

Examining Somerville's Transport Infrastructure

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Introduction

Accessibility to transportation has long been considered to have an effect on quality of life indicators such as income, education and health levels. (Syed, Gerber and Sharp 2014)

Today around the world, there are still many communities without access to all weather roads, thus limiting their residents' ability to integrate more into the wider world. In urban areas this often translates into residents of neighborhoods with underrepresented populations not having equitable access to the city's public transit system, thus making it difficult for them to have access to employment and schooling.

Somerville is a city in the Greater Boston Area (GBA) with a population of around 81,000. Due to its location, it has long been a popular residential area for students attending MIT, Tufts, and Harvard among other educational institutions. This popularity has driven up real estate values and populations thus prompting the city government to come up with a masterplan titled 'Somervision' to tackle existing and anticipated changes. (Acitelli, SomerVision Sees 6,000 New Homes, Lots of Green Line Riders 2012)

The core concerns outlined in the SomerVision masterplan document are: (Mayor's Office 2012)

1. Increased Employment
2. Increase in accessible public space
3. New Affordable Housing
4. Higher and penetrative NMT and Public Transport Options
5. Higher growth in newer areas, and preserving traditional areas

Current State of Public Transportation in Somerville

Being a constituent city of the Greater Boston Area, public transport within and beyond Somerville is served by the MBTA – The Massachusetts Bay Transportation Authority. For a North American city, Greater Boston has a superior public transit network. However, there is still some scope for improvement – especially for last mile connectivity. ^(Dungca 2016)

Extension of the Green Line of the MBTA's light rail system through Somerville towards Medford had been a long-standing demand for greater connectivity into the MBTA light and heavy rail network. Although Somerville has good bus connectivity along its main corridors, it had limited access to the metro rail network (or the 'T' as it is known in the GBA). There is also limited bus connectivity perpendicular to these main corridors – thus limiting the accessibility to the transport network of those residents with limited or impaired mobility.

The announcement of the ground breaking for the extension of the Green Line was subsequently announced on 25th June 2018. ^(Eppolito 2018)

Impact of Existing Transportation for Somerville Residents

The extended Somerville section of the Green line will not be usable till December 2021 – more than 3 years away (at time of writing this report – November 2018). It remains imperative to examine the impact of the current state of transportation on the residents of Somerville. As mentioned earlier, although the bus network is extensive, last mile connectivity still remains a challenge.

Research Question

How does the catchment size of a bus stop, and the distance people have to walk to reach it affect the usability and accessibility of that bus stop, and by extension that of the entire MBTA?

How long residents have to walk to reach a bus stop of their convenience, or even the closest one to their residence, can greatly impact travel time. One may even consider travel time to or from work as a quality of life measure. A more comprehensive measurement of travel as compared to just 'travel time' could be 'travel effort'. Variables used to measure this could include distance to/from bus stations, number of transfers required, weather conditions, gradients of routes, lighting conditions, footpath availability and conditions, etc. This by no means is an exhaustive list, and one may add to it according to local conditions as well.

From the point of view of public transportation, *travel effort* could be quantified at the bus stop level. For the extent of this research we may focus on the distances to/from the bus station as a measurable variable. In order to develop a metric to measure this *travel effort* we need to consider components people consider when choosing public transport:

- a. Distance to/from home or work
- b. Fewest transfers to reach destination
- c. Number of lines at a bus stop
- d. Distance covered by these lines
- e. Stops covered by these lines

Methodology

It was important to search for datasets that could look at answering these questions. Important among these were those that could provide information on:

- a. Addresses in Somerville
- b. Locations of bus stops
- c. MBTA bus lines
- d. Boundaries Map of Somerville

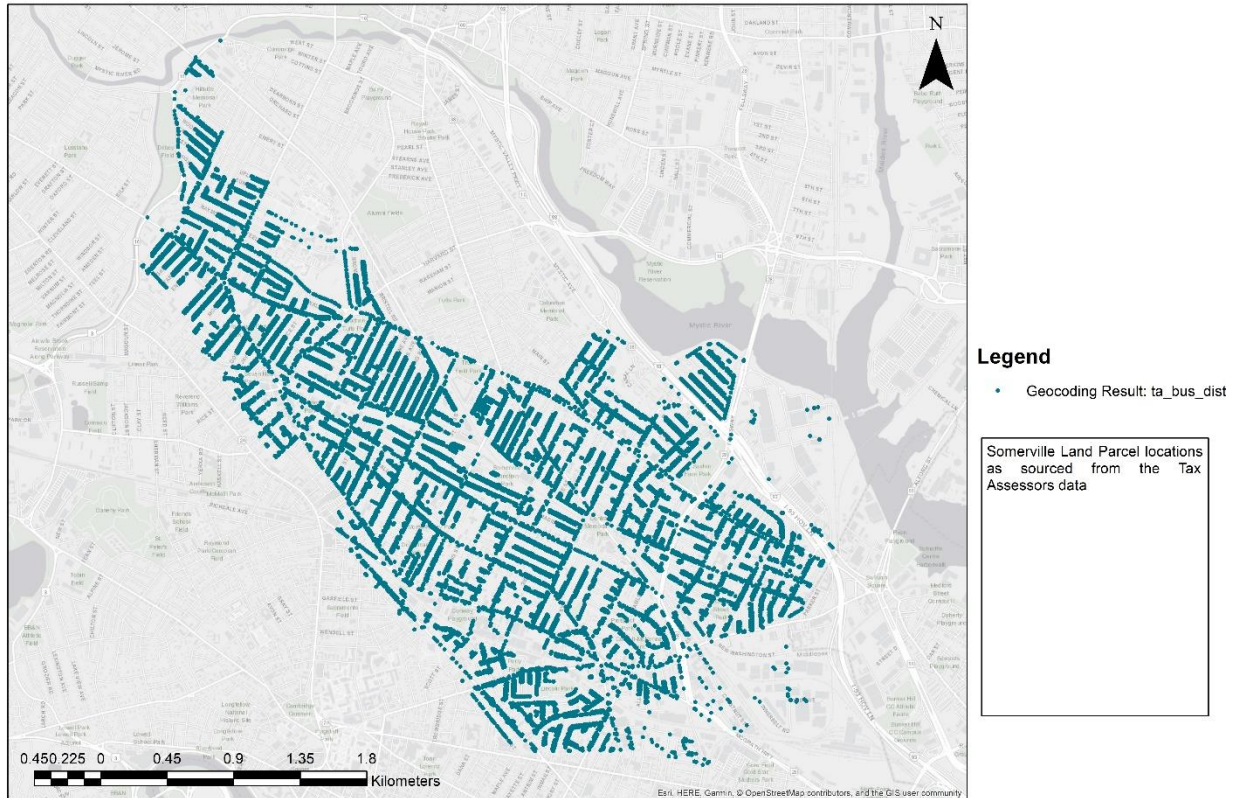
Available Data Sources (Maps attached below)

- **Somerville Tax Assessor's Data**
- **Census Boundaries Data – MassGIS**
- **MBTA Bus Routes and Stops – MassGIS**

- **Somerville Tax Assessor's Data**

This provides details of land use types for each parcel of land within Somerville city boundaries.

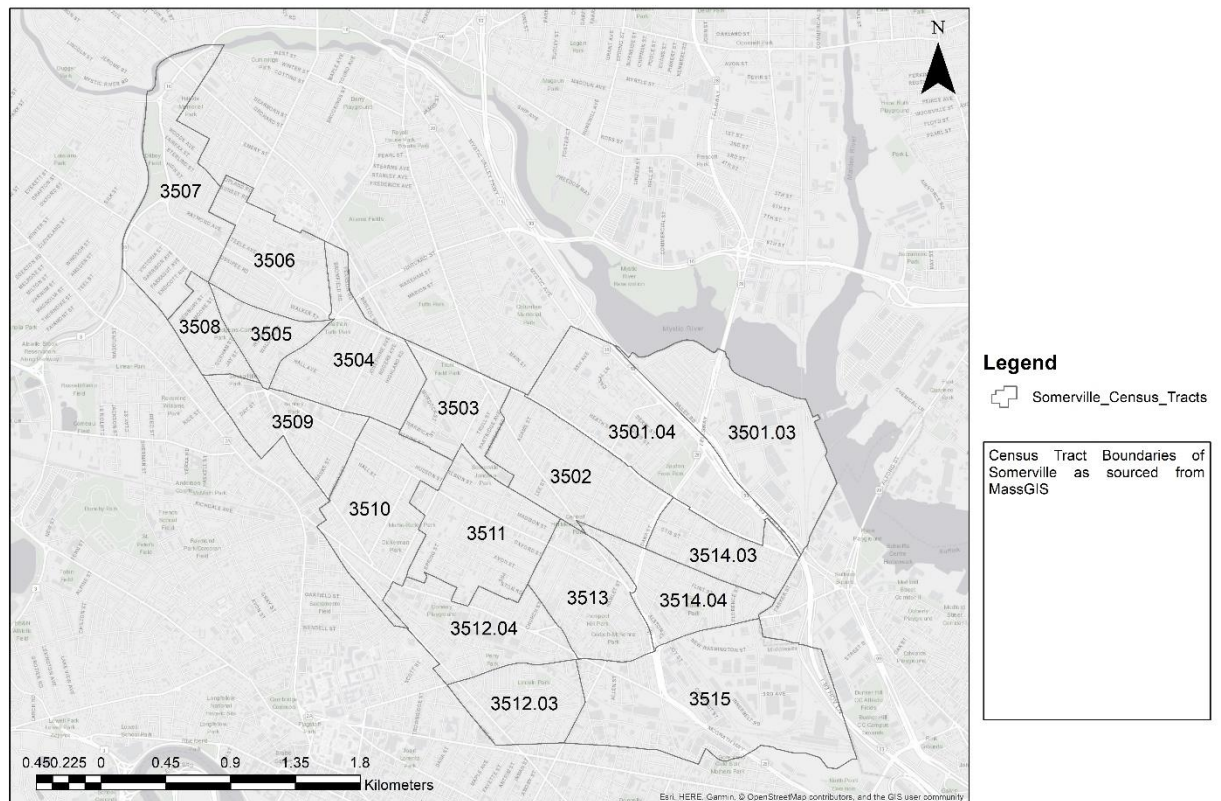
The dataset contains 37 variables on each land parcel.



Somerville Parcels according to the Tax Assessor's data

- **Census Boundaries Data – MassGIS**

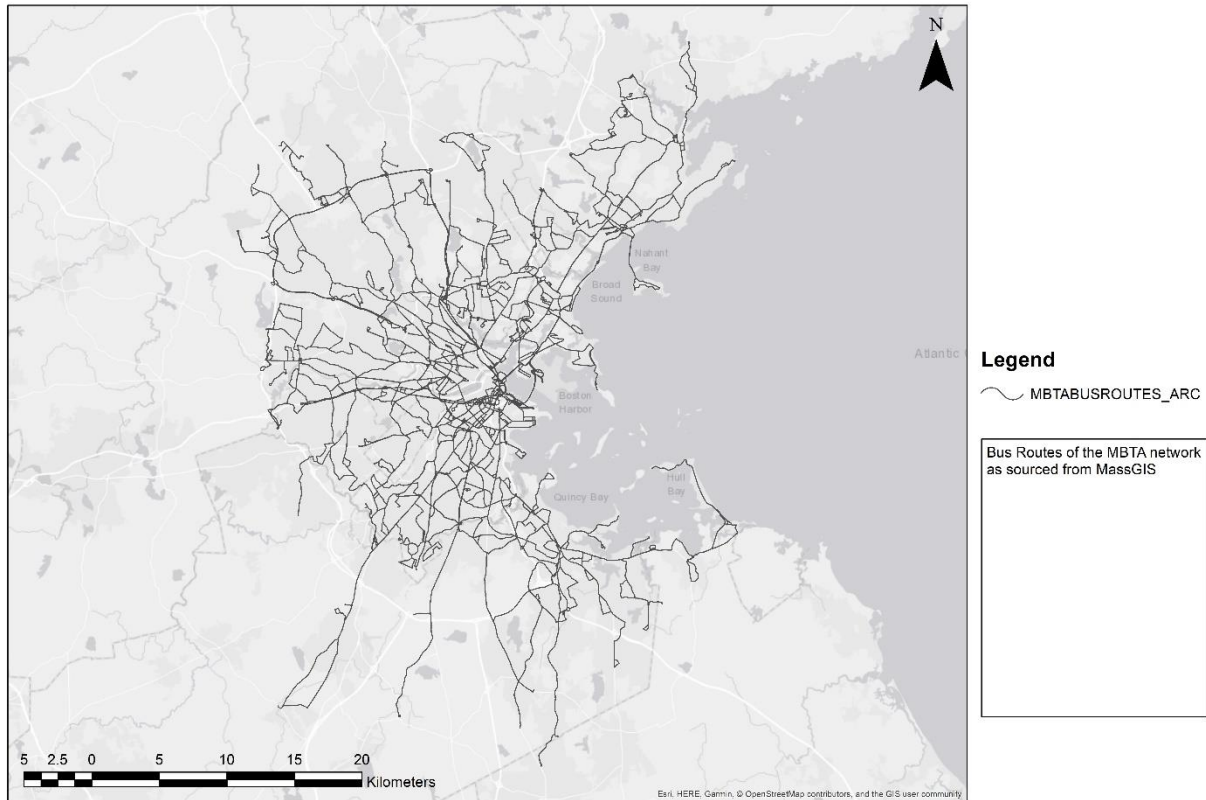
This provides details of Census Tract boundaries by county in Massachusetts. We will further focus only on those census tracts that contain the city of Somerville. Census tracts have a population between 1200-8000 averaging around 4000 residents, and can therefore serve as comparable geographic units for city-level analysis.



Somerville Census Outline

- **MBTA Bus Routes– MassGIS**

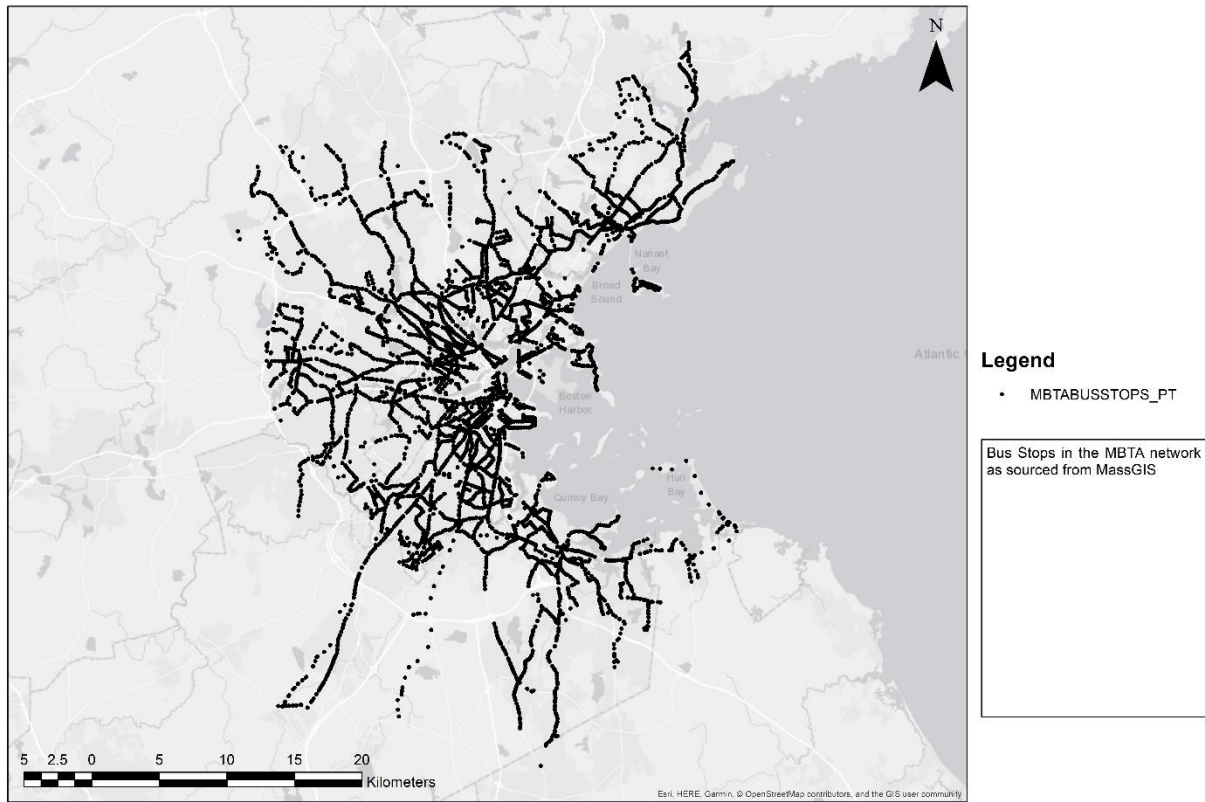
This provides details on all bus routes under the Massachusetts Bay Transportation Authority's network. Variables include route length, route number, bus stop name, etc.



MBTA Bus Routes

- **MBTA Bus Stops– MassGIS**

This provides details on all the bus stops under the Massachusetts Bay Transportation Authority's network. Variables include stop ID, stop name, town name and town ID.



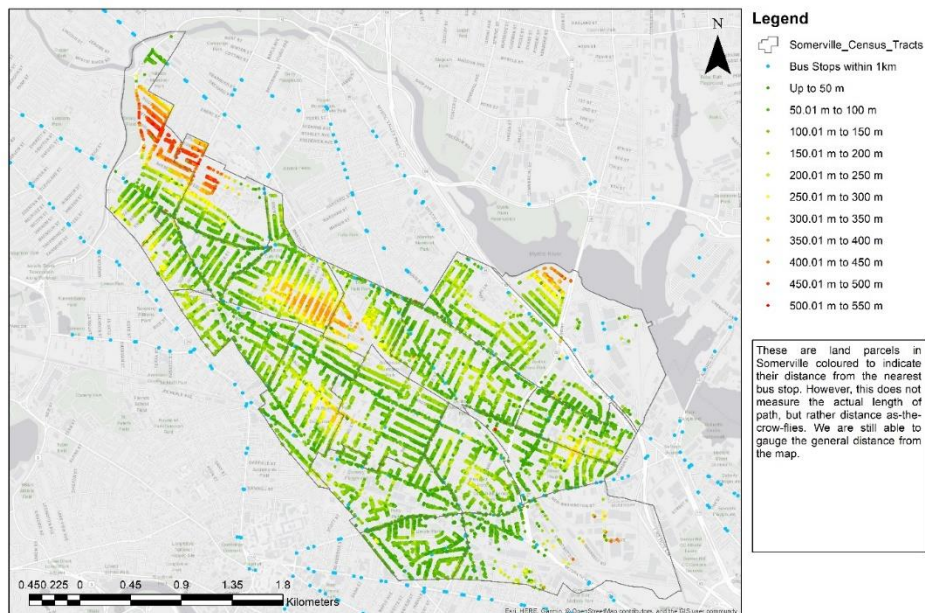
MBTA Bus Stops

Developing our Maps

There were a few intermediate maps necessary to be made before constructing our metric.

a. Distance to the Nearest Bus Stop

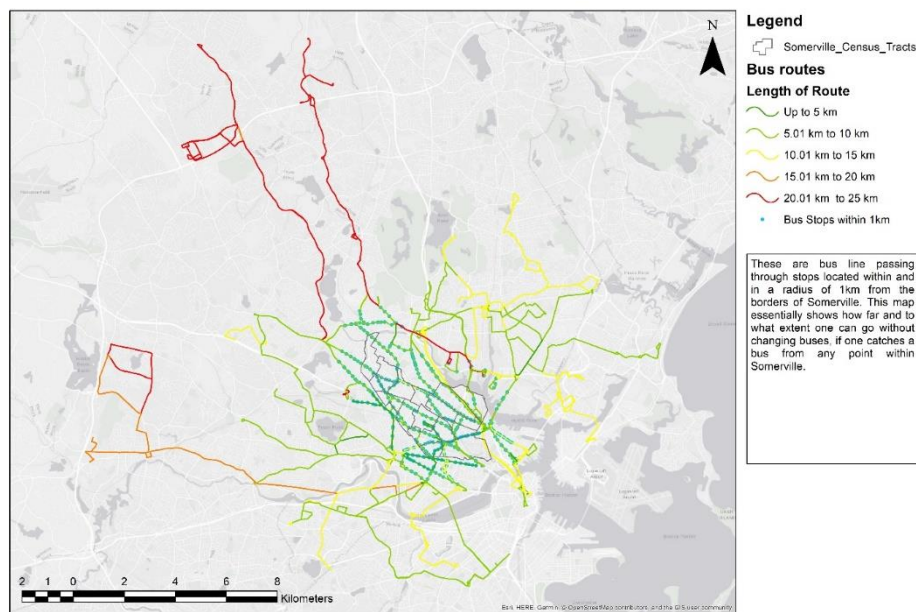
These are geocoded land parcels in Somerville. They have been classified by a graduated scale based on their distance to the nearest bus stop. The bus stops have been indicated in blue. This gives us a picture of how well served (or not) areas in Somerville are, and where to focus on improving connectivity.



Distance to nearest Bus stop from any Land Parcel

b. Bus Routes Passing Through Somerville

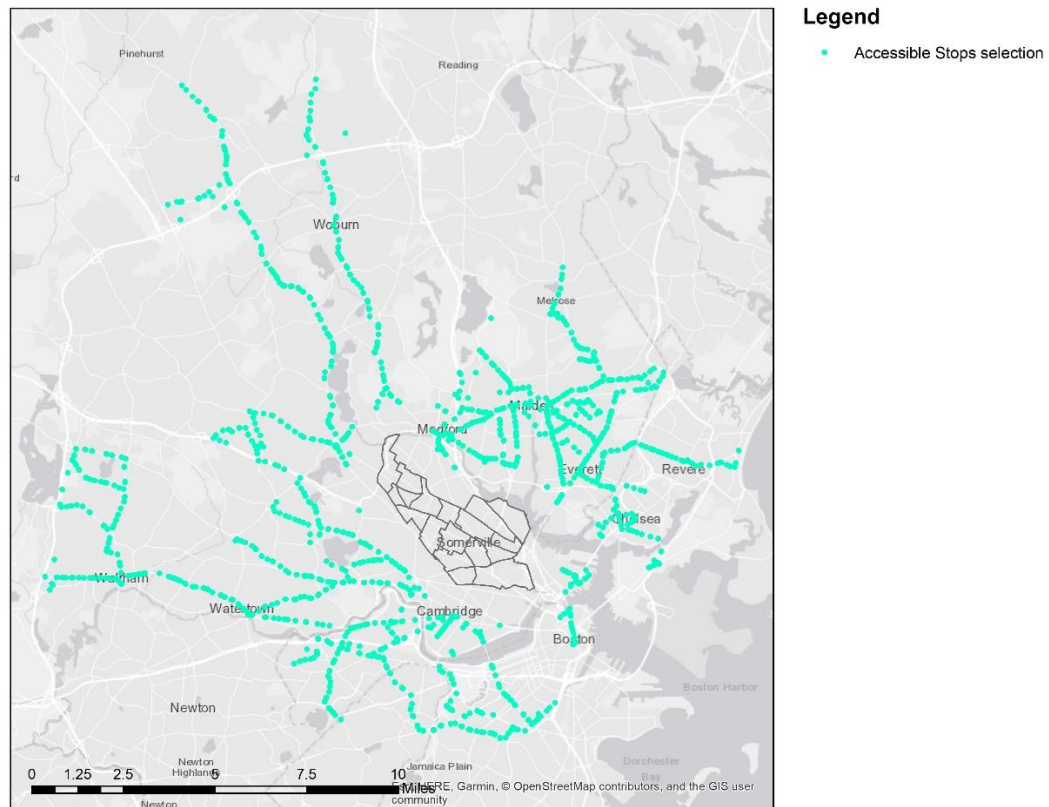
These bus routes pass through bus stops located in Somerville, and have been classified based on their length from start to end. They show the extent to which one can travel to on bus lines passing through Somerville



Bus Routes Passing Through Somerville Bus Stops

c. Points Accessible through Bus routes passing through Somerville

This map shows bus stops accessible via routes passing through Somerville bus stops. This also speaks about how far a person can go without changing the bus line. To be noted: This map excludes bus stops within a 1km radius of Somerville's borders, as we have included them due to them being relatively accessible from Somerville itself by foot.



Conclusions

With all this data we resolved to figure out where the most improvements in the MBTA Bus network are required.

We created what is called a Voronoi (or Thiessen) map for optimum areas served by each bus stop within Somerville's borders.

By **spatial join** functions, we got the following values:

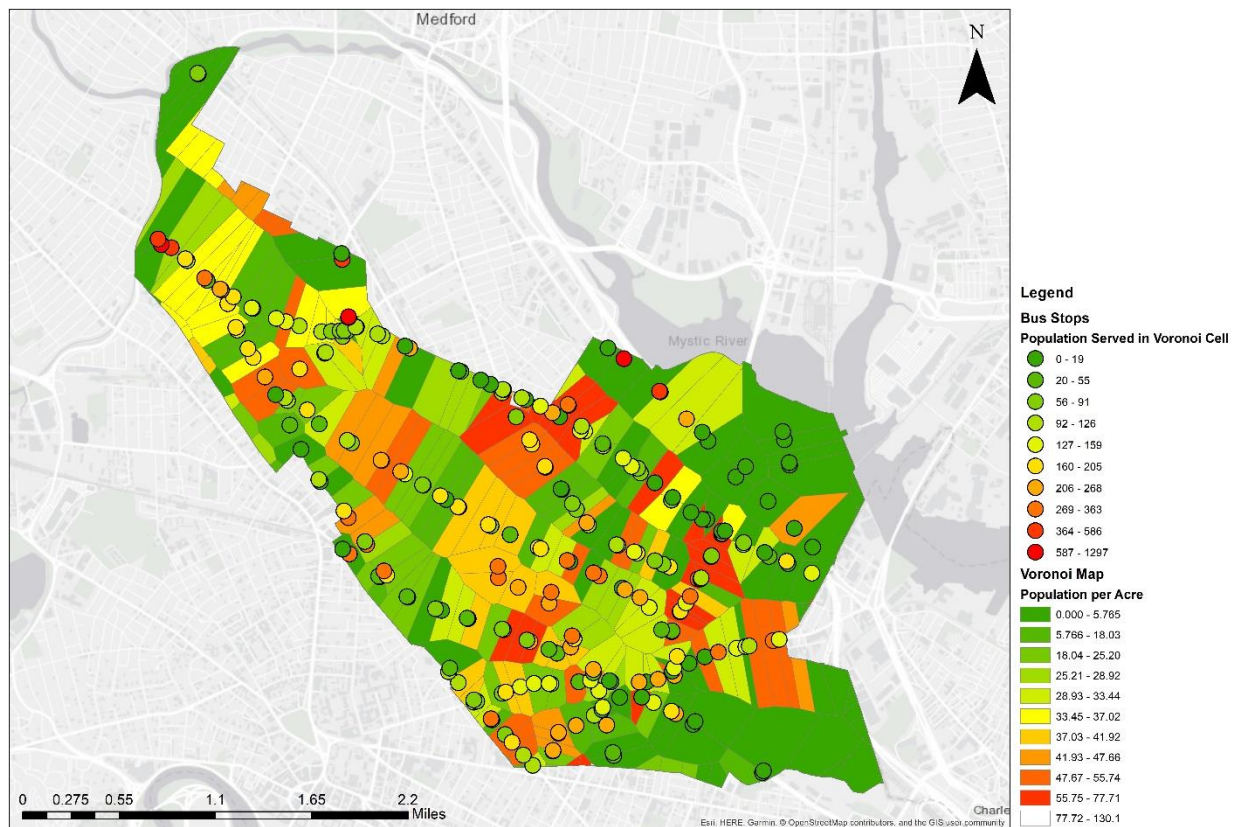
- a. Spatial joins on the Voronoi map with census data and geocoded results of the Somerville Tax Assessor's data gave us the population and household numbers and mean distance to the nearest bus stop for each Voronoi cell.
- b. Spatial joins on the bus stops with the Voronoi map gave us the mean distance from each land parcel to its nearest bus stop, and the population it serves.

These two actions allow us to see the effectiveness of a bus stop in two ways:

- a. By the population it serves
- b. By how accessible it is (by means of distances)

We can further analyze these two observations in four ways to understand the state of transportation in Somerville.

Population Served:



There are four extreme cases which can result from this analysis:

A. High population and high density

Probably underutilization of transit network. May need to review for overcrowding

B. High population and low density

Probably underserved community. May need to spread bus stops around the community

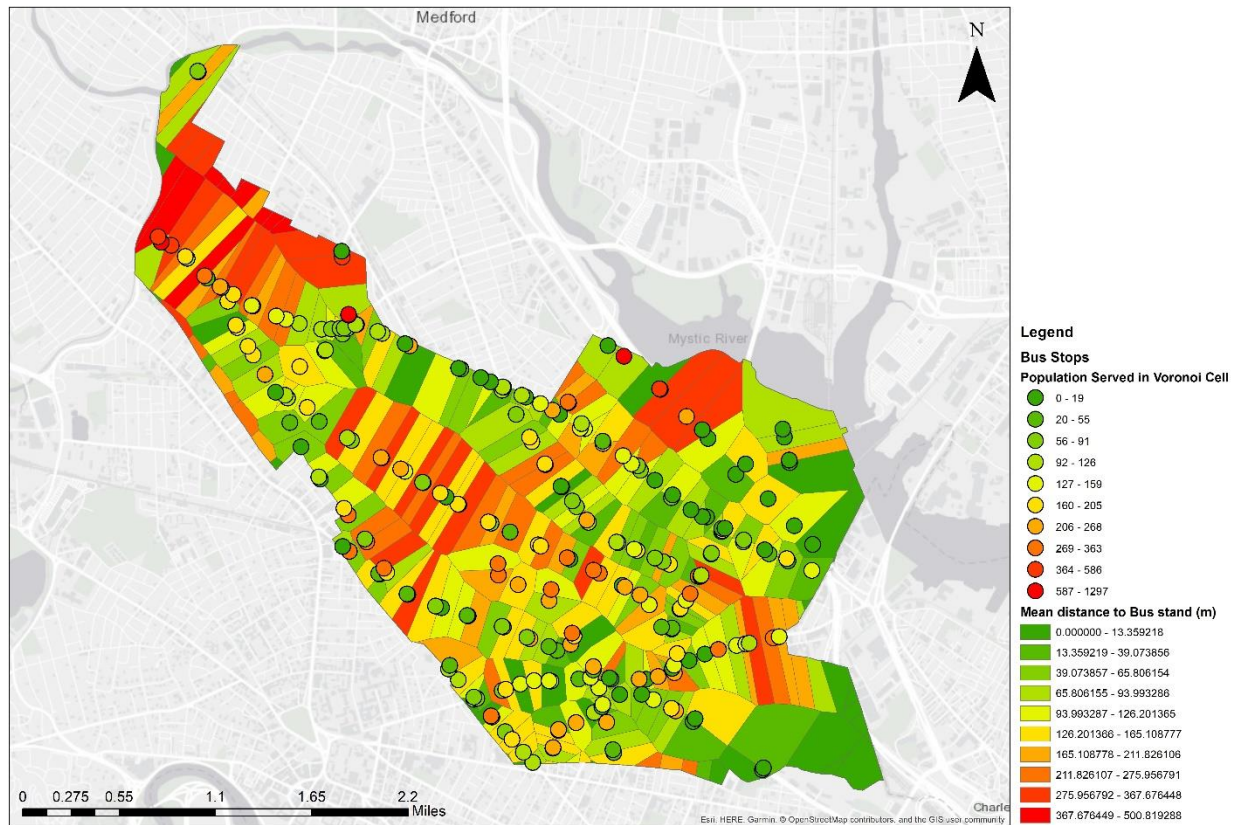
C. Low population and high density

Probably good utilization of bus stop.

D. Low population and low density

Scope for adding residential development and increasing density.

Availability of Nearest Bus Stop (Distance)



Here too we see four extreme cases which can result from this analysis:

A. High population and high mean distance

Highly underserved areas. Probably a need for increasing existing number of bus stops.

B. High population and low mean distance

Well served areas. May need to be reviewed for probable overcrowding

C. Low population and high mean distance

Low density areas, may lead to high dependence on cars. Probably look at park&ride solutions

D. Low population and low mean distance

Excellent scope to add residential development and increase population density.

Both the resultant maps are giving the same information: How well an area is served by the MBTA network. However, that information is provided by two methods:

- a. Usability – By looking at the density and population served, we see how many people can depend on it for transit requirements.
- b. Accessibility – By looking at the mean distance to the closest bus stop, we see how far one has to walk to reach the nearest bus stop.

Explicit proposals are given only for the four extreme cases for each resultant map. However, there are obviously many cases which aren't as extreme. For these, conclusions can always be drawn by comparing them to their nearest extreme case and figuring out solutions on a case by case basis.

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