Beach Nourishment Guide for Homeowners

Greg Berman
Cape Cod Cooperative Extension
& Woods Hole Sea Grant

February 27, 2023

BBAC

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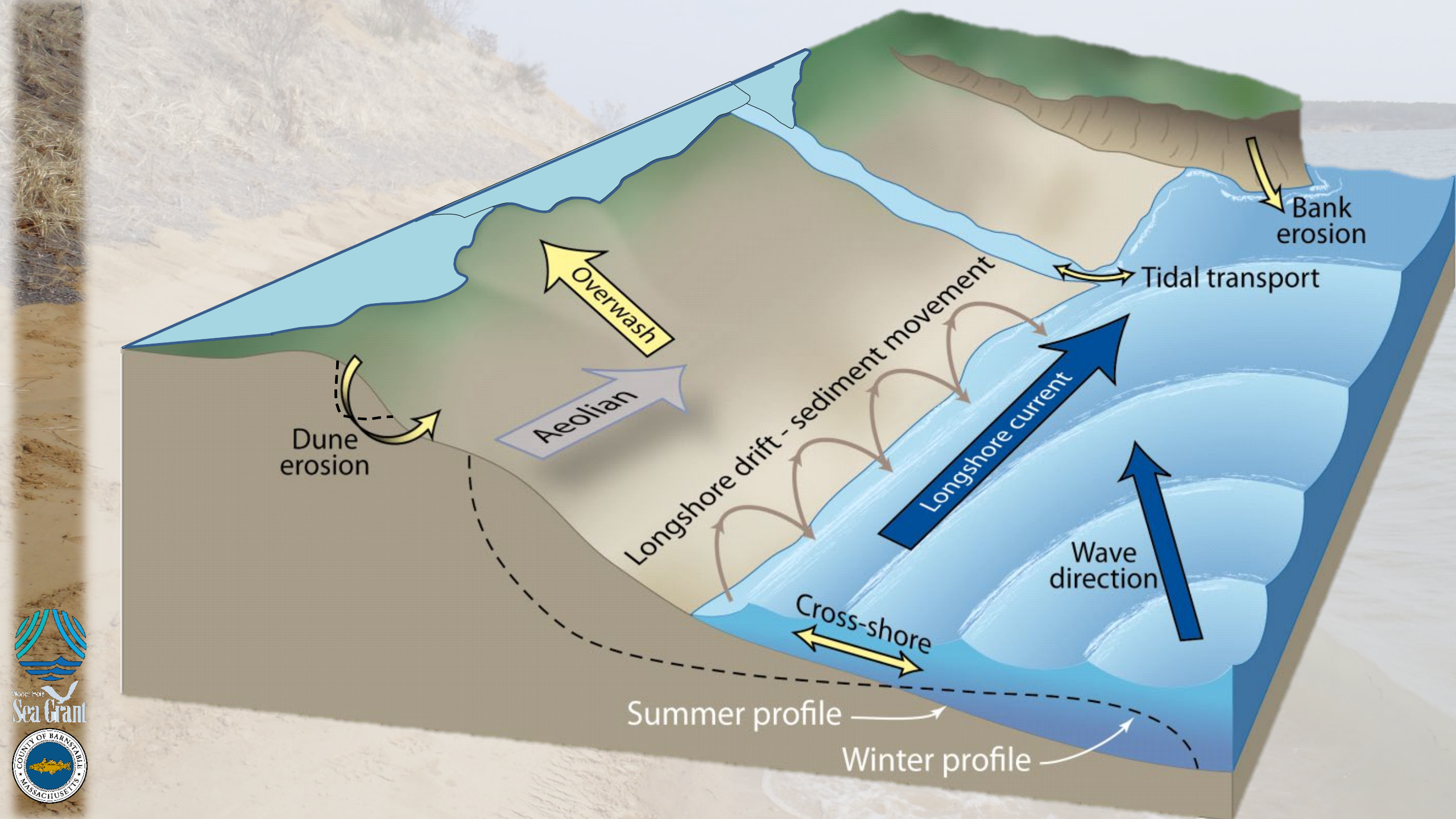
Outline:

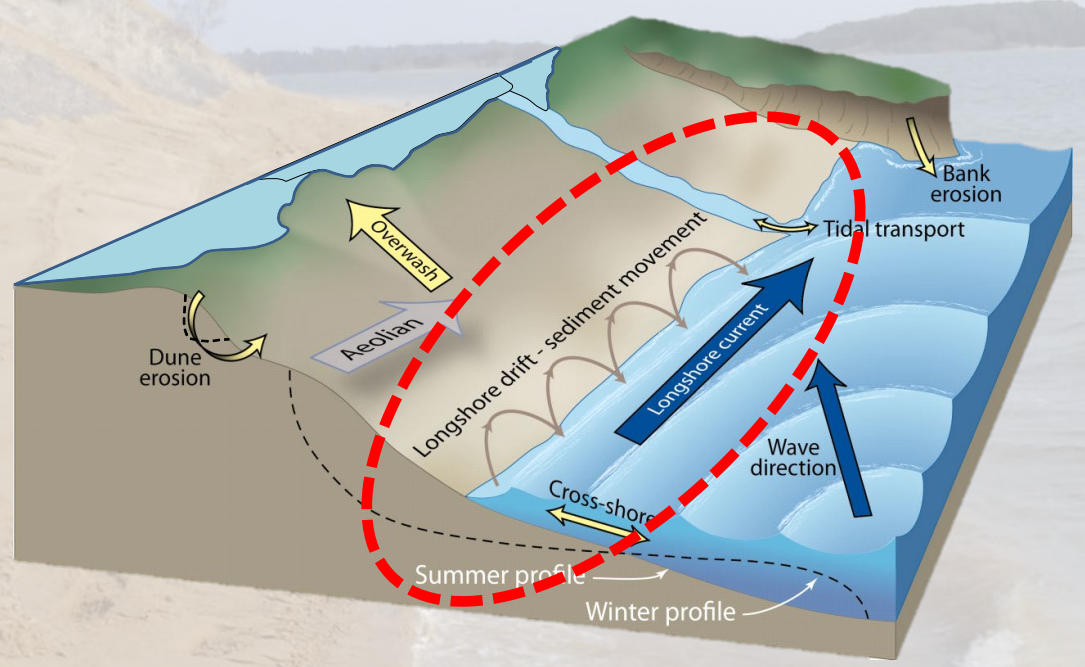
Broken up into 2 sections:

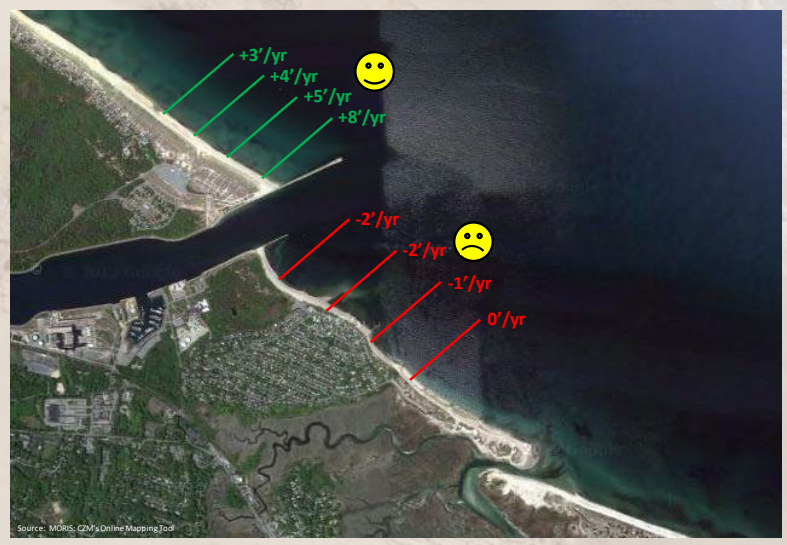
- How does sand move?
- Extension Bulletin

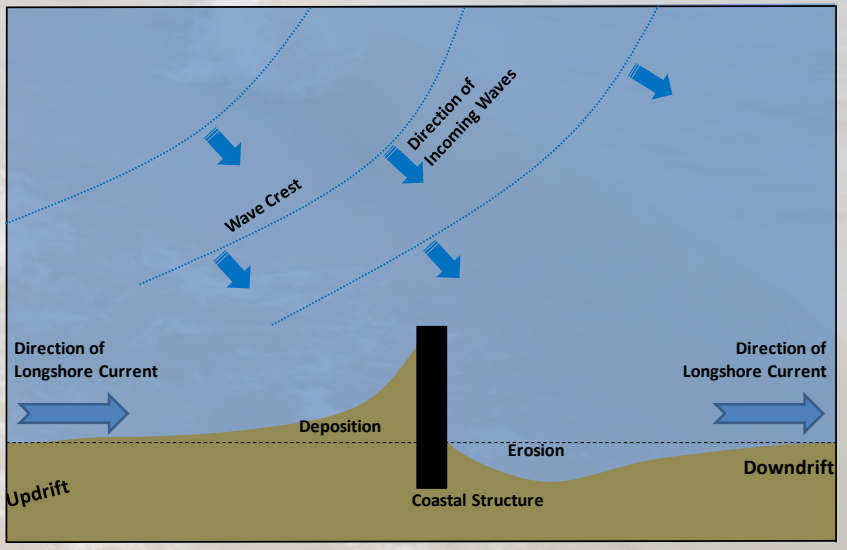
How Does Sand Move ?


Overwash
Aeolian
Dune
erosion
Longshore drift - sediment movement
Longshore current
Wave
direction
Cross-shore
Bank
erosion
Tidal transport
Summer profile
Winter profile

Cutting off the longshore sediment supply

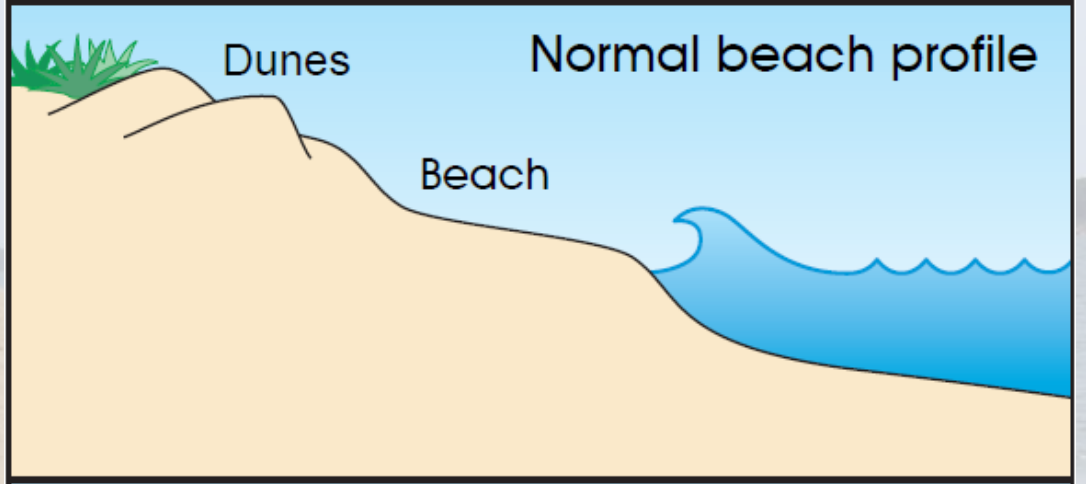


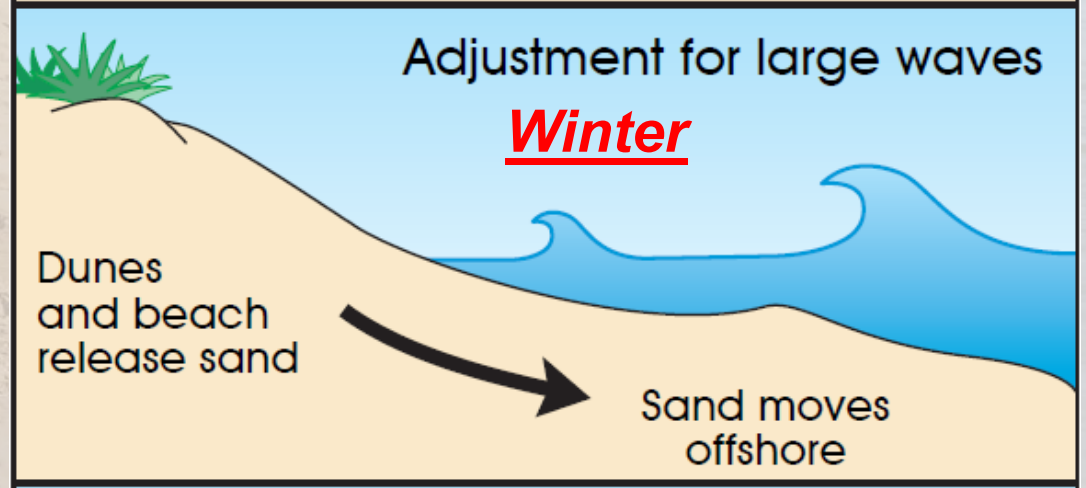


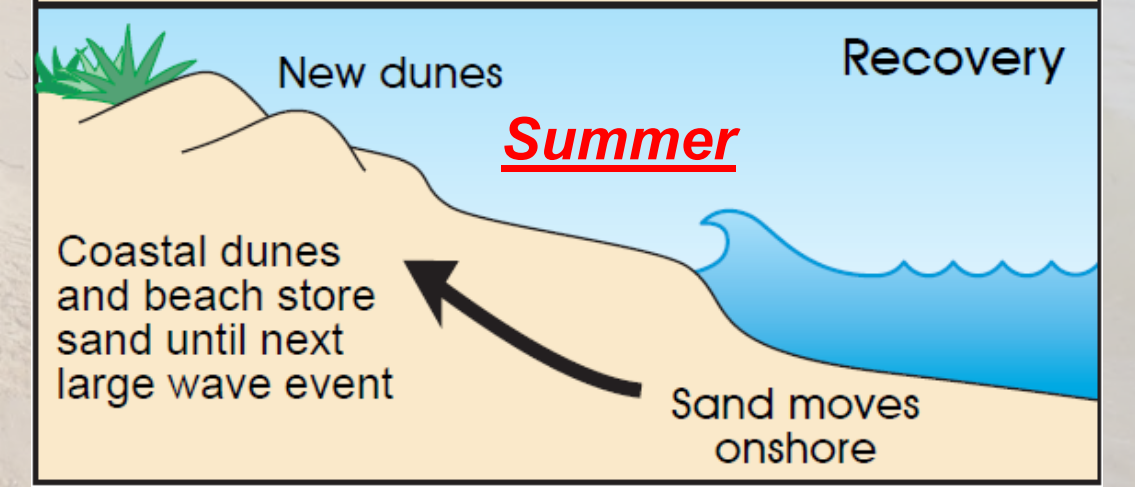


Daily/Seasonal Variability

Beach Profile Adjustments
Large waves, which tend to occur in the winter in Massachusetts, cause the beach to temporarily change its profile.

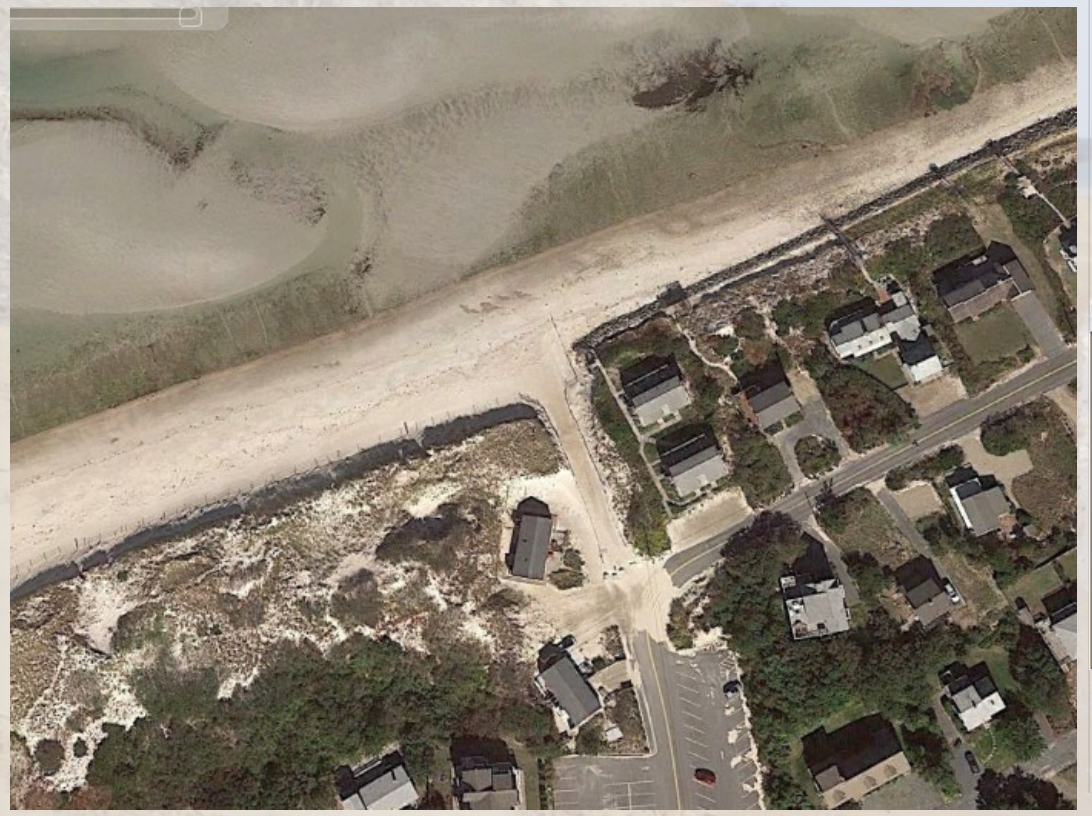


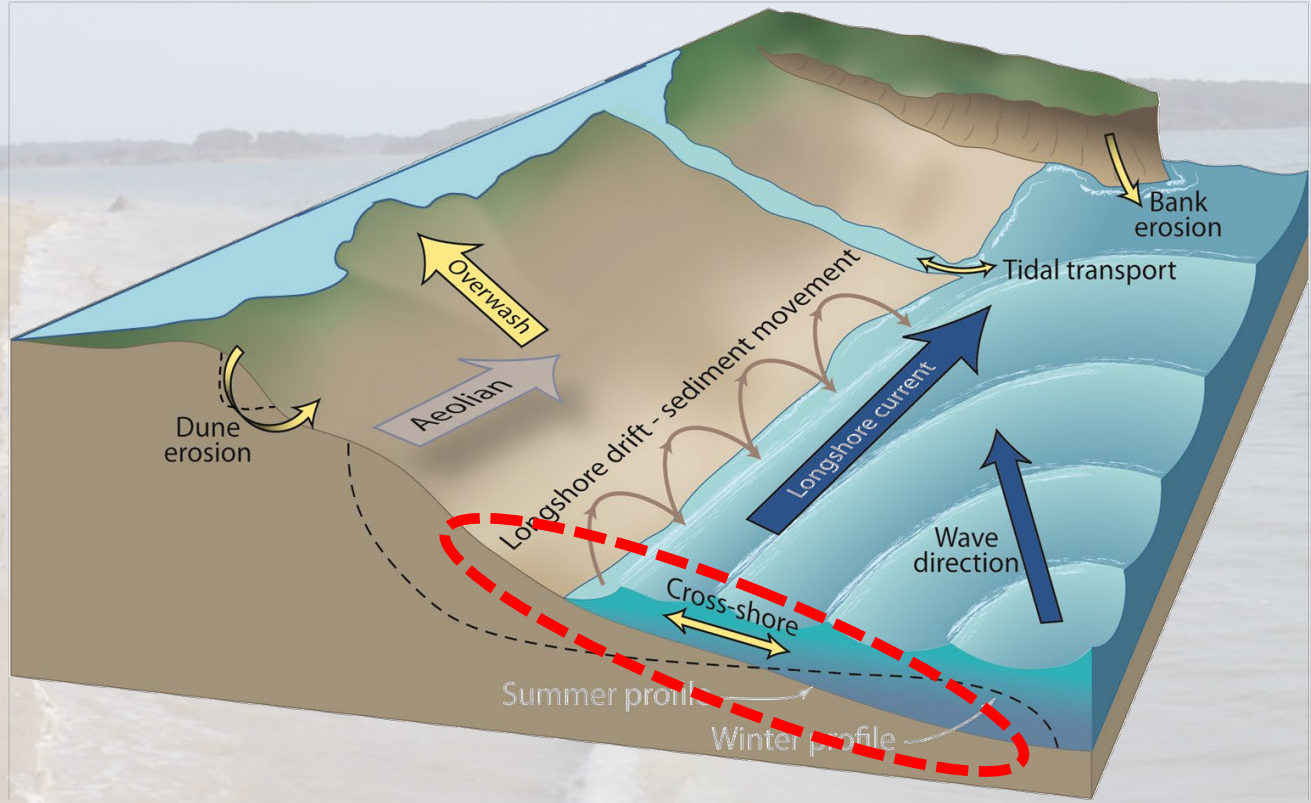


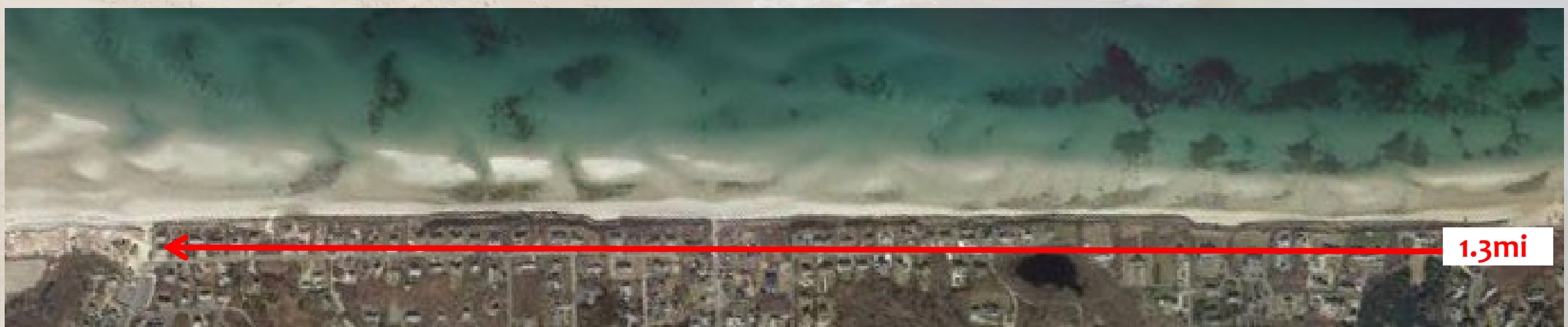


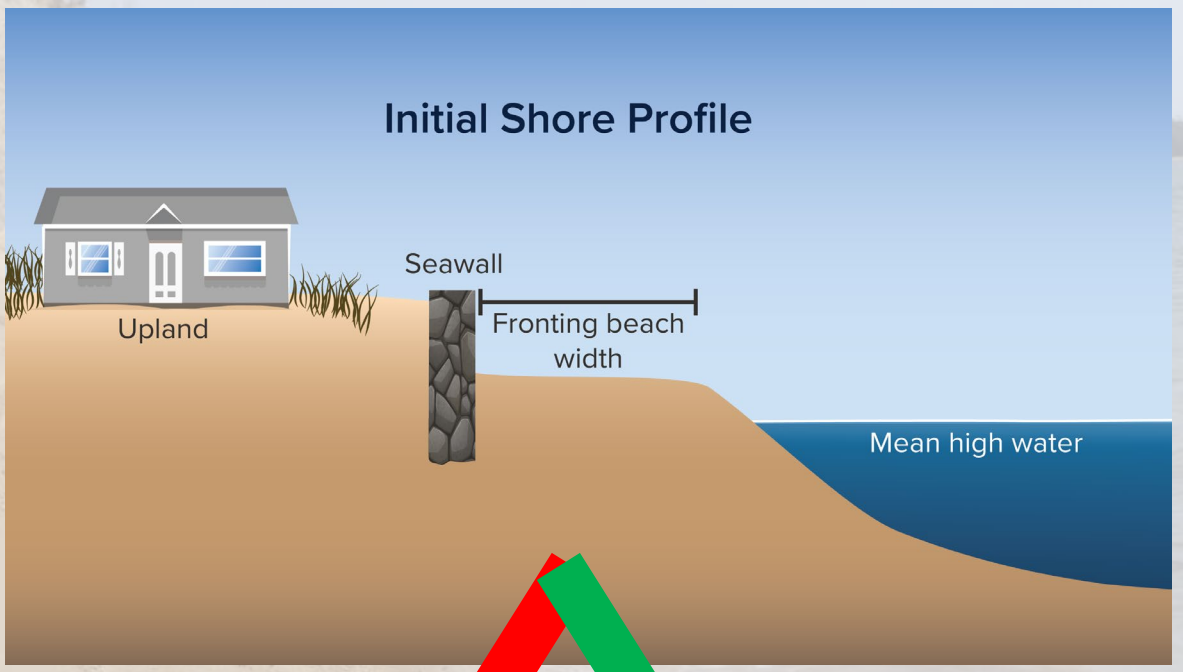
Images adapted from ***Natural Hazard Considerations for Purchasing Coastal Real Estate in Hawaii - A Practical Guide of Common Questions and Answers,*** by University of Hawaii Sea Grant College Program, 2006.

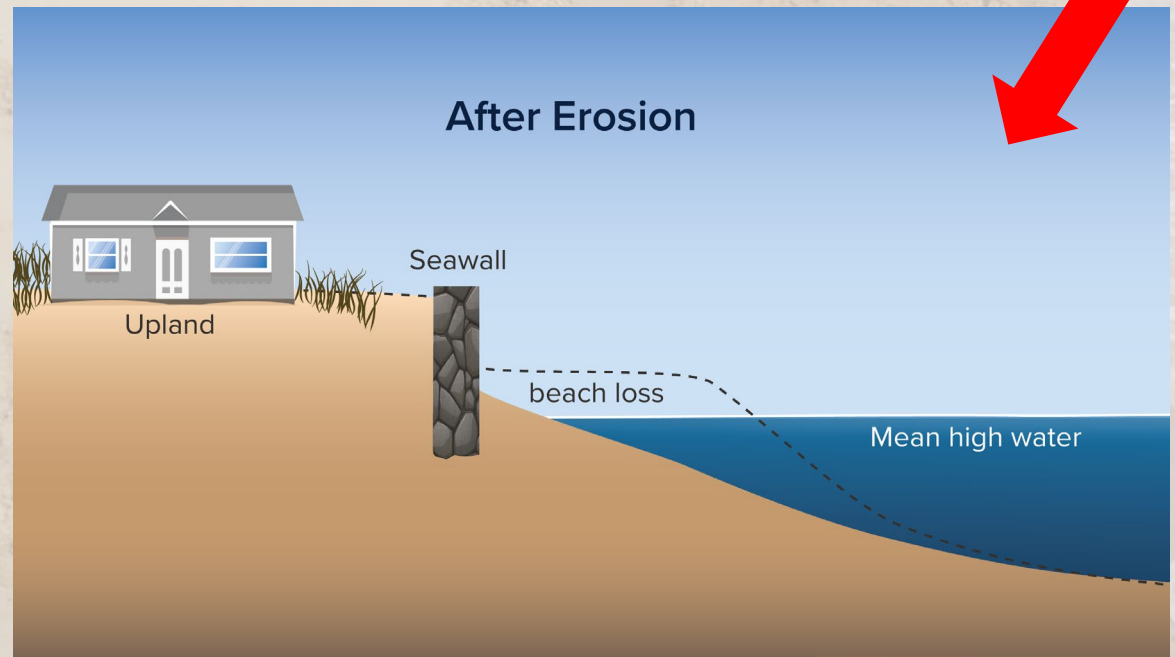
Cutting off the crossshore sediment supply

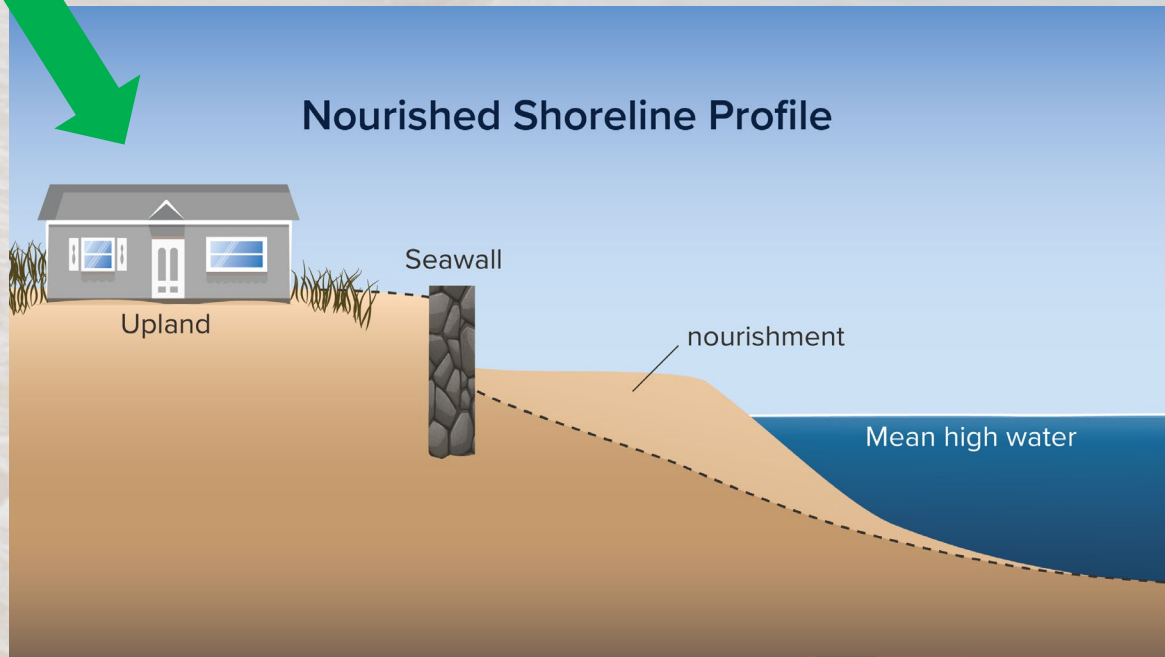







Initial Shore Profile
Seawall
Upland
Fronting beach
width
Mean high water

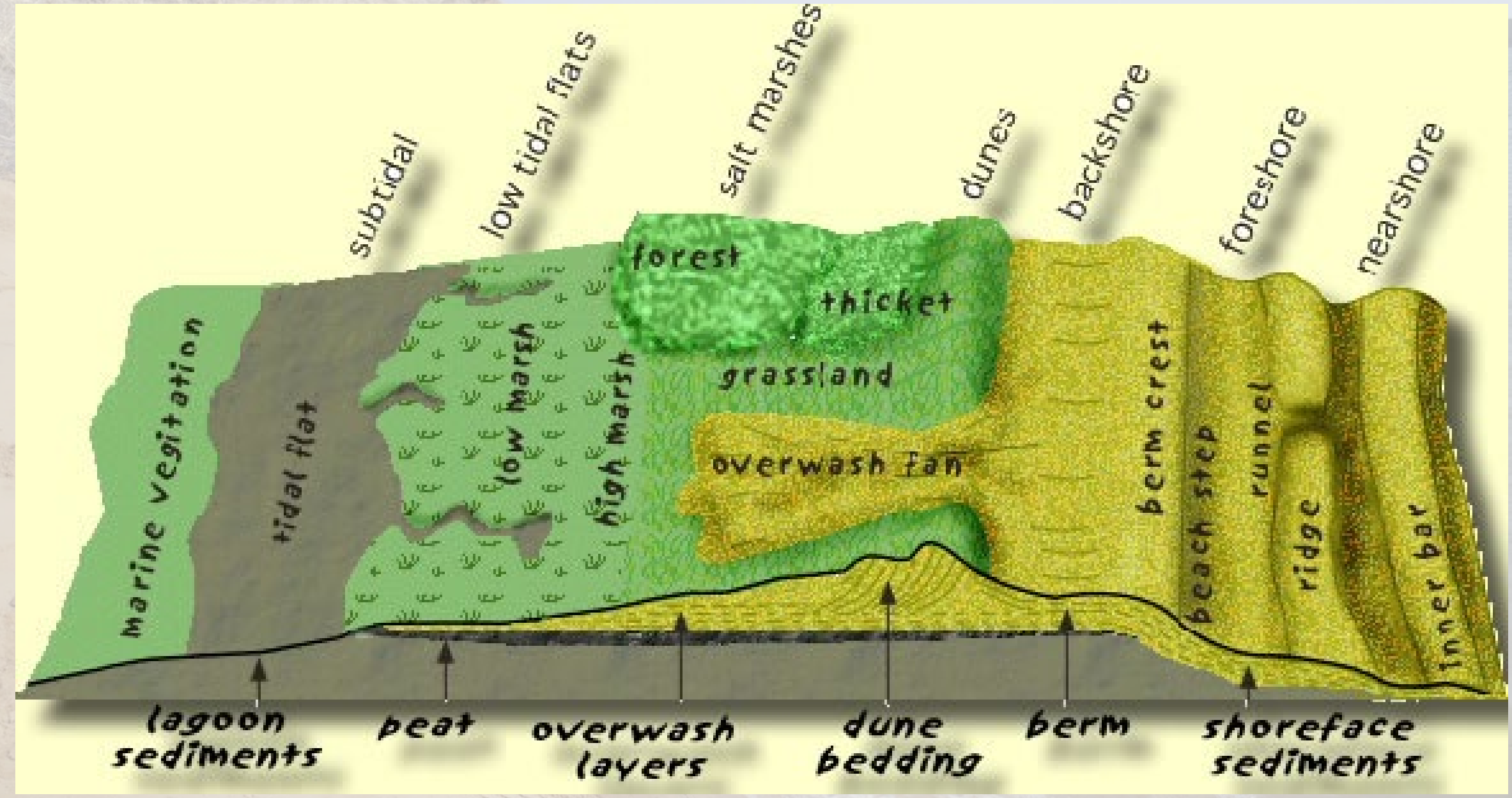

After Erosion
Seawall
Upland
beach loss
Mean high water


Nourished Shoreline Profile
Seawall
Upland
nourishment
Mean high water

What do dunes and beach provide?

- A buffer to storm damage and flooding
- A sediment source to downdrift beaches
- Protection to marine fish and wildlife habitat
- Economic impact for town.

Overwash: Storms push sand across the island and into the lagoon area beyond. Barrier `rolls over on itself.'



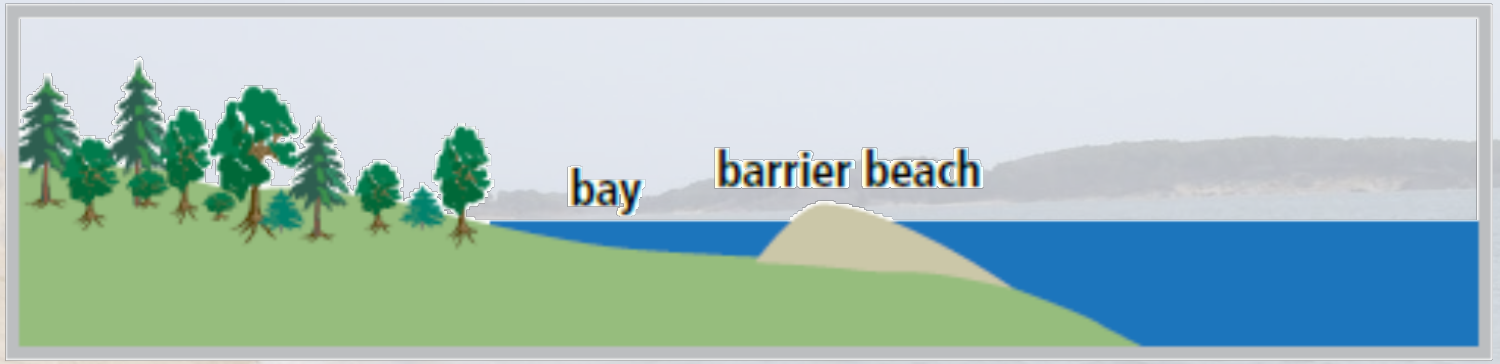
Waves

Overwash: Storms push sand across the island and into the lagoon area beyond. Barrier `rolls over on itself.‘

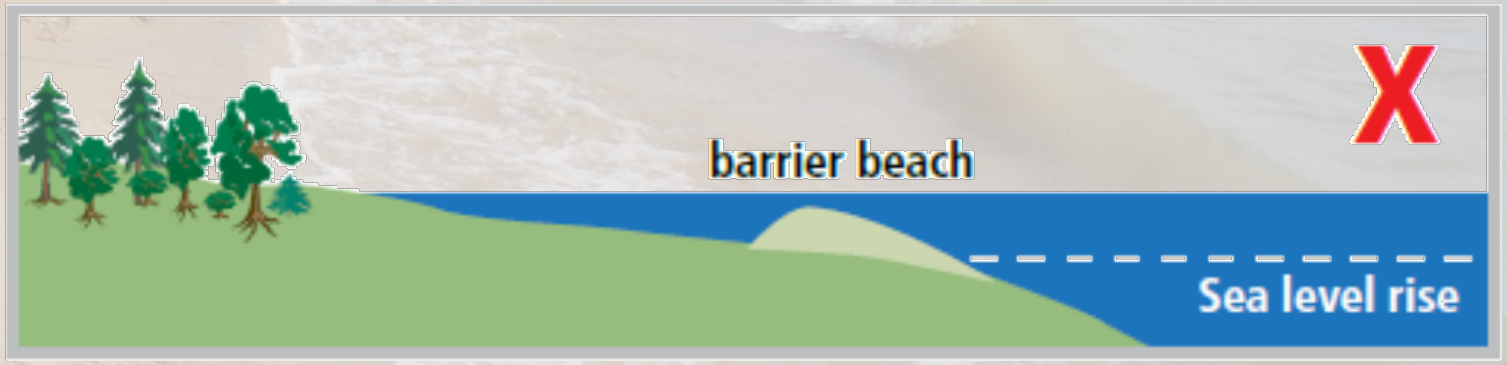
Peggotty Beach 2016, Video by Peter Miles

Sea level rise has been occurring for thousands of years.

During this time barrier beaches have migrated landward through natural processes and have avoided “drowning in place”.



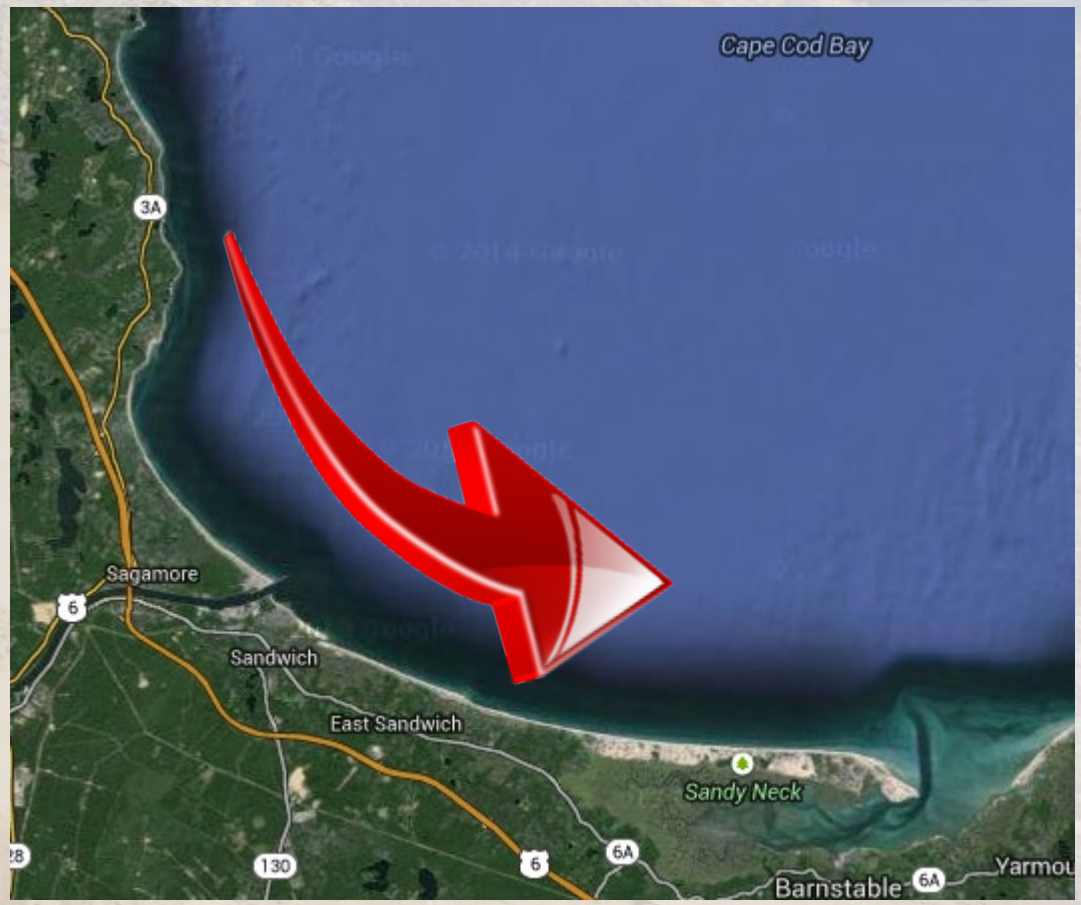
System migrates landward across the shelf as sea level rises.

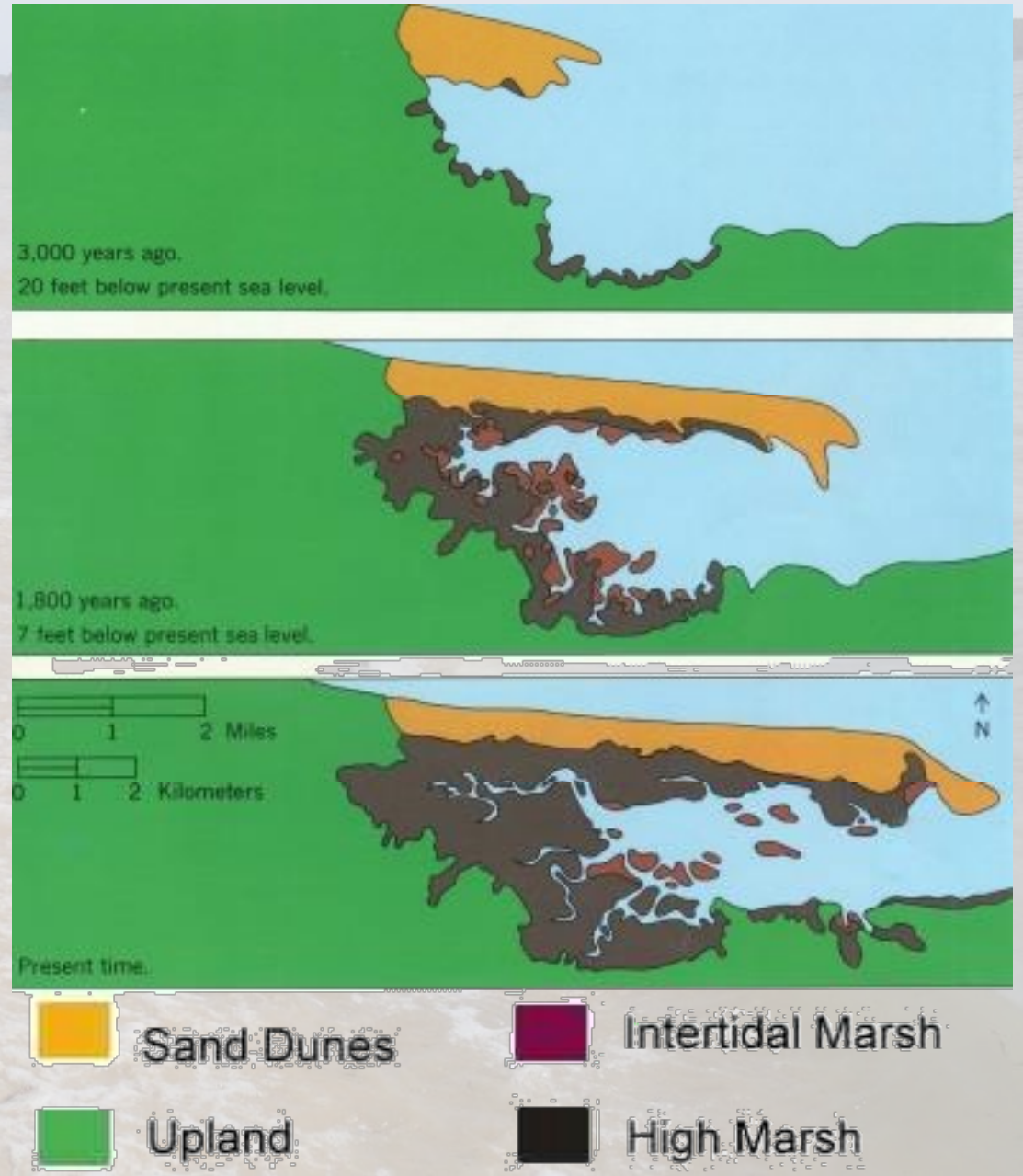


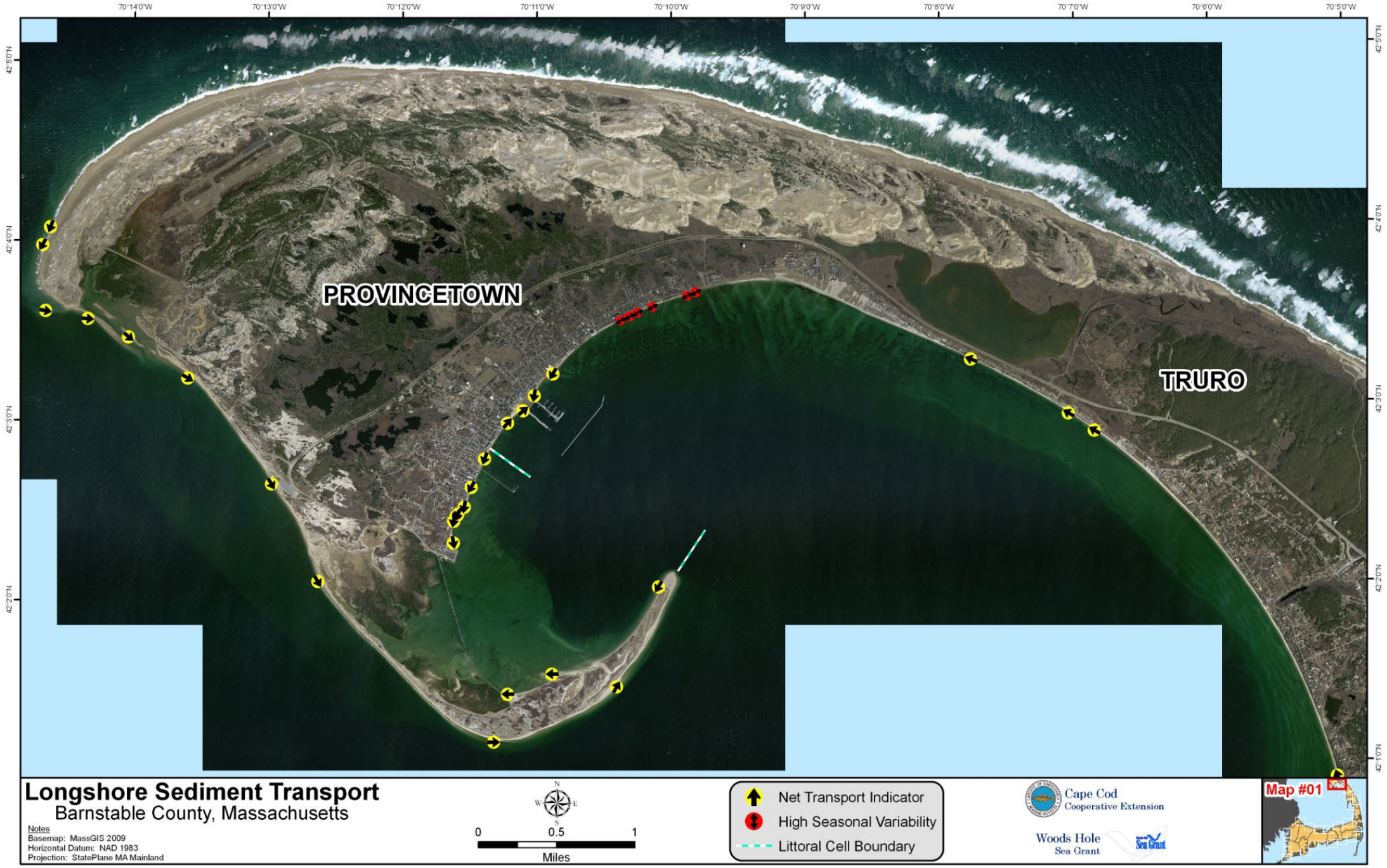
If the system did not migrate it would be submerged by the rising sea level.

Coastal Processes: Longshore Drift - Parallel to Shore

Sandwich & Sandy Neck






70°14'0"W
70°13'0"W
70°12'0"W
70°11'0"W
70°10'0"W
70°9'0"W
70°8'0"W
70°7'0"W
70°6'0"W
70°5'0"W
42°5'0"N
42°4'0"N
42°3'0"N
42°2'0"N
42°1'0"N
PROVINCETOWN
TRURO
Longshore Sediment Transport
Barnstable County, Massachusetts
Notes
Basemap: MassGIS 2009
Horizontal Datum: NAD 1983
Projection: StatePlane MA Mainland
N
W
E
S
0
0.5
1
Miles
Net Transport Indicator
High Seasonal Variability
Littoral Cell Boundary
Cape Cod
Cooperative Extension
Woods Hole
Sea Grant
Map #01

Google Earth Engine: Timelapse is a global, zoomable video that lets you see how the Earth has changed over the past 32 years. It is made from 33 cloud-free annual mosaics, one for each year from 1984 to 2016, which are made interactively explorable by Carnegie Mellon University CREATE Lab's Time Machine library.

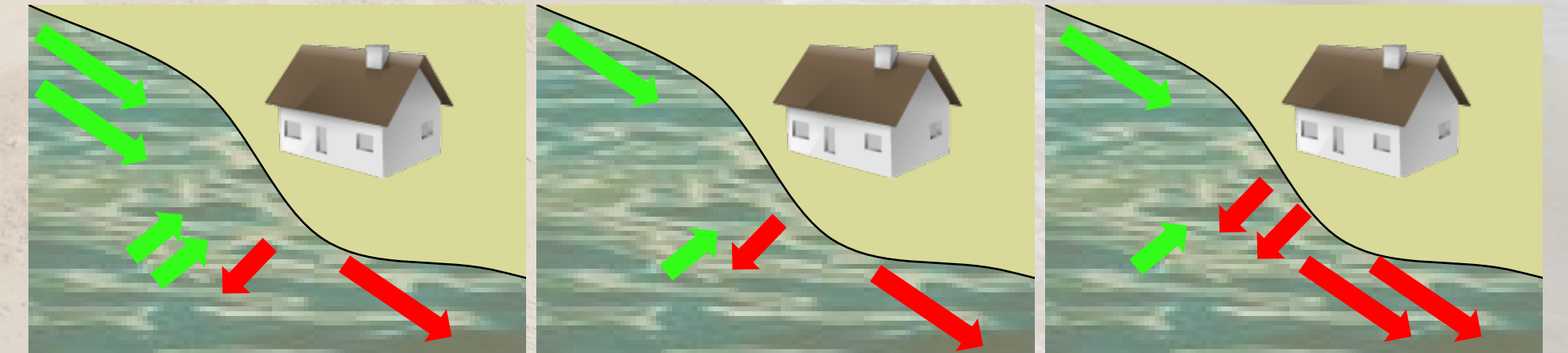
What is a littoral cell ?

Sediment Budgets

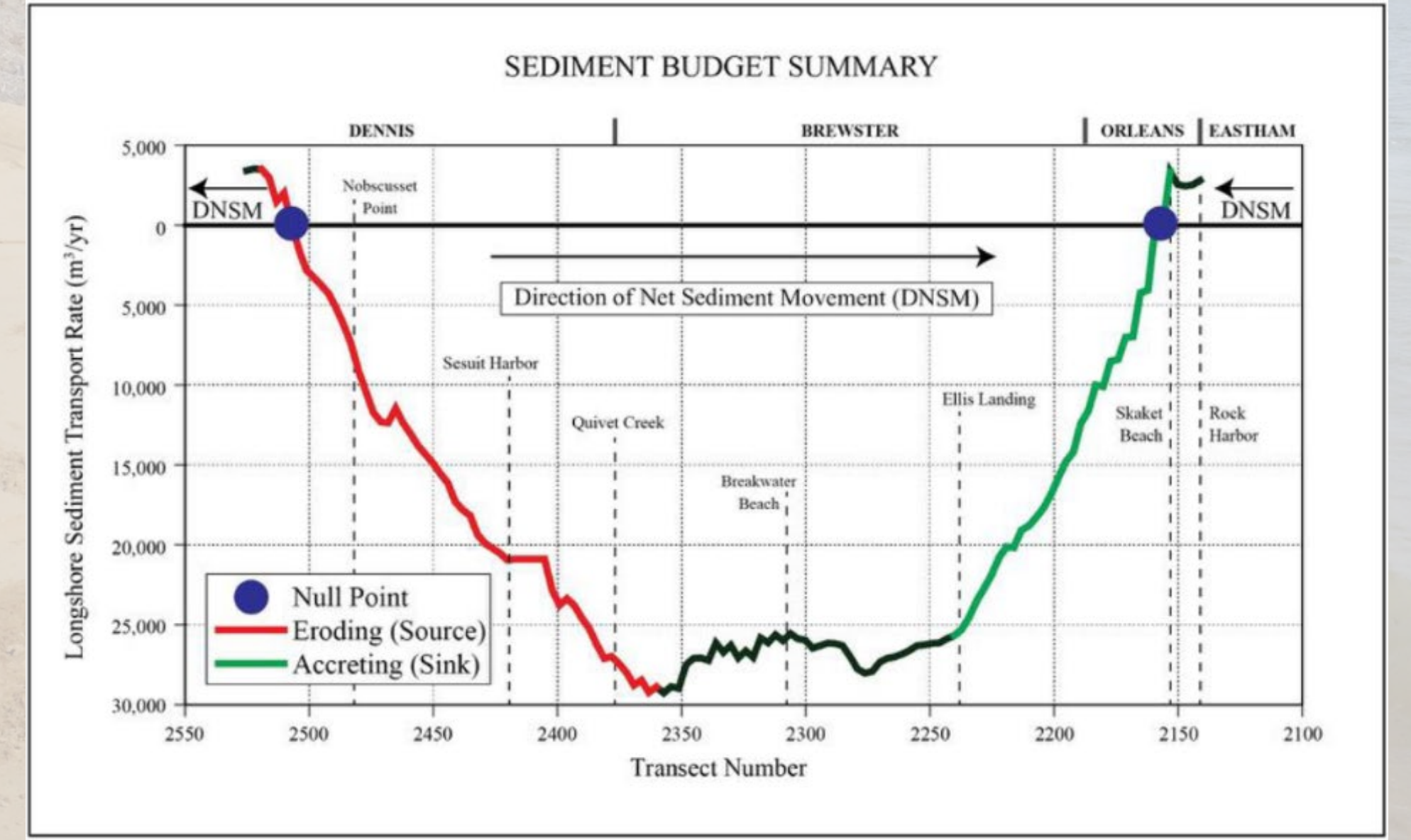
It's all sediment transport!

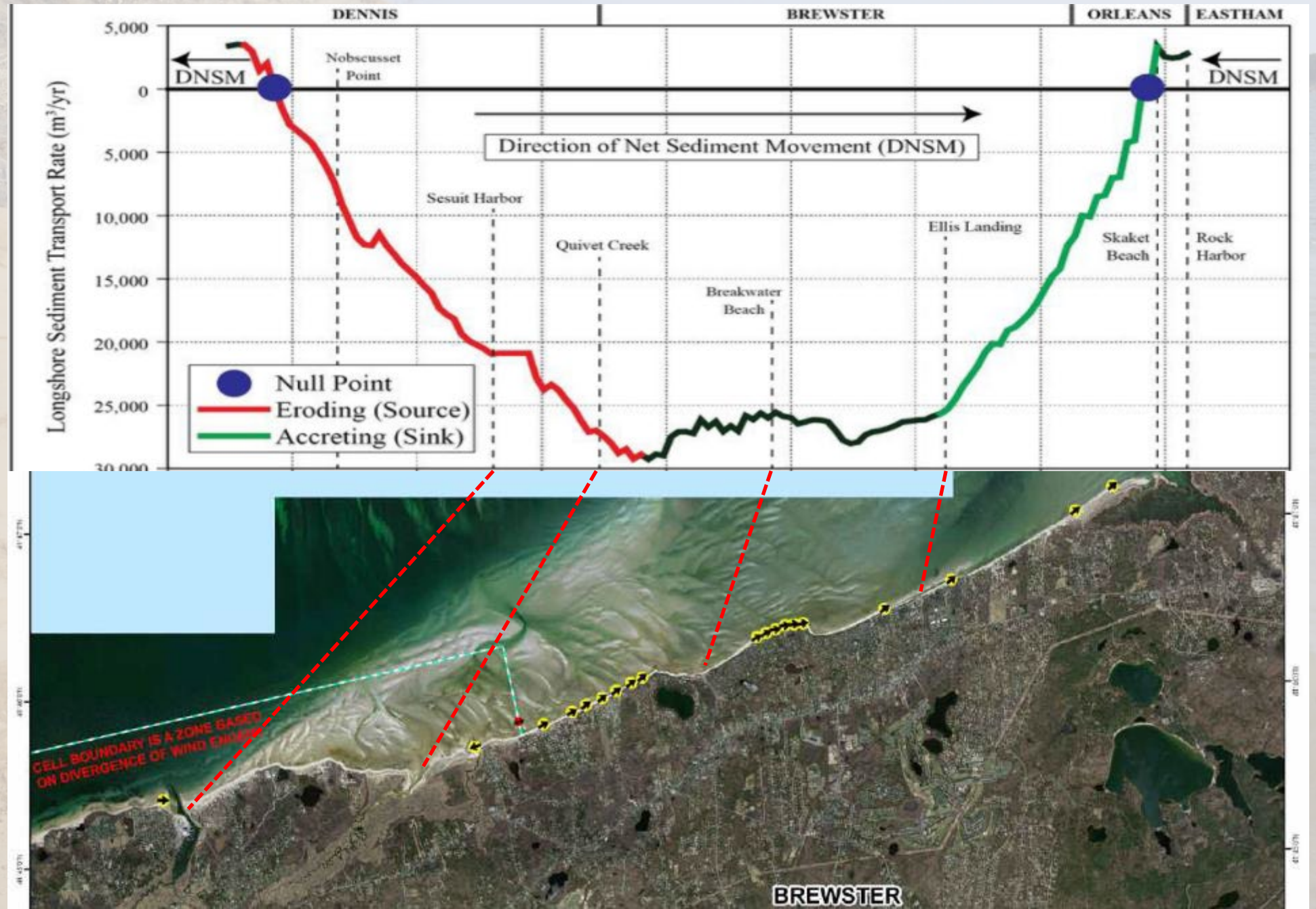
What is Erosion???..... just more leaving than coming in

Accretion | Dynamic Equilibrium | Erosion



Sediment Budgets




DENNIS
BREWSTER
ORLEANS
EASTHAM
DNSM
DNSM
Nobscusset Point
Direction of Net Sediment Movement (DNSM)
Sesuit Harbor
Quivet Creek
Breakwater Beach
Ellis Landing
Skaket Beach
Rock Harbor
Longshore Sediment Transport Rate (m³/yr)
5,000
0
5,000
10,000
15,000
20,000
25,000
30,000
Null Point
Eroding (Source)
Accreting (Sink)
CELL BOUNDARY IS A ZONE BASED ON DIVERGENCE OF WIND ENERGY
BREWSTER

Coastal Processes: Key Points

1. Erosion of glacial landforms is the MOST important source of sediment for dunes and beaches in Massachusetts.

2. Wind and waves then transport sediment.

3. Without erosion and then longshore re-deposition there would be no beaches.

Coastal Processes: Key Points

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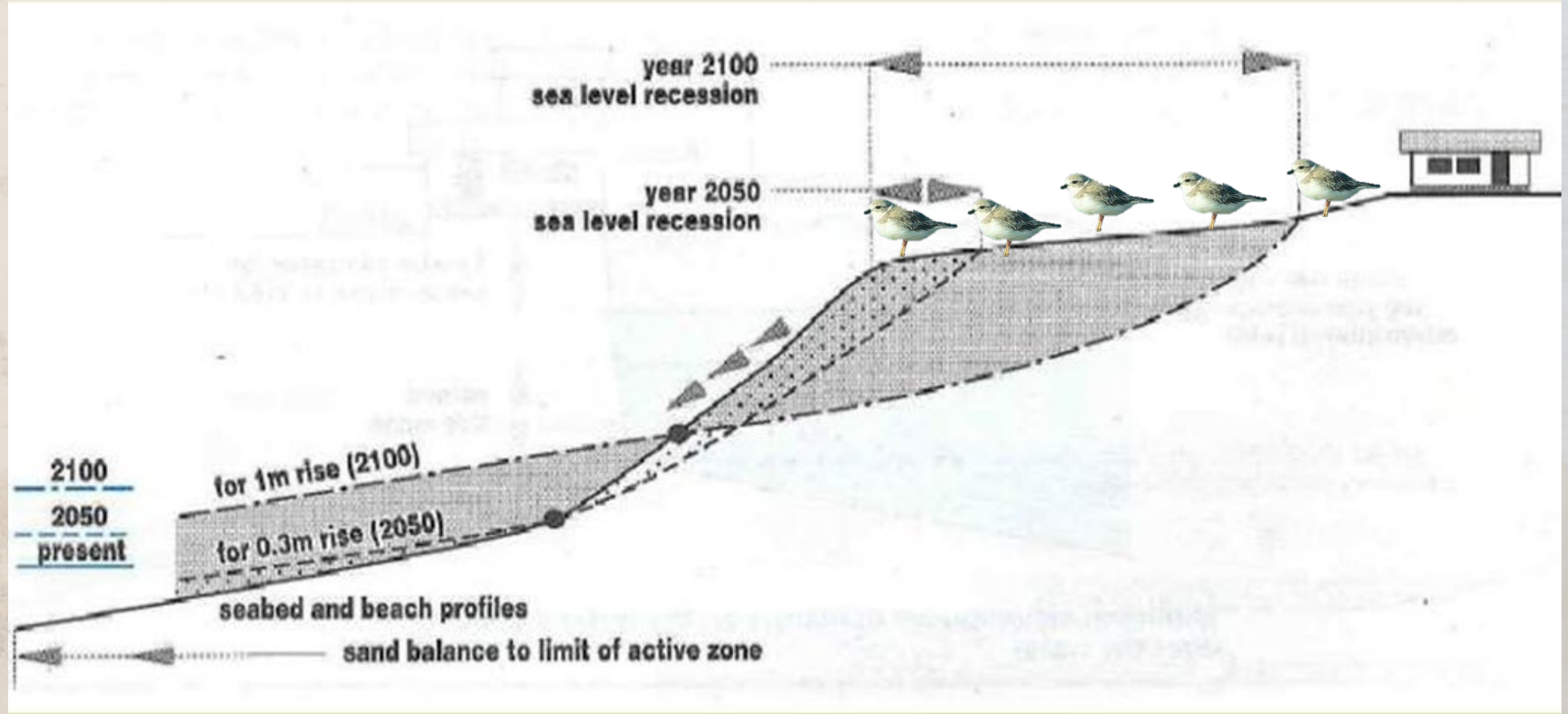
2. Wind and waves t
3. Without erosion a ion there would be no beaches.

The "Sediment-Starved" System

- The "Bruun rule" predicts recession of sandy coasts with changed water levels



Section 2

Extension Bulletin
Beach Nourishment Guide for Homeowners

The Spectrum of Coastal Erosion Control Methods

There are times when the desire to protect upland property conflicts with the ecosystem services provided by natural landforms. The key to responsible erosion control is to increase the resilience of the property while not negatively affecting the coastal resource areas.

How To Use This Spectrum

Under the Massachusetts Wetlands Protection Act (GL Ch 131, s.40) a Notice of Intent (NOI) must be filed for any activity in a natural resource area subject to protection (e.g., coastal banks, dunes, beaches, etc.). A NOI for shoreline stabilization should demonstrate that no other feasible method exists for protecting the building that would be less damaging to resource areas. (Note that it is the building that may be protected—not the lawn, pool, patio, etc.)

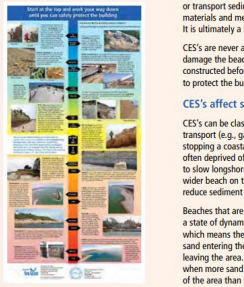
At a minimum, an alternatives analysis looks at the difference between doing nothing and the proposed action. The alternatives analysis within an NOI can be greatly enhanced by considering the various options, including those found within the spectrum (see reverse). By starting at the top of the spectrum and addressing each method until a feasible alternative is reached, the applicant can show full diligence that all other options that have lower potential impact have been examined. A good alternatives analysis should discuss each method in terms of feasibility, environmental effect, and impact on adjacent and downdrift properties.

Things To Keep In Mind

This is not a complete list. There are more methods, and many variations of the methods found on the reverse of this brochure. Additionally, new methods are frequently being invented and/or modified. Additionally, some techniques may harden a soft method to the point of being considered a Coastal Engineering Structure (CES) (e.g., wire or plastic wrapped fiber rolls).

Very few projects employ only one method. When we are determining a project's effect on coastal resource areas (as well as if it is a CES) the "hardest" aspect of the project should be considered. The images below show vegetation (very low potential impact) combined with fiber rolls and fencing (higher potential impact), therefore the entire proposed project should likely be considered as the component with the highest potential impact. If the cover of sand and vegetation erodes during a storm then the fiber rolls will be interacting with the environment.

The Spectrum of Erosion Control



Lowest potential negative impacts are at the top of the spectrum, with highest potential negative impacts at the bottom.

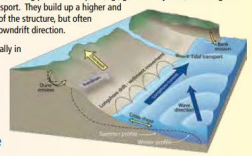
What is a Coastal Engineering Structure (CES)?

According to the Wetlands Protection Act, a CES "means, but is not limited to, any breakwater, bulkhead, groin, jetty, revetment, seawall, weir, rip-rap or any other structure that is designed to alter wave, tidal or sediment transport processes in order to protect inland or upland structures from the effects of such processes." Some town bylaws may have a more stringent definition. Basically, if a shoreline structure alters a wave's ability to erode sediment (perpendicular to beach) or transport sediment (parallel to beach) it likely qualifies as a CES. Typically biodegradable materials and methods that work to enhance natural land form stability are not considered a CES. It is ultimately a local Conservation Commission or MA DEP that makes this determination.

CES's are never allowed on dunes as they can impede the important function of the resource and damage the beach as well as adjacent properties. For coastal banks (i.e. glacial deposit), a building constructed before August 10, 1978 may be considered "grandfathered," so if there is no other way to protect the building a CES may be permitted.

CES's affect shore parallel and/or perpendicular transport

CES's can be classified as affecting sediment transport in two ways. CES's affecting perpendicular transport (e.g., gabions, revetments, seawalls, etc.) are designed to slow the shoreline retreat by stopping a coastal bank from eroding. However by stopping this source of sediment beaches are often deprived of material. CES's affecting parallel transport (e.g., groins and jetties) are designed to slow longshore sediment transport. They build up a higher and wider beach on the updrift side of the structure, but often reduce sediment supply in the downdrift direction.

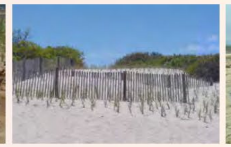


Beaches that are stable are actually in a state of dynamic equilibrium, which means there is as much sand entering the area as leaving the area. Erosion occurs when more sand is moving out of the area than is coming in.

Types of Sand Fence

There are many different types of fencing used for erosion control. Slat fencing, installed with small posts, has 50% porosity which slows down the wind causing sand to accumulate near the fence. It does not survive long when exposed to waves but, if installed landward of the reach of high tide, has relatively low potential negative impacts. Drift Fencing is typically composed of 2x3s installed with 12" pilings. This type of fencing can withstand some waves, but cannot be installed seasonally like slat fencing and has a higher potential for reflecting wave energy. Some projects have used 12" pilings spaced 1" apart. The spacing (8% porosity) allows for some exchange of sediment and water, however not as much as the slat or drift (required 50% porosity) fence. There is also a much greater chance for enhanced beach erosion due to wave reflection in addition to altering the wave environment and sediment transport processes. As porosity is reduced the structure begins to look and act more like a bulkhead than a fence. For these reasons multiple state agencies have classified this type of piling configuration as a CES.

Native Vegetation & Fiber Rolls



Native Vegetation & Sand Fence

Slat Fencing

Drift Fencing

Pile Wall

Additional Information

Massachusetts Office of Coastal Zone Management, StormSmart Properties Fact Sheets Project:
http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/stormsmart-properties/

MassDEP:
http://www.mass.gov/eea/agencies/massdep/water/watersheds/wetlands-protection.html

Woods Hole Sea Grant
www.whoi.edu/seagrant

Cape Cod Cooperative Extension
www.capecodextension.org/marine-programs/coastal-processes-2/

Local Officials
Call the local town hall. Conservation departments are a good place to start.

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Remove invasive species: USDA/MassWildlife
Managed Retreat: Bill Brine, courtesy of the Vineyard Gazette

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Dealing with Coastal Erosion

The Spectrum of Erosion Control Methods

Woods Hole Sea Grant

Cape Cod Cooperative Extension

Start at the top and work your way down until you can safely protect the building.

Note that more detail on most of these methods is available at:
www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/stormsmart-properties/

March 2013

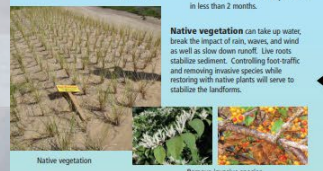
May 2013

Coastal shorelines are dynamic; if the building is far enough away from the water then **"Do Nothing"** may be an option, which will allow natural processes to continue. Structural erosion control may only be permitted if the Conservation Commission finds it is required to protect a building. Rapid erosion due to storms can be followed by rapid beach recovery. The images to the left show an area that accumulated over 5' vertically of sand in less than 2 months.

Do Nothing

Managed Retreat

If there is room on the parcel, **retreating** from an eroding shoreline can significantly lengthen the usable lifespan of property. If flooding is more of a concern than erosion elevating the building in place (e.g., on pilings) can reduce flood damage.



Native vegetation

Remove invasive species

Native vegetation can take up water, break the impact of rain, waves, and wind as well as slow down runoff. Live roots stabilize sediment. Controlling foot-traffic and removing invasive species while restoring with native plants will serve to stabilize the landforms.

Vegetation

Beach Nourishment

Beach nourishment can be accomplished by trucking from upland sources, or by dredging. This has the benefit of adding new material to the system instead of depriving downdrift beaches like most other methods. If combined with plantings beach nourishment can lead to dune creation. Nourishment sand, as opposed to dune creation, is typically considered "sacrificial" as it is placed to erode instead of what it's protecting. The placed material should be compatible with the beach.

Sand fencing slows wind, causing sand to drop out and accumulate. More details on the back of this brochure. Some materials are not suitable for the coast.

Sand Fencing

Regrade

If a slope is too steep it may prevent vegetation from stabilizing the landform. Stormwater runoff from above can rapidly destabilize the landform (left). **Regrading** a coastal bank landward to a more gentle slope, followed by extensive planting, can allow for faster stabilization.

Before

After (pre-planting)

Fiber rolls (aka bio logs, coir logs, etc.) are composed of biodegradable coconut (aka coir) fibers surrounded by twine netting. Planting native vegetation in and around the rolls can provide additional longer term stabilization. Fiber rolls should be covered with sediment, as sunlight and wind can cause rapid degradation. Proper height is also important as frequent inundation can also lead to failure. Secure anchoring is essential as if fiber rolls break free during a storm they may damage other properties, however use of other non-biodegradable components (e.g., filter fabric) should be avoided.

Fiber Roll

Coir Envelope

Coir Envelopes consist of coir fabric that is filled with appropriate sediment, then sewn closed. The coir should biodegrade over time (otherwise it would be considered a CES) and if the coir rips only sediment should be released onto the beach. While typically much larger than fiber rolls coir envelopes can also be planted with vegetation, and survive longer if covered. Use of non-biodegradable components (e.g., filter fabric) should be avoided.

IS NOT A CES

Once an erosion control structure has enough impact on coastal resource areas it is classified as a **Coastal Engineering Structure (CES)**, with major implications for permitting. Depending on how some of the above methods are designed and installed (e.g., coir envelopes, fiber rolls, fencing) they can approach being classified as being a CES. Only certain properties are allowed to have a CES. See reverse side for details.

IS A CES

Geotextile sand bags are very similar to coir envelopes except that instead of coir, a plastic geotextile is used to contain the sediment, which may end up as marine debris. The geotextile does not biodegrade and over time the structure can become very hard, reflecting wave energy on the beach. In addition to bags, long geotubes (can be >10' diameter and hundreds of feet long) are also used in this fashion.

Geotextile Sand bags/Geotube

Gabion

Gabions are wire mesh baskets filled with rocks. They have the benefit of allowing some dissipation of wave energy and if covered with sediment, vegetation may reduce some of the negative impacts associated with a CES. Coated wire last longer than bare, but are not intended for high wave energy. Regular maintenance is important as rusty metal and freed rocks may degrade the environment.

Breakwaters (not typical for a homeowner) are rock structures, built offshore and parallel to the shore, that reduce wave energy reaching the shoreline. Sills are similar to breakwaters however they are designed to be under water during portions of the tide. The reduction in wave energy can build the beach seaward towards the structure, however it may also slow or block the flow of sediment to downdrift coastal areas.

Breakwater

Groin

A **groin** (not typical for a homeowner) is designed to slow sediment transport thereby building a higher/wider beach on the updrift side. Eventually the sediment should overtop or go around the groin to allow longshore sediment transport. In many areas there is not enough sediment supply to the beach system to minimize adverse impacts from the groin. There is often erosion on the downdrift side of the groin where the beach is deprived of sediment.

Revetments are comprised of large boulders that start at the bottom (aka toe) of a coastal bank and should only extend as far up the bank as needed to protect the building. Above that salt-tolerant vegetation can help control erosion. More gentle slopes and rough face tend to dissipate more wave energy. Without a proper return end scour can damage the bank.

Revetment

Seawall

Seawalls are cement structures that are typically vertical and therefore highly reflective of wave energy. The increased turbulence at the base of the seawall tends to erode the sediment, leading to a beach that narrows and lowers in height over time. (New seawalls are generally not permissible since they fail to minimize adverse effects).

Bulkheads are vertical wooden (sometimes steel or vinyl) structures and therefore reflect wave energy and often lead to a lowering of beach height. Unlike a seawall, bulkheads are typically found in bays and rivers that do not experience frequent strong waves.

Bulkhead

Jetty

Jetties stabilize navigation channels that connect bodies of water. A jetty is similar to a groin in that it affects longshore sediment transport, however while a groin is intended to allow sediment to pass a jetty is intended to completely stop sediment. As sediment can no longer naturally bypass the inlet, it will need to be manually bypassed or the updrift side will allow sediment to flow over and around the jetty and the downdrift side will experience severe erosion.

Woods Hole Sea Grant
Woods Hole Oceanographic Institution
193 Oyster Pond Road, MS #2
Woods Hole, MA 02543-1525
508.289.2398
www.whoi.edu/seagrant

www.facebook.com/woodsholeseagrant
www.twitter.com/woodsholeseagrant
www.youtube.com/woodsholeseagrant

Cape Cod Cooperative Extension
P.O. Box 367
Barnstable, MA 02630-0367
508.375.6849
Fax 508.362.4923
www.capecodextension.org

The Spectrum of Coastal Erosion Control Methods

- **Do nothing**

1. Will system recover by itself?
2. How far is the structure from the water?
3. Grandfathering protects structures (not lawn) before August 10, 1978

The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- **Beach nourishment = Fill of a CRA**

Sacrificial

Cobble (Mixed)

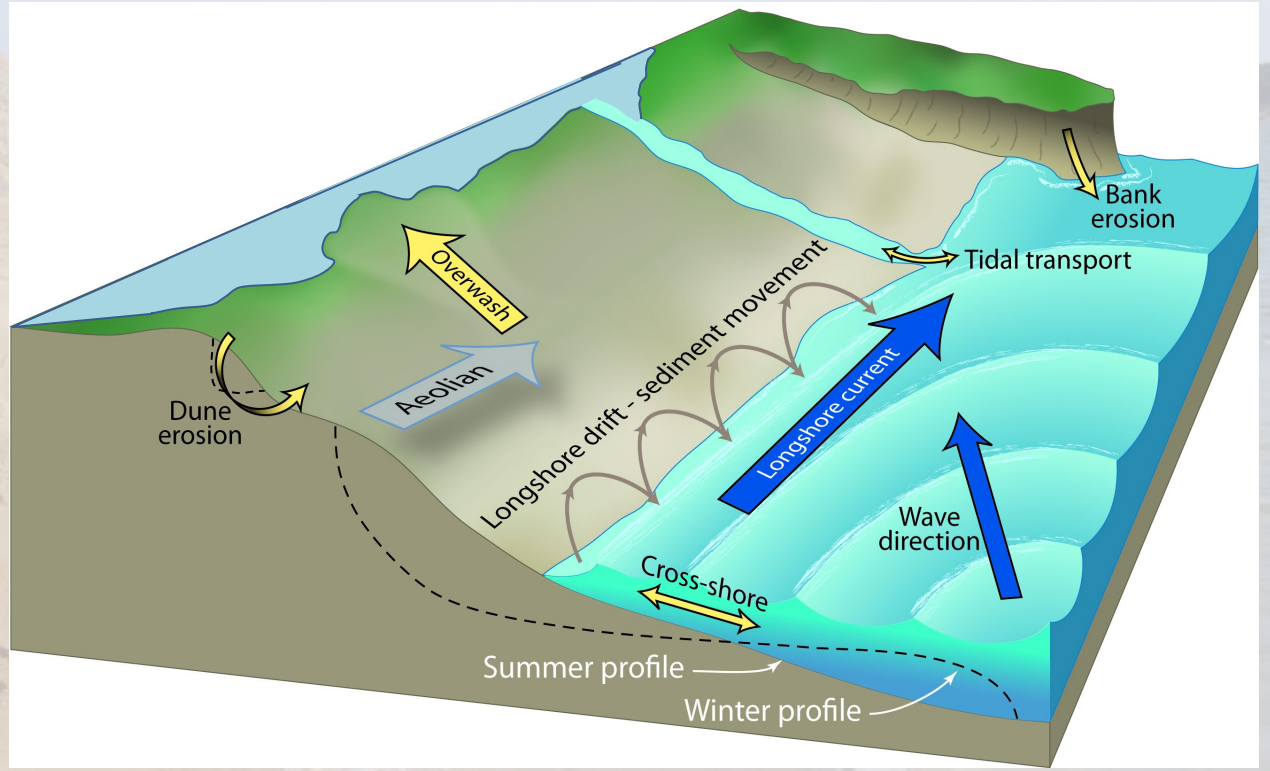
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- **Beach nourishment**

The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes

C E S



WPA: Coastal engineering structure means, but is not limited to, any breakwater, bulkhead, groin, jetty, revetment, seawall, weir, riprap or any other structure that is designed to **alter wave, tidal or sediment transport processes** in order to protect inland or upland structures from the effects of such processes.

The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes

C E S

- Groin
- Jetty
- Sand Bags
- Gabion
- Breakwater / Sill
- Revetment
- Seawall
- **Bulkhead**

Beach Nourishment Guide for Homeowners

RATIONALE FOR COMPENSATORY NOURISHMENT

HOW TO CALCULATE NOURISHMENT REQUIREMENTS

DETERMINING THE TYPE OF SAND

WHERE TO PUT NOURISHMENT

TOO MUCH OF A GOOD THING

- **Navigation**
- **Vegetation**
- **Animals**

RECOMMENDATIONS

Beach Nourishment Guide for Homeowners

(RATIONALE FOR COMPENSATORY NOURISHMENT)

To mitigate for the elimination of a sediment source for a downdrift beach

- state regulations require that the form and volume of beaches are preserved
- no longer be the same level of storm damage protection and wildlife habitat.
- recreational areas and public access sites would be eliminated without a supply of sand.
- reduce wave energy, mitigating for the structure's impact to the adjacent beach

To reduce wave energy, mitigating for the structure's impact to the adjacent beach

- Wave reflection erodes beach, also jeopardizing the base of the CES.
- Reduce terminal (aka end scour) which can flank the CES.
- Keeping the adjacent beach to proper elevation will also help maintain the beach volume in front of the structure, increasing CES longevity and reducing the frequency of maintenance with its associated short term beach impacts.

To protect biodegradable components

- Some projects use biodegradable components such as coir, which breaks down much more quickly when exposed to sunlight. Keeping the coir covered with sand will protect it and greatly increase the longevity of the material.
- Coir at the end of a CES can transition into an unarmored bank. Nourishment on, and at the end of, the coir can further reduce impacts from the end of a stabilization project.

Beach Nourishment Guide for Homeowners

(HOW TO CALCULATE NOURISHMENT REQUIREMENTS)

Erosion Rate (ft/yr) X CES length (ft) X Bank Height (ft) = Compensatory Nourishment (ft^3/yr)

Erosion Rate:

CZM Coastal Erosion Viewer is used if there is no finer scale information

Long-term rate, unless the short-term rate shows faster erosion (current conditions?)

"Best professional guess" followed by a potential uncertainty in the analysis

Rates look at the past and not the present or future

New erosion rate is not easily calculated at a site (CES installed and nourishment)

Beach Nourishment Guide for Homeowners

(HOW TO CALCULATE NOURISHMENT REQUIREMENTS)

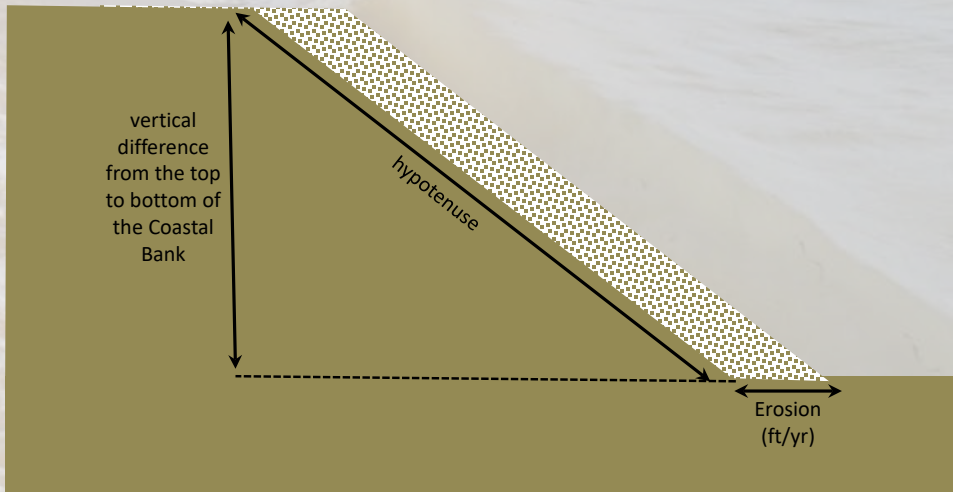
Erosion Rate (ft/yr) X CES length (ft) X Bank Height (ft) = Compensatory Nourishment (ft^3/yr)

CES length : Easy parameter to determine from Site Plans

Bank Height: CES is designed to stop erosion of the entire bank
The total height of the bank, and not just the height of a seawall should be used
In some locations it may be more appropriate to use the hypotenuse

Compensatory Nourishment:

Cubic yards per year, divide by 27
For a small amount, it may make more sense to “save up”



Beach Nourishment Guide for Homeowners

(HOW TO CALCULATE NOURISHMENT REQUIREMENTS)

11/12/2010

02/18/2011

04/02/2018

Triggers: Preserve the beach adjacent to the CES
Visible marker is installed on the CES
Monitoring !!!

Also for non-CES (ex. Coir)

Keep covered to prevent UV degradation

Beach Nourishment Guide for Homeowners

(DETERMINING THE TYPE OF SAND)

The state's **32-page** guidance describes sampling beach and comparing to offsite source material.

Beach Nourishment: MassDEP's Guide to Best Management Practices for Projects in Massachusetts
(along with the **20 pages** of technical attachments),

…But this is for shoreline protection, not necessarily for compensatory nourishment

Depending on what is most compatible with the beach, gravel or even cobbles included in nourishment.

Generally, nourishment sediment is the same, or coarser, than the receiving beach, with less than 10% fines.

Fine grained sediment can mobilize quickly and potentially smother shellfish and eelgrass.

The priority is that clean sediment of an appropriate grain size, shape, color, and texture is used.

Beach Nourishment Guide for Homeowners

(WHERE TO PUT NOURISHMENT)

If you add too much sediment above the MHW it can create an overly steep profile.

Instead of adding sand at the toe of the revetment, it can be placed on/above revetment.

If terminal scour nourishment could be focused there.

Provide nourishment off site of their property but still within the same littoral cell.

Beach Nourishment Guide for Homeowners

(TOO MUCH OF A GOOD THING - Navigation)

Natural flow of sand past a natural inlet may temporarily close it, leading to anoxic events, fish kills, etc.

Jetties are installed at some inlets to reduce these closures, however when the jetty reaches capacity to hold sand, it can be overtopped or bypassed, which then requires dredging to maintain the inlet.

Navigational channels and marinas also require occasional maintenance dredging to allow safe passage of vessels.

If too much sand is placed at a nearby stabilization project, or if it mobilizes too quickly, there is the potential to “plug” inlets, channels, marinas, private docks, etc.

Beach Nourishment Guide for Homeowners

(TOO MUCH OF A GOOD THING - Vegetation)

Coastal vegetation needs sediment to maintain the elevation in which they have adapted to thrive.
If too much sand is placed on a site, or if it mobilizes too quickly, it may smother some types of vegetation.

Marsh grass can be damaged for many years by less than a foot of burial

Eelgrass even more sensitive to burial, with as little to 2-4 cm causing 70-90% mortality
(*2008, Cabaço, S. et al. The impact of sediment burial and erosion on seagrasses: A review. Estuarine, Coastal and Shelf Science 79(3):354-366*)

Until new vegetation eventually colonizes the site, it will be more vulnerable to erosion
New vegetation may be of a different species

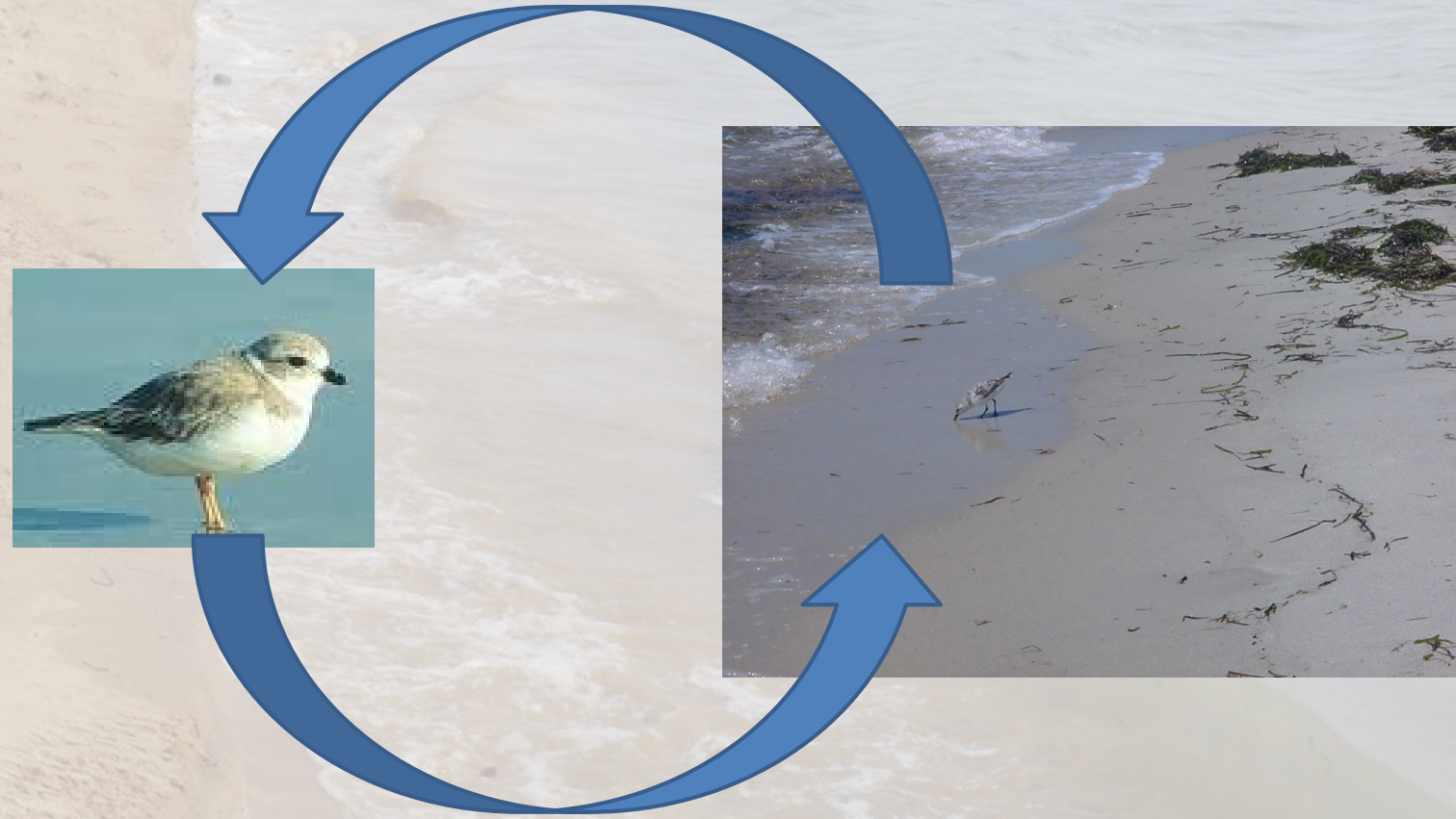
Beach Nourishment Guide for Homeowners

(TOO MUCH OF A GOOD THING - Animals)

Many rare species such as beach nesting birds, plants, insects, etc., have specific coastal habitat requirements (e.g., gentle slopes, grain size, overwash areas, etc.).

Compensatory nourishment contributes sediment to the littoral system which often supports the habitat of state-listed and common species.

While the proper amount of nourishment can be beneficial, specific design requirements may be needed to regulate the best volume, grain size, and beach geometry so as to not negatively affect the habitats of State-listed and other rare species, which is prohibited by the Massachusetts Endangered Species Act.



Beach Nourishment Guide for Homeowners

(TOO MUCH OF A GOOD THING - Animals)

Shellfish can also be negatively affected

Some species (ex. Clams) are capable of "digging out", but oysters and mussels, may be smothered

Shellfish aquaculture sites that include any bottom planted shellfish are particularly susceptible to potential smothering.

The planting of oysters on the bottom or clams under netting provides a disruption of flow where sand tends to accumulate if entering the plot in suspension

Shellfish aquaculture sites may be intertidal or subtidal and increases in sand may result in increases in the elevation

Beach Nourishment Guide for Homeowners

(RECOMMENDATIONS)

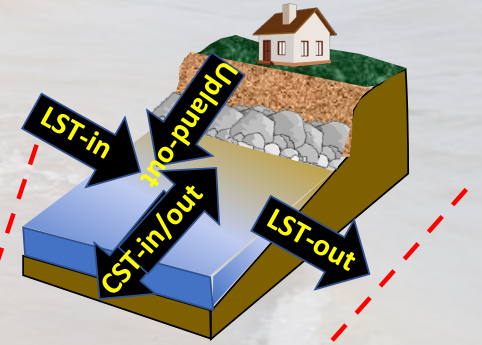
Simplified sediment budget to identify and reduce impacts.

While only larger projects may require quantitative analysis, even parcel level projects could examine the qualitative aspects of a sediment budget.

Identify factors that currently affect the sediment volume moving towards the site, the volume moving past the site, and how the proposed nourishment will affect these volumes and rates of transport.

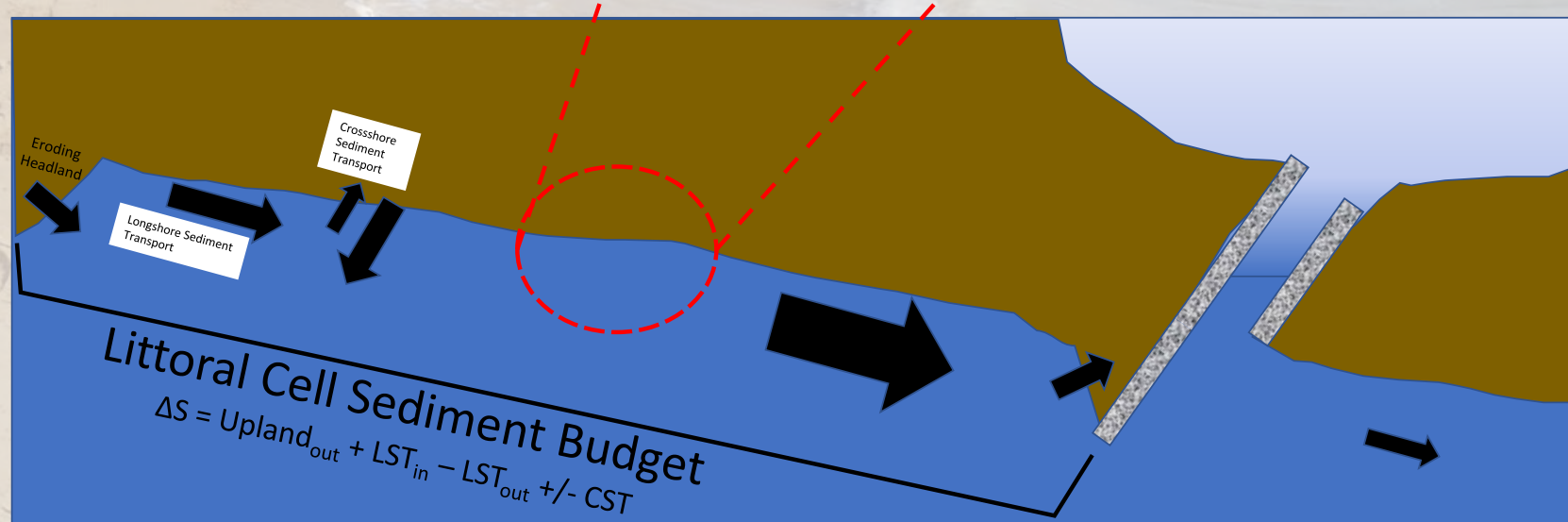
The larger littoral cell should also be examined to determine affects effects to the broader system as well as cumulative effects.

At a minimum, a parcel level sediment budget should discuss the components and net direction of sediment moving past the site.



parcel level sediment budget

$\Delta S = Upland_{out} + LST_{in} - LST_{out} +/- CST$



Beach Nourishment Guide for Homeowners

(RECOMMENDATIONS)

When beach nourishment is required, the conditions should be noted on the Conservation Commission's Order of Conditions (OOC) and be extended to the Certificate of Compliance as conditions in perpetuity. However, the exact volume requirement should be regularly re-visited. It is often helpful to make this note on the site plan and identify the monitoring plan in the OOC.

A project can be conditioned with both a trigger and an annual requirement, or may only need one of these depending on the location. Some years the volume needed to maintain the trigger will be more than the annual requirement, so no additional material would need to be placed. In years where the volume required by the trigger is less than the annual requirement, additional material would be needed. Depending on site conditions, and if the difference is a small amount, then it may be reasonable to average the difference across a few years.

In areas with sensitive resources (such as eelgrass and shellfish), correct sediment grain size becomes even more important. Sand that is coarser than the receiving beach, and containing no fines, may reduce the potential for the sediment to move quickly into eelgrass and shellfish beds, as well as aquaculture sites. It is also important that these beaches do not become over steepened, as this will also lead to more rapid mobilization of the sediment.

Beach Nourishment Guide for Homeowners

(RECOMMENDATIONS)

Annual compensatory nourishment is typically considered as “sacrificial” in that it is not required to be planted since it is intended to erode within the year and provide sediment for downdrift resource areas. Sand required due to a trigger – that is, to maintain the beach frontage – can be planted in the hopes of vegetation’s roots aiding in the stabilization of the resource area on the site.

Compensatory nourishment is almost always required for a proposed new CES. Reconstruction of existing CES should include design improvements based on the best available techniques to reduce impacts, improve structure longevity, and minimize maintenance costs. Even if an existing stabilization project doesn’t have a nourishment requirement, it is reasonable to add this requirement during the permitting process for reconstruction or repair.

Don’t forget a Monitoring Plan !!!

Beach Nourishment Guide for Homeowners

(RECOMMENDATIONS - **Monitoring Plan !!!**)

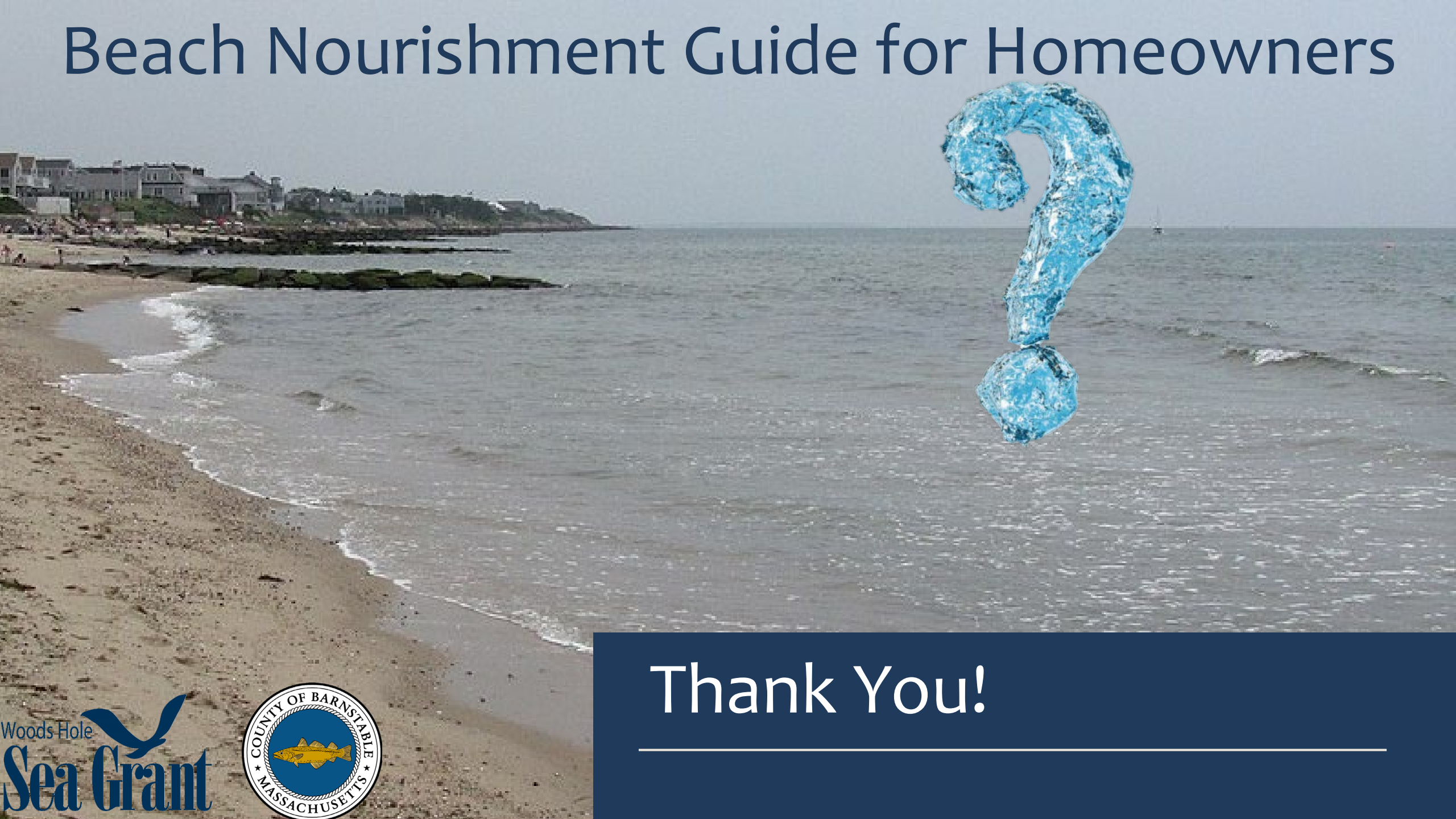
A monitoring plan should be part of any project that includes nourishment. Such a plan would address:

- How frequent is the monitoring?
  - Typically once per year and right after storms
  - Same time of year to reduce seasonal variations
- Who does the monitoring?
  - Can the homeowner just submit pictures or does this need to be professionally surveyed?
- Who gets the reports?
  - Typically submitted by a certain date to the ConCom agent
- How to measure the beach elevation?
  - Typically with fixed markers but some may require regular topographic surveys
  - Examples of fixed markers are grooves cut into revetment stones or how much a sand fence is exposed
- How to determine if a trigger is reached?
  - Make sure it's well defined and easily determined at the site.
  - How much of an array has to be uncovered to require nourishment sand? (ex. ??% of total, or ??' exposed)
  - How much sand must be put down if the trigger is reached? (ex. cover to ??" over entire array, or refill up to ?? CY to design elevation)
- What was the volume and grain size of the sediment?
  - Receipts showing the volume and when it was placed
  - A grain size analysis provided to the ConCom agent before placement
- What are the indicators for changing the required volumes?
  - Additional sediment may be needed to mitigate for erosion
  - Sediment may be need to be reduced if impacting navigation, vegetation, or animals.

Sea Grant

COUNTY OF BARNSTABLE MASSACHUSETTS

Beach Nourishment Guide for Homeowners



Thank You!

Woods Hole Sea Grant

County of Barnstable Massachusetts