The use of GIS in advancing resilient municipal planning

NEARC Conference - Newport, RI - November 07, 2017
The use of GIS in advancing resilient municipal planning

1. Trends - it’s getting wetter: Recent storm & Cloudburst events
2. How can municipalities adapt better to these events?
3. Resilient municipal strategies
4. Assessing Risks and Vulnerabilities with GIS
5. Smart solutions for a more resilient community
More intense storms and stronger hurricanes are on the rise.

Source: Joanna Mojica
Source: Business Insider
Source: USA Today

Hurricane Harvey in Houston
August 30, 2017

Source: New Yorker

Source: USA Today
Heavy rainstorm events are on the rise in the Northeast.

Impacts from heavy downpours:
- Framingham (above): Sept. 2015
- Somerville (below): Sept. 2017

Source: Alastair McLean

Source: Joanna Mojica

Powderhouse Blvd., Somerville, 09/14/17
The Northeast is seeing a trend in heavier rainstorm events.

Comparison of Precipitation changes for two timeframes:
- 1900 - 1960 and
- 1960 - 1991

Source: Peterson, 2013.
How can municipalities better adapt to these events?

Source: Houston Chronicle
Learn how to swim?

Figure: Cat that tries to stay dry after being captured in an inundated apartment complex. Source: The Atlantic.
Make waterproof foot wear mandatory?

Source: Dutch-clogs.com
Upgrade to bigger storm water pipes everywhere?

Source: Kanapipeline

One size fits all?
Identify the underlying issues

Pictures: Copenhagen, DK
Resilient municipal strategies to reduce risks and vulnerability

1. Identify and Assess the risk
2. Assess the vulnerability
   i. Conduct exposure analysis
3. Identify resilient solutions
4. Develop a strategy for your community
Resilient municipal strategies to reduce risks and vulnerability - The example of Fairhaven, MA -

Fairhaven - View from Causeway Connector
GIS-based Risk Assessment for the Town of Fairhaven

Fairhaven - Hazard profiles*

- Coastal Erosion and Sea Level Rise
- Coastal Storm (incl. hurricanes, tropical storms etc.)
- Flood
- Drought
- Earthquake
- Extreme Temperatures
- Fire
- Severe Weather
- Severe Winter Storms

*not ranked

Pictures: West Island, Fairhaven, MA
The use of GIS in advancing resilient municipal planning - GIS based Risk Assessment in Fairhaven
Isabel Kaubisch, Clarendon Hill Consulting LLC - NEARC Presentation 11/07/17
The use of GIS in advancing resilient municipal planning - GIS based Risk & Vulnerability Assessment in Fairhaven
Isabel Kaubisch, Clarendon Hill Consulting LLC - NEARC Presentation 11/07/17
Resilient municipal strategies: GIS-based Vulnerability Assessment for the Town of Fairhaven

- Exposure analysis identified the **number** and **value** of all properties including their **building** and **property values** located in identified hazard zones.
  - Exposure = **parcels with building footprints** that intersect with **mapped hazard zone**

- Data was obtained per land use category (Fairhaven’s assessor parcel data)

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### Land Use Categories

<table>
<thead>
<tr>
<th>Fairhaven land use categories</th>
<th>Land use codes used in vulnerability analysis</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (Single Family)</td>
<td>101, 106</td>
<td>Residential single family lots</td>
</tr>
<tr>
<td>Residential (Multi Family)</td>
<td>013, 102, 103, 104, 105, 109, 111, 112, 111, 112, 959</td>
<td>Multi-Family units, apartments, condos etc.</td>
</tr>
<tr>
<td>Commercial</td>
<td>031, 037, 0137, 140, 325, 325, 325, 325, 325, 325, 330, 331, 332, 335, 337, 340, 342</td>
<td>Retail stores and shops, offices, restaurants, automotive centers, commercial parking lots etc.</td>
</tr>
<tr>
<td>Industrial</td>
<td>034, 041, 313, 315, 316, 318, 334, 400, 401, 402, 403, 423</td>
<td>Oil and gas storage, gas stations, lumberyards, and other storage and warehouse facilities</td>
</tr>
<tr>
<td>Public Services</td>
<td>091, 350, 351, 354, 900, 910, 931, 934, 935, 951, 953, 954, 955, 957, 960, 961, 962, 970, 972, 980</td>
<td>Banks, hospitals &amp; medical offices, childcare services, schools, fire stations, buses, marinas, funeral services, electrical substations and other utility towers, town offices, post offices, churches, courthouses, libraries, etc.</td>
</tr>
<tr>
<td>Temporary Lodging</td>
<td>300, 301, 304</td>
<td>Hotels, inns, resorts, nursing homes</td>
</tr>
<tr>
<td>Agriculture</td>
<td>016, 017, 076, 601, 713, 716, 717, 718</td>
<td>Agricultural land, orchards, forested land, cranberry bogs, etc.</td>
</tr>
<tr>
<td>Open Space</td>
<td>910, 950</td>
<td>Residential open space, non-productive agricultural land, beaches, conservation land etc.</td>
</tr>
<tr>
<td>Vacant</td>
<td>130, 131, 132, 390, 391, 392, 395, 920, 921, 926</td>
<td>Vacant developable, potentially developable, and undevelopable land</td>
</tr>
<tr>
<td>Recreation</td>
<td>384, 958</td>
<td>Golf courses, bowling, tennis, golf, ice skating, campground, boat ramps, bike paths, function halls, community centers, clubs etc.</td>
</tr>
</tbody>
</table>

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Figure: Land use categories
Resilient municipal strategies: GIS-based Risk Assessment for the Town of Fairhaven

Summary: Building Exposure to Hurricane Storm Surges

<table>
<thead>
<tr>
<th>Storm Category</th>
<th>Number of Parcels with Buildings</th>
<th>Value of Buildings</th>
<th>Value of Total Property</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total in Hazard Area</td>
<td>% in Hazard Area</td>
<td>Total in Hazard Area</td>
</tr>
<tr>
<td>Category 1</td>
<td>782</td>
<td>5.7</td>
<td>$69,025,800</td>
</tr>
<tr>
<td>Category 2</td>
<td>808</td>
<td>5.9</td>
<td>$92,011,900</td>
</tr>
<tr>
<td>Category 3</td>
<td>678</td>
<td>5</td>
<td>$80,724,200</td>
</tr>
<tr>
<td>Category 4</td>
<td>3388</td>
<td>24.9</td>
<td>$457,042,300</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5656</strong></td>
<td><strong>41.50%</strong></td>
<td><strong>$698,804,200</strong></td>
</tr>
</tbody>
</table>
Resilient municipal strategies:
GIS-based Risk Assessment for the Town of Fairhaven
Resilient Municipal Solutions and Strategies

Examples of Fairhaven’s Solutions and Strategies (Under development):

1) **Continue and expand open space:**
   a) Preserve natural protective features incl. barrier beaches, wetlands, salt marshes
   b) Preservation land and
   c) open space and recreational areas

2) **Reduce Flood risk through**
   a) drainage improvements and
   b) floodplain zoning requirements

3) **Continue Emergency Preparedness Planning Efforts**
The use of GIS in advancing resilient municipal planning - Scalable Resilient Municipal Solutions and Strategies
Isabel Kaubisch, Clarendon Hill Consulting LLC - NEARC Presentation 11/07/17

Scalable Resilient Municipal Solutions

Figure: New Rainwater Catchment Basins
(Source: Tredje Natur)

Copenhagen, DK - Osterbro Cloudburst Area

Ostergro rooftop farm is run by the local community group.
Smart solutions

The use of GIS in advancing resilient municipal planning - Smart Solutions for balancing the water cycle.

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Resilient municipal strategies: Resilient Programs

Climate Vulnerability Preparedness Program launched by EEA in MA this year:

- Over 70 MA municipalities have been awarded with funding to conduct municipal vulnerability preparedness (MVP) projects
- Goal: complete vulnerability assessments and develop action-oriented resiliency plans
- First round of projects is starting now
Thank you for your attention.

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