Decision Making in the Face of Uncertainty

Key Questions:

Will we be impacted by the storm, and if so when? For how long?

How much coastal flooding and where?

What about wind and inland flooding from rain?

Who do we need to evacuate?

When does the evacuation need to start and how long will it take?

HES and NHC/NWS products assist/support you with evacuation decision making.
Hurricane Evacuation Studies (HES)

Critical Information for Planning and Response...
Hazards Analysis

Understanding Storm Surge Potential

• Storm surge has the highest potential for death and damage
• Storm surge is the main reason we evacuate the coast
• Worst Case Scenario Surge Maps used to assess risk in your community
Evacuation Zones

“Know Your Zone”

- Communicate risk to the public
- Communicate evacuation orders by zone
- Must use evacuation zones from HES or clearance times will not be valid!
Vulnerability Analysis

Who may need to evacuate and What is at risk

- Citizens residing in surge prone areas
- Critical facilities
- Mobile/Manufactured home communities
- Vulnerable shelters
- Colleges/Universities

Table 3-13: Critical Facilities – Community Health Centers

<table>
<thead>
<tr>
<th>Town</th>
<th>Zone</th>
<th>Facility</th>
<th>Address</th>
<th>Zip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnstable</td>
<td>Inland</td>
<td>O'neill/Duffy Health Center Noah Shelter</td>
<td>77 Winter St</td>
<td>02601</td>
</tr>
<tr>
<td></td>
<td>Inland</td>
<td>Duffy Health Center</td>
<td>105 Park St</td>
<td>02601</td>
</tr>
<tr>
<td></td>
<td>Inland</td>
<td>Mid-Upper Cape Community Health Center</td>
<td>30 Elm Ave</td>
<td>02601</td>
</tr>
<tr>
<td>Falmouth</td>
<td>A</td>
<td>Cape Cod Free Clinic &amp; Community Health Center</td>
<td>65C Town Hall Sq</td>
<td>02540</td>
</tr>
<tr>
<td>Harwich</td>
<td>Inland</td>
<td>Ellen Jones Community Dental Center</td>
<td>351 Pleasant Lake Ave</td>
<td>02645</td>
</tr>
<tr>
<td>Mashpee</td>
<td>Inland</td>
<td>Cape Cod Free Clinic &amp; Community Health Center</td>
<td>40 Steeple St</td>
<td>02649</td>
</tr>
<tr>
<td>Orleans</td>
<td>A</td>
<td>Outer Cape Health Services, Inc.</td>
<td>260 Cranberry Hwy</td>
<td>02653</td>
</tr>
<tr>
<td></td>
<td>Inland</td>
<td>WIC Nutrition Program</td>
<td>159 Route 6A</td>
<td>02653</td>
</tr>
<tr>
<td>Provincetown</td>
<td>B</td>
<td>Provincetown Health Center</td>
<td>49 Harry Kemp Way</td>
<td>02657</td>
</tr>
<tr>
<td>Wellfleet</td>
<td>Inland</td>
<td>Wellfleet Health Center</td>
<td>3130 State Hwy</td>
<td>02667</td>
</tr>
<tr>
<td>Bristol County</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall River</td>
<td>Inland</td>
<td>HealthFirst Family Care Center, Inc.</td>
<td>102 County St</td>
<td>02723</td>
</tr>
<tr>
<td></td>
<td>Inland</td>
<td>SSTAR Family Healthcare Center</td>
<td>386 Stanley St</td>
<td>02720</td>
</tr>
<tr>
<td></td>
<td>Inland</td>
<td>St. Vincent’s School</td>
<td>2425 Highland Ave</td>
<td>02720</td>
</tr>
<tr>
<td>New Bedford</td>
<td>Inland</td>
<td>Greater New Bedford Community Health Center</td>
<td>874 Purchase St</td>
<td>02740</td>
</tr>
</tbody>
</table>
Hurricane Behavioral Analysis

- Attitudes about risk from hurricane hazards – Primarily storm surge
- Evacuation intentions and past experiences
- Evacuation destinations
- Evacuation routes
- Sources of forecast information

Table 4-2: Perceived Vulnerability of Home – Believe Home would Flood Dangerously

<table>
<thead>
<tr>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A / 1-2</td>
<td>B / 3-4</td>
<td>Non-Surge</td>
</tr>
<tr>
<td>28%</td>
<td>18%</td>
<td>15%</td>
</tr>
</tbody>
</table>
Shelter Analysis
Understanding Shelter Need

Key Sheltering Information:

- Location/Identification
- Potential Shelter Demand
- Flood Risk
- Capacity
- ARC vs. Local Shelter
- Pet Friendly

Table 5-8: Public Sheltering Demand and Sheltering Capacity – Plymouth County

<table>
<thead>
<tr>
<th>Community</th>
<th>Scenario A Low Occ</th>
<th>Scenario A High Occ</th>
<th>Scenario B Low Occ</th>
<th>Scenario B High Occ</th>
<th>Shelter Capacities*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duxbury</td>
<td>203</td>
<td>216</td>
<td>331</td>
<td>347</td>
<td>0</td>
</tr>
<tr>
<td>Hingham</td>
<td>334</td>
<td>339</td>
<td>542</td>
<td>549</td>
<td>230</td>
</tr>
<tr>
<td>Hull</td>
<td>531</td>
<td>561</td>
<td>531</td>
<td>561</td>
<td>0</td>
</tr>
<tr>
<td>Kingston</td>
<td>178</td>
<td>183</td>
<td>304</td>
<td>311</td>
<td>2,910</td>
</tr>
<tr>
<td>Marion</td>
<td>215</td>
<td>231</td>
<td>233</td>
<td>249</td>
<td>0</td>
</tr>
<tr>
<td>Marshfield</td>
<td>799</td>
<td>839</td>
<td>915</td>
<td>956</td>
<td>0</td>
</tr>
<tr>
<td>Mattapoisett</td>
<td>169</td>
<td>193</td>
<td>214</td>
<td>239</td>
<td>0</td>
</tr>
<tr>
<td>Plymouth</td>
<td>531</td>
<td>629</td>
<td>1,178</td>
<td>1,341</td>
<td>2,918</td>
</tr>
<tr>
<td>Rochester</td>
<td>8</td>
<td>10</td>
<td>56</td>
<td>59</td>
<td>0</td>
</tr>
<tr>
<td>Scituate</td>
<td>393</td>
<td>424</td>
<td>518</td>
<td>553</td>
<td>0</td>
</tr>
<tr>
<td>Wareham</td>
<td>974</td>
<td>1060</td>
<td>1,070</td>
<td>1,163</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td>4,335</td>
<td>4685</td>
<td>5,892</td>
<td>6,328</td>
<td>6,058</td>
</tr>
</tbody>
</table>

* Based on American Red Cross National Shelter Survey (NSS) database shelter capacities.
Transportation Analysis
Understand traffic congestion potential based upon evacuation decisions

- Traffic Patterns (bottle necks)
- Evacuating Vehicles

Clearance Time tables
Variables of:
- Response
- Population
- Evacuation Scenarios (one way, Multi state)
- Storm Category
Clearance Time = 48hrs

Evacuation Clearance Times

Timeline

Evacuation Start Time

Forecasted Onset of TS winds or surge

Clearance Time = 48hrs

Begins when the first evacuating vehicle enters the road network, ends when the last vehicle reaches an assumed point of safety.
Evacuation Decision Calculation

NHC Forecast Advisories

Arrival Time of TS Winds

HES Data: Pre-determined Evacuation Zones

Clearance Time

Evacuation Start Time
The Hurricane Evacuation Study:

Informs your plans with data from the 5 analysis

Supports your response operations by providing:

- Information on which populations and facilities to evacuate
- Information on shelter risk capacity and demand
- **Timing guidance in HURREVAC**
- Clearance Times for specific storm scenarios
- Information on critical traffic bottlenecks and suggested traffic control points
Hurricane Scenario

Advisory 40
Issued at 11AM
Saturday August 31st
Cat 3
Moving 13mph
Center located off the coast of GA/SC
Assume a 24 hour CT
Lower/Outer Cape community

Mobilize response assets? Call for an evacuation? **When** do you take action?
This was Hurricane Edouard 1996

In this scenario, given a 24 hour Clearance Time, evacuations would have to begin early Sunday AM in order to be complete before the onset of TS force winds.

This would leave 24 hours from the issuance of this advisory to make an evacuation decision, notify the public, and mobilize response assets.
Key forecast products, clearance times and local planning factors guide Evacuation Decision Making and other Response Actions.

Product Timelines
When is key information available?

National Weather Service
Tropical Cyclone Products

> 5 Days
- 5 Day Forecast
- Public Advisory
- Wind Speed Forecast
- Large Forecast

3-5 Days
- TS/Hurricane Watches
- TS/Hurricane Local Statements
- TS/Hurricane Operational Storm Surge Products

2-3 Days
- TS/Hurricane Warnings
- TS/Hurricane Local Statements
- Operational Storm Surge Products

1-2 Days
- TS/Hurricane Warnings
- TS/Hurricane Local Statements
- Operational Storm Surge Products

Cape Cod Emergency Traffic Plan Implementation and Stages...
Cape Cod Emergency Traffic Plan (CCETP)

Multi-Jurisdictional Evacuation Procedure

Developed Following Hurricane Edouard

Primary Tasks
- Evacuation on Route 6 and 28
- Shelter-of-Last Resort at JBCC
CCETP Update - Purpose and Scope

Validate and update all traffic and traffic management related components of the Commonwealth of Massachusetts Cape Cod Emergency Traffic Plan (CCETP).”

Incorporate New Emergency Traffic Projections
- Cape Cod Traffic Study (Pilgrim Nuclear) – Evacuation Time Estimates
- Hurricane Evacuation Study (FEMA and US Army Corp) – Evacuation Clearance Estimates

Project Management Team
- State Agencies, US Army Corp, National Guard, and Local Jurisdictions
Emergency Traffic Management

There is no trick of engineering or traffic management that will ease traffic on the Cape during an emergency response.

The solution lays with:
- Understanding the scope of the response
- Executing your plan as smoothly as possible
- Giving yourselves as much of a lead as possible
  - Coordination
  - Communication
  - Staffing up
  - Pre-staging

Understanding the timeline you are working within
Cape Cod Emergency Traffic Plan

Informed and Efficient Emergency Traffic Management should also include:

- Time Management
- Communication – Internal/Public
- Resource Staging and Logistics
- Coordination/Response Integration
- Situational Awareness
- Flexibility and Scalability
Using the Hurricane Evacuation Study

<table>
<thead>
<tr>
<th></th>
<th>Scenario A – Cat 1-2</th>
<th>Scenario B – Cat 3-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Season</td>
<td>22.1</td>
<td>31.7</td>
</tr>
<tr>
<td>Off-Peak Season</td>
<td>12.2</td>
<td>18.1</td>
</tr>
</tbody>
</table>

(Assumes “Medium” Response)

What the Numbers Tell Us:
• Provides an estimated time that it will take for every resident and visitor that is likely (and able) to self evacuate the Cape to do so, following a public advisory.

What the Numbers DON’T Tell Us:
• Preparation time to support self evacuation
• Impact of roadway “failure”
• Impacts of time of day* and weather conditions
• Imperfect notification

* Partially taken into account by estimates
Cape Cod Emergency Traffic Plan – DRAFT Activation Timeline

**Pre-Planning (24 Hour)**
- Weather and Situational Assessment
- Resource and Personnel Identification
- Personnel Activation

Source: Hurricane Checklist, MSP Personnel Activation, Past Events

**Staging and Deploying (12)**
- Put personnel and equipment in place to control and manage emergency traffic

Source: Hurricane Checklist, MSP, MassDOT, Past Event

**Public Call – Affected Areas (12)**
- Phased Public Advisory
  - “Areas of highest impact”
  - “Regional advisory”

Source: HES, Traffic Management, Past Events

**Public Call – All Others (X)**

**Buffer/End Evacuation**

**Buffer Period**
- buffer for unexpected complications
- Avoid bridge closure reroute problems
- Avoid inclement weather travel
- Allow for reallocation of resources

Source: HES, Past Events
Expected Self Evacuation Curve

Traffic Volume

Roadway Failure

Call for Evacuation

Time

Here There Be Monsters

Late Night
Traffic Volume

Roadway Failure

Time

Call for Evacuation

Hazard

Shift Curve Backward and Smooth

- Targeted Notification
- Phased Notification
- Avoid Bridge Closure Reroute Problems
- Avoid Inclement Weather Travel
- Leaves Buffer for Unexpected Complications
- Allow for Reallocation of Resources

Buffer

Traffic Volume

Roadway Failure

Buffer for Evacuation

Time

Hazard
Scenario B/Peak Season – Category 3-4
68 Hours - Activation
32 Hours - Public
20 Hours

Scenario B/Off-Peak – Category 3-4
54 Hours
18 Hours
6

Scenario A/Peak – Category 1-2
58 Hours
22 Hours
10

Scenario A/Off-Peak – Category 1-2
48 Hours
12 Hours
Positioning for Success Beyond the Estimates

Develop Realistic Lead Time Estimates for Assessing, Staging, and Deploying Resources
- Personnel
- Equipment
- Signage

Develop Effective and Targeted Communication
- Permanent Residents
- Vacationers
- Motorists

Training and Coordination Among Response Partners

Success
Review of Traffic Control Points

Full Review of State Police Traffic Control Points

- Resource Requirements and Lead Time
- Identify and Prioritize Choke Points
- Increase Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Per 12 Hour Shift</th>
<th>Backstop</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Police</td>
<td>~40 vehicles</td>
<td></td>
</tr>
<tr>
<td>Bourne</td>
<td>14 vehicles</td>
<td>MSP</td>
</tr>
<tr>
<td>Sandwich</td>
<td>15 vehicles</td>
<td>MSP</td>
</tr>
</tbody>
</table>
Traffic Control Point Flexibility

- Include Current TCPs
- Change Language To “May Activate”
- Prioritize TCPs
  - Roadway Closers/Redirects
  - Choke Points (Prior to Bridges)

- Develop Standardized MSP TCP Post Order Form
  - Identify Active TCPS, Responsibilities, Communication
  - Provide Consistent Information for All Partners
    - Which TCPs are Active
    - How are They Directing Traffic
Public Notification

- Reaching Permanent Residents
- Reaching Non-Resident
  - CC Chamber of Commerce
  - State and National Parks/Beaches

Communication with Motorists
- Traffic Control Points
- Fixed Message Signs
- Variable Messaging Signs
- Mobile Public Address
CCETP Project Next Steps

- Education and Coordination of Stakeholders
- Access to Resources and Personnel
- Training and Exercises
- Annual Review and Updates
Questions?

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