**Locate a New Fire Station in Revere, Massachusetts**

Revere is a city in Massachusetts, located approximately five miles from downtown Boston, with 50,945 population in 2010. Currently, there are five fire stations in Revere — four in the east, one in the middle. Mr. Arrigo, the mayor of Revere, recently received some complains from the residence that they worried about they cannot receive timely fire response. He assembled members of the City Council to discuss the plan of construction a new fire station in order to reduce fire response travel time. They had two main concerns — construction cost and protection coverage. The mayor asked me to find the optimal fire station in Revere by minimizing costs and maximize protection coverage.

### Background

The table below shows the criteria I used to select the suitable sites.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Criteria</th>
<th>Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimize purchase cost</td>
<td>City-owned or total value less than $20,000</td>
<td>Parcels [L3]</td>
</tr>
<tr>
<td>Minimize demolition cost</td>
<td>Vacant</td>
<td>Parcels [L3]</td>
</tr>
<tr>
<td>Provide enough room for buildings and parking</td>
<td>500 square meter or larger</td>
<td>Parcels [L2]</td>
</tr>
<tr>
<td>Avoid steep sites requiring exceeding grading</td>
<td>Average slope less than 10%</td>
<td>Slope [L6]</td>
</tr>
<tr>
<td>Avoid sites near existing fire stations</td>
<td>More than 1000 meter from an existing fire station</td>
<td>Fire Stations [L2]</td>
</tr>
</tbody>
</table>

**Suitable Sites**

Two steps are needed to find the optimal location. First, find the suitable sites by minimize the cost of construction. Second, find the optimal location among these potential suitable sites by maximizing the protection coverage.

Suitable sites were selected according to their parcel attributes. Risk of fire damage to property and humans is proportional to the amount of time it takes the fire truck to get from the fire station to the fire. According to the travel time to fire station, the city could be divided into “Quick”, “Low Average”, “Higher Average” and “Waiting” area. Less than 90% of travel time were defined as “Quick” area. 1.5 to 3, 3 to 5 and more than 5 minutes were defined as “Low Average”, “Higher Average” and “Waiting” area respectively. Zonal statistic tools were used to calculate the population in each area. The optimal sites should cover more population in “Quick” and “Low Average” area. What’s more, the existing fire stations in other city will also provide service to Revere, the fire stations within 5000 meters with Revere boundary were also taken into consideration when calculate travel time.

### Methodology

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### Results & Conclusion

**Fire Trucks travel time were showed in the above map. Population could covered by exist and proposed fire station were showed in the bar chart below. Proposed Site 4 is the optimal sites for locate a new fire station. It could covered 21857 population in “Quick” area, around 10% of total population increased compared to the status quo. And only left 3025 population in “High Average” area, around 1/3 of population coverage in the status quo. The fire trucks travel time involved proposed fire station were showed below.**

### Limitations

I used speed-limit provided by ESRI Street [1] to calculate travel time. And in the area without road, I assumed the walking speed is 10km/h. Considering the fire-trucks are very big and heavy, they could not drive very fast, especially in corners and typically stop at major intersections. Thus, I assumed they could only reach 80% if the speed-limit. However, the load situation is unpredictable, travel time may varied depends on the real-time road situation.

### Reference

[1] Which-parcels are suitable sites for a fire station? ArcGIS Desktop, Online Link

**Cartographer:** Mengyuan Ruan  |  **May, 2018**

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**Projection:** Massachusetts State Plane

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