Are You Ready for the Next Big Storm?: A Workshop for Hardy Cape Codders

The Spectrum of Erosion Control Methods

Greg Berman
(WHOI Sea Grant & Cape Cod Cooperative Extension)

November 2, 2017
Outline:

• ~30 min talk & time for questions

• Practical measures that can protect homeowners, renters, and their families, as well as minimize damage to homes and property from hurricanes, nor’easters, and flooding.

• Pros and cons of various shoreline stabilization techniques
5,000 copies of the handbook were first made available during Hurricane Preparedness Week (May 26 – June 1) and over ½ were distributed that 1st week.
Myth 1: “I survived Hurricanes Bob, Irene and Sandy, so I am sufficiently prepared.”

Myth 2: “If a disaster occurs, it won’t be that bad.”

Myth 6: “My house survived Hurricanes Bob and Sandy, so I do not need to retrofit for hurricanes.”

Things You Can Do to Prepare

• Gather emergency supplies

• Compile an evacuation kit

• Create an evacuation plan for both a flood and a coastal storm

• Know your property and take appropriate action

• Know your house and take appropriate action

• Don’t gamble with your house
Contents

Part 1 — Introduction .................................................. 1
Part 2 — Natural Hazards: An Overview for Homeowners ...................... 7
Part 3 — Protecting Yourself and Your Family .................................. 19
Part 4 — Protecting Your Property ............................................... 31
Part 5 — Protecting Your Property with Insurance .............................. 65
Part 6 — Climate Change and Potential Impacts on Natural Hazards .......... 69
Appendix A — Emergency Contact Information .................................. 75
Appendix B — Shelter Information .............................................. 76
Appendix C — Construction at the Coast, Beach Management, and Coastal Property Checklist ........................................ 78
Endnotes ............................................................................. 85
Acronyms and Abbreviations .................................................... 87
Useful Links and Resources ..................................................... 88

1938
Carol / Edna
Bob
Sandy
(Nor’easters)
Emergency Notification Systems

Shelter
In place or at a designated shelter? Arrangements for pets? Medicine?
The Severity of the Hazard Event

Your Location

How and When Your House Was Built

How Your House is Maintained

How You Strengthen Your House

wind and rain resistant envelope

continuous load path
Retro-fitting

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Part 4 — Protecting Your Property ............................................... 31
Part 5 — Protecting Your Property with Insurance ............................ 65
Part 6 — Climate Change and Potential Impacts on Natural Hazards ...... 69
Appendix A — Emergency Contact Information ................................ 75
Appendix B — Shelter Information ............................................... 76
Appendix C — Construction at the Coast, Beach Management, and Coastal Property Checklist .................................................. 78
Endnotes .................................................................................. 85
Acronyms and Abbreviations ......................................................... 87
Useful Links and Resources ......................................................... 88

hurricane clips

bracing - polyurethane foam
### Table 4-1. Pros and Cons of Various Types of Window Protection

<table>
<thead>
<tr>
<th>Type of Protection</th>
<th>Pros</th>
<th>Cons</th>
<th>Approx. Cost for 3’ x 4’ Window Protection (2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll-down Shutters</td>
<td>Easiest to deploy; Good overall protection, especially from wind-driven rain</td>
<td>Most expensive of permanent shutter system; Motorized versions need manual backup for power outages or an emergency power source</td>
<td>$360 to $600</td>
</tr>
<tr>
<td>Accordion Shutters</td>
<td>Easily deployed; Simple manual operation; Good overall protection; Modest cost</td>
<td>Possible aesthetic issues</td>
<td>$300 to $360</td>
</tr>
<tr>
<td>Bahama Shutters</td>
<td>Easily deployed; Good protection; Provides shade</td>
<td>Blocks some light and view</td>
<td>$360 to $480</td>
</tr>
<tr>
<td>Storm Panels</td>
<td>Strong; Removable; Relatively inexpensive permanent shutter system; Good protection for the costs</td>
<td>Manual deployment required; Requires adequate space for storage when not in use</td>
<td>$144 to $168</td>
</tr>
<tr>
<td>Stainless Steel Impact Screens</td>
<td>Always in place; Provides shade</td>
<td>Some aesthetic impact; Emergency escape issues must be considered; Less effective for wind-driven rain</td>
<td>$375 to $750</td>
</tr>
<tr>
<td>Flat Impact Polycarbonate Units</td>
<td>Always in place; Minimal aesthetic impact</td>
<td>Emergency escape issues must be considered; Care must be taken in cleaning</td>
<td>$375 to $525</td>
</tr>
<tr>
<td>Fabric Windscreen (Direct Mount)</td>
<td>Inexpensive; Easy to handle and store</td>
<td>Manual deployment required; Greater shutter deflection than metal systems</td>
<td>$105 to $180</td>
</tr>
<tr>
<td>Impact Resistant Windows and Doors</td>
<td>Attractive and energy efficient; Provides security protection and storm resistance; Always in place; Many styles and options</td>
<td>Costs vary widely and can be high; Replaces existing windows or doors; Glass can still break requiring expensive replacement</td>
<td>Wide range in costs: $360 to $600 and higher</td>
</tr>
<tr>
<td>Plywood</td>
<td>Materials readily available; Easy to install on lower levels; Inexpensive</td>
<td>Not as strong as some other shutter systems; Manual deployment is difficult on upper levels; Must be properly stored; Doesn’t provide impact-resistance for winds &gt; 130 mph</td>
<td>$25 to $35 for materials only</td>
</tr>
<tr>
<td>Laminates</td>
<td>Storm, security and UV protection; Energy efficient; Always on; Allows light in; Ideal for hard-to-reach windows</td>
<td>Other systems are stronger; Need to lock laminate to frame; Frame must be strong; Window may need replacement after storm</td>
<td>$180 to $204</td>
</tr>
<tr>
<td>Plastic honeycomb</td>
<td>Strong system; Lightweight; Reasonable cost; Won’t warp or rot</td>
<td>Storage of panels; Time to create and deploy. While cost is reasonable, still most expensive of deployable systems; Materials difficult to obtain</td>
<td>$140 to $170</td>
</tr>
</tbody>
</table>
DRY vs. WET floodproofing
Pre-Disaster Activities

Protect Your Home from Damage
Communicate with Your Insurance Agent

10 months later:
2,000 more people have policies
$160,000 more to be saved

CRS Across Barnstable County

<table>
<thead>
<tr>
<th># Policies In-force</th>
<th>Written Premium In-force</th>
<th>10% Savings</th>
<th>15% Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/30/2014</td>
<td>10,474</td>
<td>$15,487,001</td>
<td>$1,548,700</td>
</tr>
<tr>
<td>2/28/2015</td>
<td>12,350</td>
<td>$17,101,036</td>
<td>$1,710,104</td>
</tr>
<tr>
<td></td>
<td>1,876</td>
<td>$1,614,035</td>
<td>$161,404</td>
</tr>
</tbody>
</table>

10 months later: 2,000 more people have policies $160,000 more to be saved
Part 5 — Climate Change and Potential Impacts on Natural Hazards

Table 6-1. Summary of observed and documented current climate trends in the Northeast region.

<table>
<thead>
<tr>
<th>Climate Change Variable</th>
<th>Current Trend in the Northeast Region</th>
<th>What This Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Temperature</td>
<td>Since 1900, the annual mean temperature has risen 1.5°F, with more rapid increases occurring over the past few decades (2°F since 1970).</td>
<td>Longer, hotter summers increasing drought potential and human health effects.</td>
</tr>
<tr>
<td>Ocean Water Temperature</td>
<td>Annual average temperatures in the waters off the southern New England coast have increased by 2.2°F since the 1970s.</td>
<td>Change in species composition and dynamics. Decline of some fish species while other southern species increase. Potential for more harmful algal blooms and invasive species.</td>
</tr>
<tr>
<td>Precipitation and Weather</td>
<td>Studies have found a 5 to 17 percent increase in regional precipitation during roughly the last 100 years.</td>
<td>More rainfall in more intense storms means increased risk of flooding. Less snow in winter.</td>
</tr>
<tr>
<td>Storminess</td>
<td>Hurricane intensity in the western North Atlantic Ocean has increased.</td>
<td>Increased erosion and damage to roads, bridges, buildings. Interruption of business.</td>
</tr>
<tr>
<td>Sea-Level Rise</td>
<td>Rates of local relative sea-level rise are variable across the Northeast region. Sea level in Massachusetts has risen 11 inches over the past 100 years.</td>
<td>Increased flooding. Loss of waterfront property and impacts to public access.</td>
</tr>
</tbody>
</table>
Massachusetts
Coastal Storms
Floods
Drought/Extreme Heat
Sea-Level Rise
Appendix B — Shelter Information

When an emergency situation requires shelter, access to a wide range of options is available. Shelters are available in various locations, including public buildings, schools, and community centers. The emergency management agency in your area will provide information on available shelters.

Shelter planning is essential for individuals and families. Disasters, such as hurricanes, floods, and other natural disasters, can occur without warning. Shelters provide a safe haven for those in danger.

Shelters are typically equipped with food, water, and other basic necessities. It is important to know how to use these resources efficiently. Shelters are usually staffed with trained personnel who can provide assistance.

If you are unable to find a shelter, or if you prefer to stay at home, you can take steps to prepare your home for an emergency. This includes making sure your home is structurally sound and that your water and sanitation systems are in good working order.

In summary, shelters are a critical resource during times of disaster. Knowing where to find a shelter, knowing how to use it, and preparing your home for an emergency are all important steps in ensuring your safety.

References:


Appendix C — Construction at the Coast, Beach Management, and Coastal Property Checklist

Construction at the Coast

When constructing a home or business at the coast, it is important to consider the potential risks associated with coastal environments. This includes factors such as erosion, flooding, and storm surges. By taking these risks into account, you can ensure that your property is safe and secure.

Beach Management

Beach management is a crucial component of coastal management. This includes activities such as beach clean-up, beach nourishment, and beach protection. Beach management helps to maintain the aesthetic and ecological value of coastal areas.

Coastal Property Checklist

When purchasing or leasing coastal property, it is important to consider the potential risks associated with coastal environments. This includes factors such as erosion, flooding, and storm surges. By taking these risks into account, you can ensure that your property is safe and secure.

References:

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The Spectrum of Erosion Control Methods

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November 2, 2017
What is Erosion?
It’s all sediment transport!
What is Erosion???. just more leaving than coming in

Accretion  Dynamic Equilibrium  Erosion
Parallel Transport.......Blocked LST

Downdrift
Direction of Longshore Current

Coastal Structure
Direction of Longshore Current

Erosion
Deposition

+5'/yr
+8'/yr
+4'/yr
+3'/yr
-2'/yr
-2'/yr
0'/yr
-1'/yr

Source: MORIS: CZM's Online Mapping Tool
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.
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 longshore redeposition there would be no beaches.

Thanks for contributing sand to our coastal resource areas.
Erosion Control Structures

Designed to extend the “usable life” of a property.

General practice 1920s – 1950s.

Scientists wrote letter in 1970’s... MA “needs” erosion.

310 CMR 10: “no new coastal engineering structure on a coastal beach/dune/bank to protect a structure built after 8/10/1978”

Towns: Engineered structures may require nourishment
Shoreline Stabilization
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

- Plant Natives:
  - Root systems stabilize.
  - Take up water.
  - Break the impact of raindrops or wave-splash.
  - Slow down runoff

Remove Invasive
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
Adaptation - Brewster

09/29/2015 - 01/15/2016 - 10/12/2017
The Spectrum of Coastal Erosion Control Methods
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

Before

After

Repair
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
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The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
The Spectrum of Coastal Erosion Control Methods

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

Diameter
12”-20”
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- **Fiber rolls**
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes
The Spectrum of Coastal Erosion Control Methods

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

Photo Credit: 2Fathom
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
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- Sand fencing
- Fiber rolls
- **Coir Envelopes**
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
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**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
- Groin
The Spectrum of Coastal Erosion Control Methods

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

Source: MORIS, CZM's Online Mapping Tool
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
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- Beach nourishment
- Sand fencing
- Fiber rolls
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- Groin
- Jetty

Sand Bags
The Spectrum of Coastal Erosion Control Methods

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

Gabion (10-20 yrs)
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes
- Groin
- Sand Bags
- Gabion
- Breakwater / Sill
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes
- Groin
- Sand Bags
- Gabion
- Breakwater / Sill
- Revetment
- Jetty
A beach undergoing net longterm retreat will maintain its natural width.

Beach loss eventually occurs in front of a seawall for a beach experiencing net longterm retreat.

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.
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes
- Groin
- Sand Bag
- Gabion
- Breakwater
- Revetment
- Seawall
- Jetty
The Spectrum of Coastal Erosion Control Methods

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- Groin
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- Gabion
- Breakwater / Sill
- Revetment
- Jetty
- Sea Wall
The Spectrum of Coastal Erosion Control Methods

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- Groin
- Jetty
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- Seawall
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- Groin
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- Gabion
- Breakwater / Sill
- Revetment
- Seawall
- Jetty
- Bulkhead

C E S
The Spectrum of Coastal Erosion Control Methods

How the “Spectrum” could be used:

Notice of Intent (NOI) → → → → Alternative Analysis

...start at top and move down, explaining why each one isn’t suitable.

- Do nothing
- Vegetation
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- Sand fencing
- Fiber rolls
- Coir Envelopes
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- Seawall
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### The Spectrum of Coastal Erosion Control Methods

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- Jetty
- Bulkhead

*Not a complete list (and methods are being invented/modified)*
The Spectrum of Coastal Erosion Control Methods

- Do nothing
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- Sand fencing
- Fiber rolls
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C E S
- Groin
- Sand Bags
- Gabion
- Breakwater / Sill
- Revetment
- Seawall
- Bulkhead

- Not a complete list (and methods are being invented/modified)
- With revetments...if neighbors don’t do the same then you’ll have to keep extending return.
- Very few projects only employ 1 method, and when we are determining if it’s a CES we need to use the “hardest” aspect of the project.
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
- Sand Bags
- Gabion
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- Seawall
- Jetty
- Bulkhead

Combination
The Spectrum of Coastal Erosion Control Methods

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

Combination

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

CES
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
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C E S

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- Sand Bags
- Gabion
- Breakwater / Sill
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Combination
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- Seawall
- Bulkhead
- Jetty

Combination
The Spectrum of Coastal Erosion Control Methods

Questions?

↑ Resilience ≠ ↓ Natural Systems