GIS Method for Characterizing Fire Flow Capacity

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What we will talk about today:

- GIS and Urban Fires
- Research Design for this Project
- Methods
- Results and Discussion
- Conclusions and Future Research
GIS and Urban Fires

Past studies have:

Investigated linkages between socioeconomic characteristics with fire risk and specific types of incidents

Assessed fire station location and response

Combined with spatial statistics as analytic tools to investigate fire incidence

Current research need:

There is a lack of studies about fire hydrant location and the implications for providing adequate fire flow.

Combine the temporal characteristics of fire incidence with the existing spatial patterns of hydrants to ascertain whether adequate fire flow is available.

Thus, an *a priori* risk assessment can be made by fire departments to identify locations within their coverage area that may lack adequate fire flow.

This research is designed to provide fire personnel the ability to make a risk assessment about fire flow capacity at specific locations.
Research Design for this Project

Hypothesis

Fire-fighting capacity is not sufficient in all cases, especially when structural fires occur and hazardous materials are involved

Experimental Groups

Two communities with different characteristics; designed to capture the significant variability of land uses within the region

Data Collection

Material Safety Data Sheets
Fire hydrant locations and flow rates
3-year fire history
Land Parcels
Methods

- Plot the locations of all fire hydrants; add flow data for each hydrant

- Plot the locations of all fires occurring in the last 3 years; include the International Fire Codes for each fire; these codes indicate if hazardous materials were involved

- Use GIS to perform spatial overlay of the 3-year fire history, and the fire hydrants

- Develop GIS model to compute fire flow capacity within specified radii

- Compute the fire-flow capabilities in zones where fires are clustered

- Compare the existing fire-flow capacities to the required standards
### Fire-flow Capacity Assessment

**TABLE C105.1 NUMBER AND DISTRIBUTION OF FIRE HYDRANTS**

<table>
<thead>
<tr>
<th>FIRE-FLOW REQUIREMENT (gpm)</th>
<th>MINIMUM NUMBER OF HYDRANTS</th>
<th>AVERAGE SPACING BETWEEN HYDRANTS(^{a, b, c}) (feet)</th>
<th>MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,750 or less</td>
<td>1</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>2,000-2,250</td>
<td>2</td>
<td>450</td>
<td>225</td>
</tr>
<tr>
<td>2,500</td>
<td>3</td>
<td>450</td>
<td>225</td>
</tr>
<tr>
<td>3,000</td>
<td>3</td>
<td>400</td>
<td>225</td>
</tr>
<tr>
<td>3,500-4,000</td>
<td>4</td>
<td>350</td>
<td>210</td>
</tr>
<tr>
<td>4,500-5,000</td>
<td>5</td>
<td>300</td>
<td>180</td>
</tr>
<tr>
<td>5,500</td>
<td>6</td>
<td>300</td>
<td>180</td>
</tr>
<tr>
<td>6,000</td>
<td>6</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>6,500-7,000</td>
<td>7</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>7,500 or more</td>
<td>8 or more(^e)</td>
<td>200</td>
<td>120</td>
</tr>
</tbody>
</table>

Model to determine fire flow capacity
Results and Discussion

- Several locations were identified with potential fire flow deficiencies

- The model also demonstrates the capacity to identify areas with potential fire flow surpluses
Flint Township: potential areas of fire flow deficiency

Potential Fire-Flow Capacity
- Red: Potential Deficient Fire-Flow
- Green Star: Sufficient Fire-Flow
- Yellow Square: Potential Excessive Fire-Flow

Vacant Properties

Legend:
- Hydrants

A

B

Scale: 0 m, 500 m, 1,000 m

N

Grand Blanc: potential areas of excess hydrant capacity
Future Research

- Watershed-wide investigation
- Development of specific risk reduction strategies (examples on the next 2 slides)
Questions?