Low-lying Roads: Dennis

Project funded by the Economic Development Administration

Cape Cod Commission: Heather McElroy, Martha Hevenor, Michele White, Liz Kellam, Colleen Medeiros, and Tara Lewis
Woods Hole Group: Joe Famely
Purpose and Objectives of Workshop

- Review flood projections and impacts on roadways for the town under future scenarios
- Discuss vulnerable low-lying roads or other transportation infrastructure
- Prepare the town to address priority road segments for design and permitting
Agenda

▪ Project Overview
▪ Vulnerability and Risk Assessment
▪ Results of Low-Lying Roads Screening
▪ Breakout Groups
▪ Next Steps
Low Lying Roads Project

EDA and MVP funding thru 2023

Vulnerability assessment of low-lying roads and transportation infrastructure
Municipal prioritization
Potential design solutions

NEXT STEPS: PUBLIC MEETINGS

Prioritize most critical road segments for development of alternative solutions for sea level rise and storm surge adaptation

FALL - DECEMBER
6 public workshops

Yarmouth, Orleans, Eastham, Wellfleet, Sandwich, Dennis

LATE WINTER - SPRING
4 public workshops

Barnstable, Bourne, Brewster, Truro
HAZARD
Storms, SLR & Flooding
Adaptation Strategies

- Green Infrastructure, or Nature-based Solutions
- Gray Infrastructure, or Traditional Engineering Structures
- Other approaches – Managed Retreat, Abandonment
PROJECT TIMELINE

- Shoreline Projections
- Vulnerability Assessment
- Prioritize Roadway Segments
- Workshop
- Roadway analysis & alternatives
- Solutions Identification

- September
- October
- November
- Spring 2022
Questions?

- Workshop Purpose or Objectives
- Low Lying Roads project
  - Key components
    - Vulnerability Assessment - Identify Potential Sites
    - Public Outreach and Engagement
    - Roadway Feasibility and Alternative Solutions
    - Solutions Identification
  - Timeline
MA EOEEA Probabilistic Sea Level Rise Projections
MC-FRM NORTH (DeConto & Kopp, 2017)

NOTES:
Projections from Resilient MA
Labels in flags are relative sea level rise from baseline year of 2008 (1999-2017) in MC-FRM

- Observed Monthly Average
- Extreme
- High
- Intermediate-High
- Intermediate
- MC-FRM Scenarios (High)
- Intermediate Proxies for MC-FRM Scenarios

+1.3 ft by 2030
+2.5 ft by 2050
+4.3 ft by 2070
+7.7 ft by 2100
MA EOEEA Probabilistic Sea Level Rise Projections
MC-FRMSOUTH (DeConto & Kopp, 2017)

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+1.3 ft by 2030
+2.6 ft by 2050
+4.4 ft by 2070
+7.9 ft by 2100
Tropical / Extra-tropical Storms

[Map of storm tracks with color codes for different categories of storms]
Why Hydrodynamic Modeling? Why Probabilistic?
Massachusetts Coast Flood Risk Model (MC-FRM)

INPUTS

- SEA LEVEL RISE
- TROPICAL / EXTRA-TROPICAL STORMS
- LANDSCAPE
- ELEVATION
- CHANGING CLIMATE

PROBABILISTIC / HYDRODYNAMIC MODEL

Includes relevant physical processes:
- sea level rise, tides, storm surge, wind, wave setup / run-up / overtopping, future climate scenarios

Future version to incorporate coastal erosion

OUTPUTS

- FLOOD PROBABILITY
- FLOOD DEPTH
- FLOOD DURATION
- FLOOD VOLUMES
- FLOOD PATHWAYS
- WINDS
- WAVES
- CURRENTS
MC-FRM Resolution - Dennis
MC-FRM Coastal Flood Exceedance Probability – Dennis
Massachusetts Coast Flood Risk Model

SUMMARY

Hydrodynamically modeled projections
Sea level rise and storm surge – combined
Annual chance of flooding under 2030/2050/2070 climate conditions

QUESTIONS?
Cape Cod Low Lying Roads Vulnerability Assessment Methods

[Diagram showing coastal flood exceedance probability with elevation at present]

Legend:
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Present
Cape Cod Low Lying Roads Vulnerability Assessment Methods

Coastal flood exceedance probability for 2030.
Cape Cod Low Lying Roads Vulnerability Assessment Methods

2050

[Diagram showing coastal flood exceedance probability with various elevation and probability markers.]
Cape Cod Low Lying Roads Risk Assessment Approach

1. Extract roadway/bridge critical elevations (CEs)
   - From LiDAR at 20m interval along surface

2. Compile 2030/2050/2070 MC-FRM water surface elevations (WSEs)
   - 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20%, 100%

3. Compare CEs to WSEs to determine vulnerability
   - Highest probability WSE exceeding CE

4. Score road segment criticality
   - Usage/Network Function
   - Economy
   - Vulnerable Populations
   - Community and Emergency Services

5. Probability * Criticality = Risk

6. Prioritize high-risk road segments for community consideration
Low Lying Roads Nuisance (MHW) Flooding (Dennis)

Nuisance Flooding

Year
Inundated
- 2070
- 2050
- 2030

Road Miles 2030
0.7/278.4

Road Miles 2050
5.7/278.4

Road Miles 2070
14.3/278.4
Low Lying Roads 2030 Inundation Probability (Dennis)

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Low Lying Roads 2050 Inundation Probability (Dennis)

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Low Lying Roads 2070 Inundation Probability (Dennis)

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Low Lying Roads Criticality Scoring (Dennis)
Low Lying Roads 2030 Risk Results (Dennis)

High Risk Road Segments:
- Route 28 (Weir Creek)*
- Indian Trail
- Lower County Rd (Weir Creek)
- Lighthouse Rd
- Uncle Stephens Rd
- Trotting Park Rd
- Route 6A (Quivett Creek)*
Low Lying Roads 2050 Risk Results (Dennis)

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- Old Wharf Rd
- Upper County Rd
- Lower County Rd (Swan Pond River)
- Route 28 (Swan Pond River)*
- Route 28 (West of Center St)*
- Cold Storage Rd and Salt Works Rd
- Bridge St
- New Boston Rd
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- New Boston Rd
- Doctor Bottero Rd
- Shad Hole / Lower County Rd
- Route 28 (Bass River)*
<table>
<thead>
<tr>
<th>Name</th>
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<th>Description</th>
<th>Segment Storm Probability (%)</th>
<th>Nuisance Length (ft)</th>
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<tbody>
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<td>A</td>
<td>*Route 28 (Weir Creek)</td>
<td>1220</td>
<td>Main St at Weir Creek &amp; Old Main St</td>
<td>0.5-100 10-100 20-100 280</td>
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<tr>
<td>B</td>
<td>Indian Trail</td>
<td>1500</td>
<td>Residential area off Upper County Rd</td>
<td>100 100 100 1400 1500</td>
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<td>C</td>
<td>Lower County Rd (Weir Creek)</td>
<td>1240</td>
<td>Near Uncle Stephens Pond and Weir Creek</td>
<td>10-100 20-100 100 260 940</td>
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<td>1460</td>
<td>At Uncle Stephens Pond</td>
<td>2-100 20-100 100 200 780 1420</td>
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<tr>
<td>E</td>
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<td>920</td>
<td>Some segments may be private</td>
<td>20-100 20-100 100 360 820</td>
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<td>G</td>
<td>*Route 6A (Quivett Creek)</td>
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<td>Old Wharf Rd</td>
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<td>Adjacent to Nantucket Sound shoreline</td>
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<td>Upper County Rd</td>
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<td>L</td>
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<td>780</td>
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<td>M</td>
<td>Cold Storage Rd and Salt Works Rd</td>
<td>2680</td>
<td>East side of Sesuit Harbor</td>
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<td>Doctor Bottero Rd</td>
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<td>Access to Chapin Memorial Beach</td>
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<td>Shad Hole and Lower County Rd</td>
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<td>920</td>
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<td>0-20 2-100 20-100 420</td>
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* = MassDOT roadway
**Group Discussion**

**DISCUSSION QUESTIONS**

1. Are there roads that we missed?

2. How would you prioritize these roads – what local knowledge or concerns can you bring to the discussion?

3. What are the high-priority road segments?
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NEXT STEPS

- Town staff to select 2 road segments
- Feasibility analysis
- 3 solutions + costs per segment
- Solutions available to view on Low Lying Road webpage late spring 2022: https://www.capecodcommission.org/our-work/low-lying-roads-project/
THANK YOU!