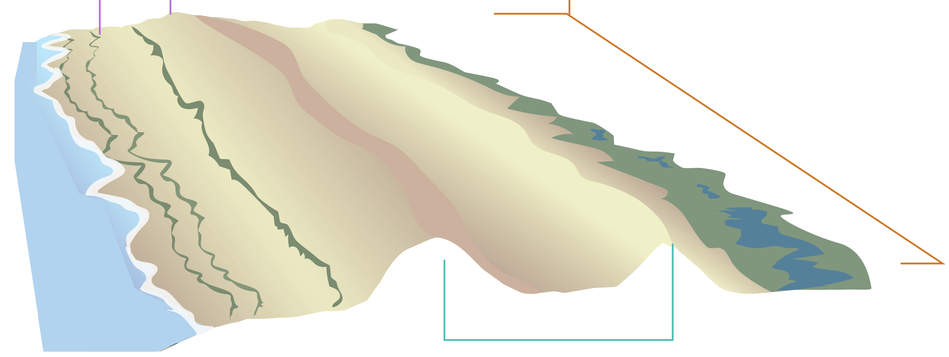
## ANATOMY OF A BARRIER BEACH

### Beach Face

"The side of the barrier beach facing the ocean where waves crash is called the **beach face**. Here, sand is constantly being deposited, shifted, and reshaped by the tides and wave energy.

### Back Barrier

The landward side of the barrier beach consisting of bodies of water such as bays and lagoons, as well as marshes, tidal creeks, and tidal flats is defined as the **back barrier.** These systems are protected from direct wave action, and their low energy environment provides essential nursery and feeding habitat for many coastal organisms. Back barriers are also vital for water filtration and flood protection.



### Dunes

Behind the beach face, sand **dunes** form. Dunes are small hills or ridges of sand, gravel, and cobble formed by wind and waves that are often stabilized by beach grass and other vegetation, which helps trap the sand.


Tidal Inlet at Mouth of Westport River

**Tidal inlets,** such as the mouth of the Westport River, are openings that allow water to flow between the ocean and a back barrier bay. Their presence can create different types of barrier beaches, like barrier islands or barrier spits, that are connected to the mainland at only certain locations.

## Why are barrier beaches important?

Barrier beaches are essential for coastal resilience and ecosystem health in Westport. Their natural features provide several key benefits:

### Storm Damage Prevention & Flood Control:

Barrier beaches act as natural shields, protecting inland areas from storm surge and powerful waves.

During storms, they absorb wave energy reducing flooding impacts on nearby communities.

### Erosion Control:

Dunes provide a natural source of sand, which is gradually released during storms. This mitigates beach erosion and protects inland areas from being flooded or washed away.

### Wildlife Habitat:

Barrier beaches provide critical nesting and feeding grounds for protected shorebirds

(Piping Plovers and Terns).

The tidal flats and marshes of the back barrier support organisms like clams, crabs, and small fish.

Piping Plover

Tern

*Photo Sources: American Bird Conservancy*

### Recreation and Economy:

Beaches are unique and attractive sites for residents, beach clubs, visitors, and tourists; Westport's beaches are a vital asset for the local tourist economy.

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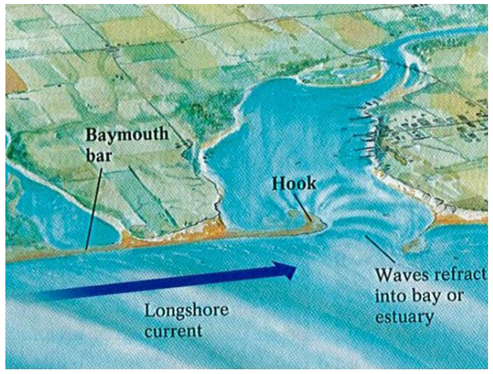
## HOW DO BARRIER BEACHES FORM?

# WESTPORT'S GEOLOGICAL ORIGINS

Barrier beaches in Westport have evolved over thousands of years through the interaction of **waves, winds, and currents** that transport, deposit, and shift sediment along the coastline. These dynamic environments are formed when large amounts of sand is transported away from land and deposited offshore. In shallow coastal areas, this sandbar grows over time and builds up enough to form a beach.

**Barrier beaches depend on the following for their geological creation:**




## Barrier beach sustainability depends on sand availability.

Barrier beach development and sustainability depends on sediment sources. When sediment sources are reduced or removed, barrier beaches erode and shift landward. Sources of sand in Massachusetts include:

**Eroding cliffs, headlands, and glacial deposits**:

The Massachusetts shoreline gradually wears away, releasing sand into the water. The erosion of glacial landforms from thousands of years ago is a primary source of the sand, gravel, and cobble that now supply coastal areas.

Erosion in Nantucket

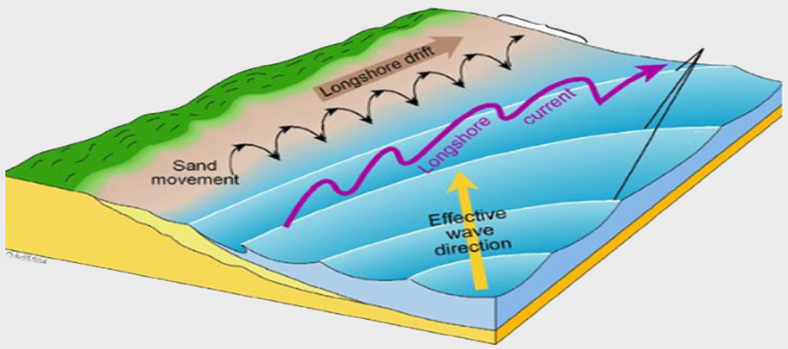
**Rivers and estuaries:**

Waterways carry sediment from inland areas to the coast, adding sand, gravel, and cobble to beaches.

## Longshore currents transport sediment to build up barrier beaches.

Wind direction and shoreline orientation drive waves to the coast at an angle, creating **longshore currents**, currents that run parallel to the shore and carries water and sediment in a zigzag along the coast. As waves wash ashore, some sediment is deposited, and some remains suspended in the wave.

As this process repeats, large amounts of water and suspended sand shift along the coast in a predominant direction.




Over time, longshore currents can form sand spits and barrier beaches by depositing these transported sediments in the same location.

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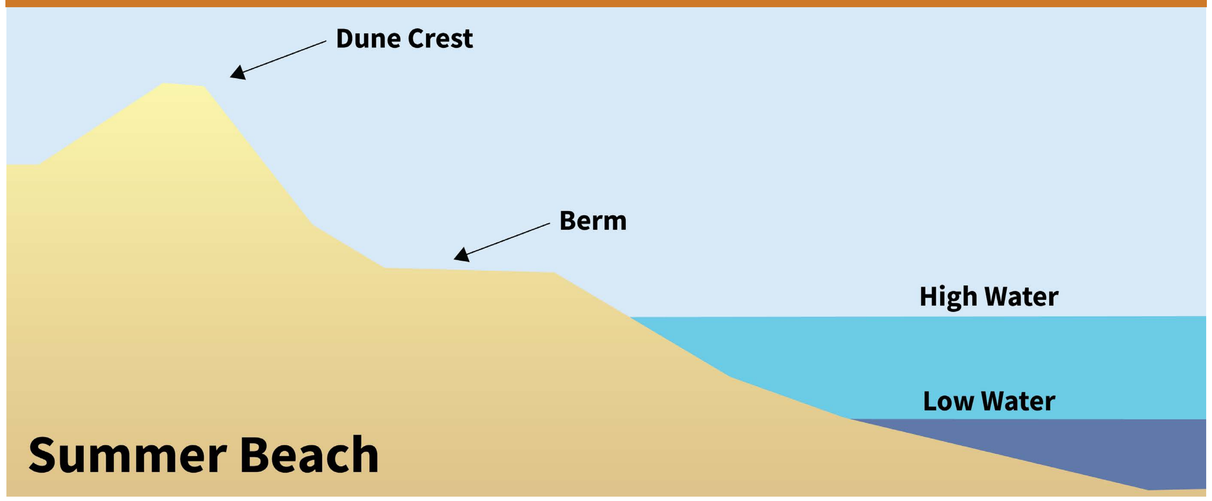
## HOW DO SEASONAL CHANGES AFFECT WESTPORT'S COAST?

# SOAKING UP THE SUN IN SUMMER & WINTER

Beaches constantly evolve with the seasons due to changes in wave energy, winds, and sediment movement. We see these differences by comparing the beach profile – **a cross-sectional view** of the beach from the dune to the water's edge – from one season to another.

## SUMMER BEACH PROFILE

In the summer, calmer weather allows sand to be deposited on the beach.

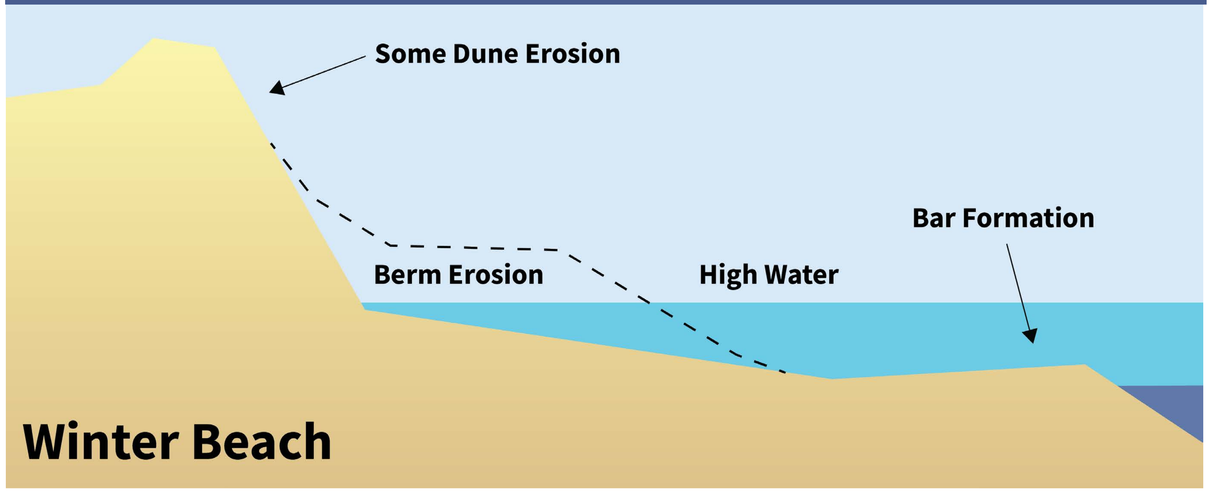



Summer in New England is characterized by prevailing winds from the southwest and an overall lower wind speed, which creates gentler and smaller waves that are depositional in nature. Events such as tropical storms and hurricanes bring larger storm tides and wave heights which both overwash and erode beaches.

During this time, sand builds up, creating a higher, wider, and more gently sloped beach. Windblown sand trapped by bank vegetation can also change the dune landscape, collecting in crests and leacing shallow berms. Sand is the most visible sediment type on the beach in the summer as it covers any cobble and rock.

## WINTER BEACH PROFILE

In the winter, sand is eroded and transported offshore, forming sandbars.




In the winter, prevailing winds from the northwest combined with storms and Nor'easters create a much more erosional and high-energy environment on the beach. Wind speeds increase in the winter due to the large temperature difference between the poles and the equator.

This increased windspeed causes winter waves to cut into the beach, transporting the sand offshore and narrowing the beach. With less sand covering the beach, more cobble and rocks are exposed. By absorbing some of the energy from the stronger winter waves, the barrier beach can protect the mainland.

## HOW IS WESTPORT'S COAST CHANGING?

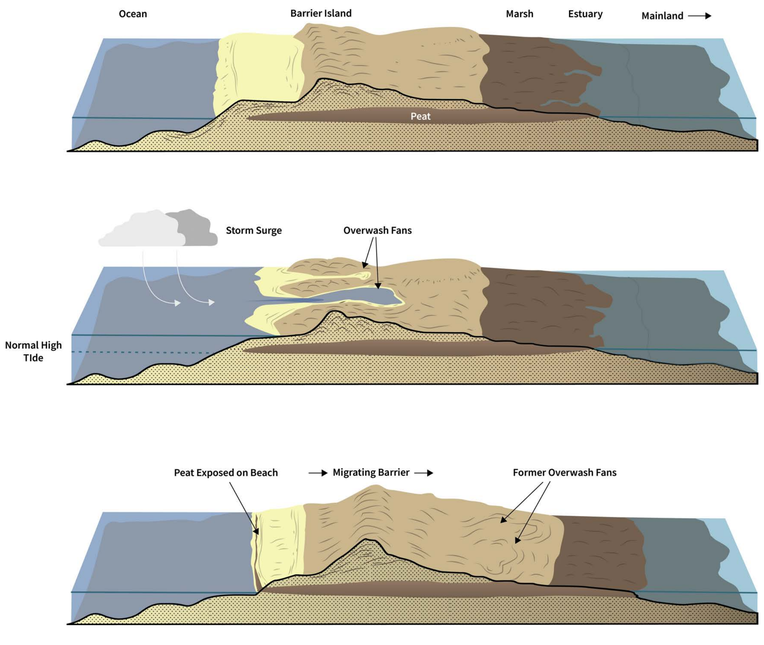
# STORMS RAPIDLY CHANGE BEACHES

Storms are extremely high energy events that generate a lot of wind and large waves which can transport large amounts of sand offshore. As a result, the shape and location of the shoreline can change drastically before and after a storm.

## Overwash Events

Overwash events occur during storms when waves surge overtop the dunes to the landward side or move through tidal inlets into the bay or river behind the barrier beach, pushing sand and water inland. This process deposits layers of sand on the landward side of the beach, which gradually builds new dunes or raises the elevation of existing ones.

As these overwash events repeat over time, the entire barrier beach system shifts landward because large amounts of sand is washed over to the landward side of the barrier beach. This is a natural process that allows the beach to keep pace with changing conditions and helps to maintain its protective function against storms.




### East Beach



*Photo Sources: Westport Historical Society*

### The Knubble



*Photo Sources: Westport Historical Society*

## A Timeline of Major Storms

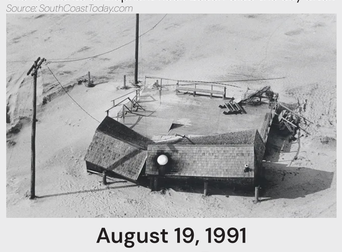
The Trafford cottages before (above) and after (below).
*Source: Westport Historical Society*

**September 21, 1939**
The Great New England Hurricane

**August 31, 1954**
Hurricane Carol

*Source: Westport Historical Society*

The remnants of Elephant Rock Beach Club the day after.
*Source: SouthCoast Today.com*

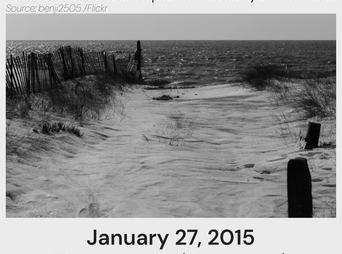


**August 19, 1991**
Hurricane Bob

**October 29, 2012**
Superstorm Sandy

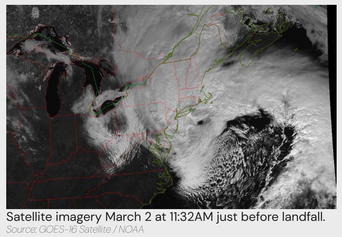
Image taken during the storm at Horseneck Beach.
*Source: MassDOT*

Horseneck Beach access path is covered by 24 in of snow.
*Source: benji2505 /Flickr*



**January 27, 2015**
Blizzard Juno (Nor'easter)

**March 2-3, 2018**
Nor'easter Riley



Satellite imagery March 2 at 11:32AM just before landfall.
*Source: GOES-16 Satellite / NOAA*

Henri caused strong surf and dangerous ocean conditions.
*Source: WCVB*

August 22, 2021 – Hurricane Henri

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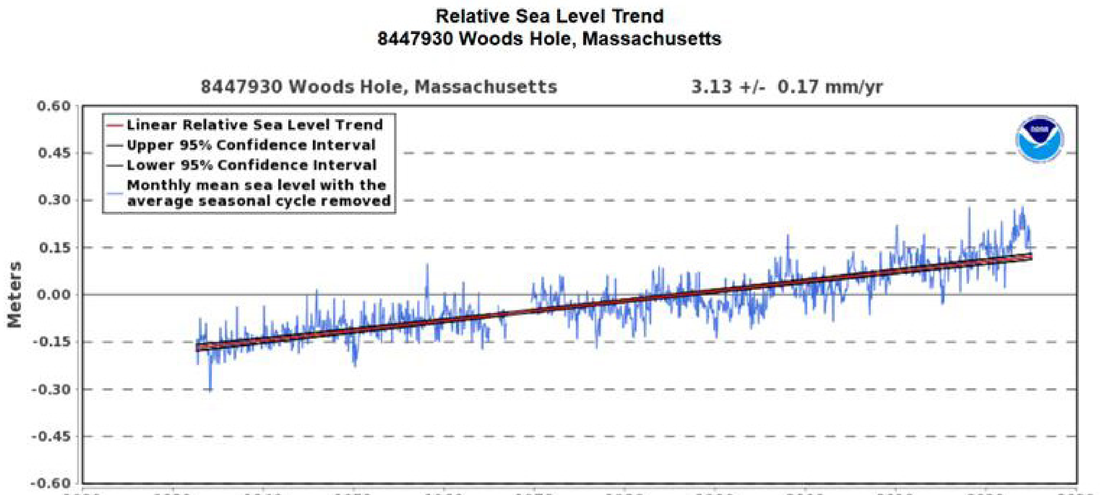
## HOW IS WESTPORT'S COAST CHANGING?

# SEA LEVEL RISE IMPACTS SHORELINES

Sea level rise is the increase in the ocean surface's average height over time. The global average sea level has risen about 8-9 inches since 1880. In Massachusetts, the average sea level increased by about 1 foot over the last century.




*Source: NOAA Tide Station 8447930 (https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8447930)*

## Causes of Sea Level Rise

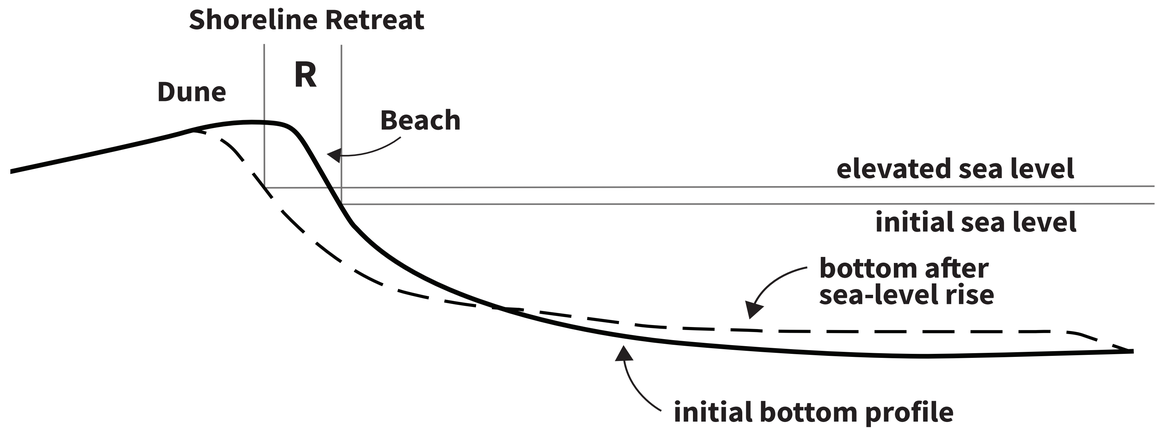
Rising sea levels are mainly caused by two factors: thermal expansion and melting sea ice.

**Thermal expansion** is a physical property of water that is caused by absorption of heat. As ocean water absorbs excess heat from the air, the molecules that make up water ($H_2O$) gain energy and push away from each other. Because the ocean is so vast, even a small increase in temperature can cause a large increase in the average sea level.

Much of Earth's water is stored in permanently frozen sea ice sheets and glaciers. As the average global temperature rises, satellite observations have shown that tons of this sea ice has melted over the last decades, increasing the overall volume of water in our oceans.

## Effects of Sea Level Rise

Higher average sea levels mean that coastal areas are at risk. As waves and tides wash ashore, the water level reaches further inland causing flooding and erosion. More powerful and frequent storms can overwash dunes easily and erode the beach causing **shoreline retreat**. The eroded sediment is carried away and deposited onto the nearshore bottom. As more sediment is transported away, the shoreline of the barrier beach shifts inland to maintain equibilibrium with wave processes. If more sand is removed than replaced, the beach will continue to move inland.



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# IMPACT OF GRAIN SIZE

## UNDERSTANDING SAND AND SEDIMENT DYNAMICS

How big of an effect can the grain size of sand have on barrier beaches? Turns out a big one! Sand, like cobble or gravel, is one of the various types of **sediments** on Westport's barrier beaches.

Variation 1

### Sand – *Always shifting*

Sand is lightweight and easily displaced by wind, waves, and currents. Typically, areas of low wave energy correspond with fine sand and even silt or clay material, such as bayside tidal flats and deep offshore seabeds. Open ocean beaches tend to contain coarser sand. During storm events it is washed offshore, reducing beach width but forming sand bars which can reduce wave energy. Sand beaches are gently sloped, and require large widths in order to dissipate wave energy. Overwash or windblown sand is critical to forming natural vegetated dunes, serving as the soil matrix for beach grass and the consequent stability provided by its roots.

Western Portion of East Beach

Variation 2

### Cobble and Gravel – *Dynamic yet stable*

While we love the feel and look of a sandy beach, cobble plays an important role in stabilizing beaches. Cobble and gravel are heavy and respond differently to large waves. Instead of being carried away, cobble and gravel can shift landward, creating a steeper beach which reflects wave energy. Cobble beaches are also rough and permeable, they dissipate energy through friction and infiltration. Sandy beaches and cobble beaches respond differently to storms, but both provide critical functions to a natural barrier beach.

Eastern Porton of East Beach



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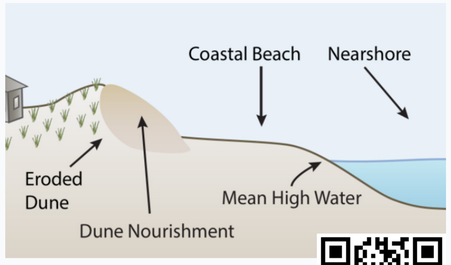
# WHAT YOU CAN DO TO HELP?

The barrier beaches of Westport are vital to protecting surrounding communities and infrastructure from storm damage and erosion. By focusing on protecting and enhancing dune habitats, which are natural barriers to inland flooding and storm surge, we can reduce erosion and storm damage. Here are some ways to take action:

## Dune Nourishment.

Proper slope stabilization reduces the risk of dune collapse and limits sand loss over time. More gentle, gradual slopes help trap windblown sand, allowing the dune to grow over time. If the bottom of a dune has eroded and the slope is steeper than the upper portion of the dune, it is likely unstable. Efforts to restore the dune slope should be considered.




**Read More!**

## Plant dune grass.

Salt-tolerant plants with extensive root systems can help address coastal erosion problems. Native vegetation such as beach grass helps hold sand in place due to its deep root system. Dune plants can root up to 9-feet deep, providing significant stabilization over turf grass which roots on the scale of inches. They can also slow wind speeds and trap windblown sand, which is important for building dune volume. Vegetation also absorbs water from raindrops or waves, which reduces runoff erosion during a storm. Unlike seawalls or rock revetments, vegetated coastlines absorb and dissipate wave energy, rather than reflecting waves and causing scour and beach loss. Note that planting of native vegetation should be coordinated with your local Conservation Commission and follow best practices to avoid impact to sensitive shorebirds. Guidance will be documented in the Beach Management Plan

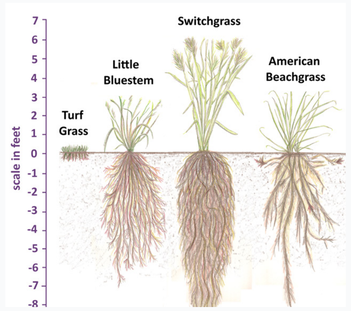



*Image citation: Dede Christopher, Tennessee Valley Authority*

**Read More!**

## Stay off the Dunes.

Walking or driving on dunes damages vegetation and weakens their structure, which will make the dune more prone to erosion and provide less protection during storms. It is important to establish designated walkways and beach access points to minimize damage.


### Close Dune Openings or Weak Points.

Gaps or weak spots in dunes create pathways for water and wind, which makes the dune more vulnerable to erosion. Reinforcing weak points and minimizing the number of inlets through the dune strengthens the overall dune system, which will offer better protection to inland areas.

**Read More!**

## Install Sand Fencing.

Sand fencing is often used to capture sand and build up dunes. As wind blows through sand fencing, it creates a drag that reduces the wind speed and sad is deposited at the base of or behind the fence. Sand fencing is a low-cost and easy way to build dunes and protect inland areas from storm damage. Unlike seawalls or rock revetments, sand fencing doesn't push waves onto nearby beaches or properties.

**Read More!**

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# STUDY AREA

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