Network Analysis of Access to Public Transportation in New York City

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INTRODUCTION

New York City, as one of the most truly global cities in the world, is home to one of the most **expansive** transportation networks in the world. Subway, buses, and trains connect all nearly points of the city together. However, not all parts of the city have equal access to these transportations systems.

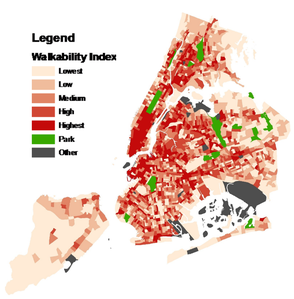
This project uses GIS network analysis tools to determine which areas of the city have the longest walking time to any relevant method of public transportation. Using the road networks as a guideline for walking paths and a consolidated map of public transportation stops, it is possible to **seek out** the least accessible areas within the city and to find out what reason, if any, these areas have for lacking accessibility.

All of the subway and bus routes in New York City, displayed according to their respective lines.

METHODOLOGY

In order to determine accessibility, I would need the stops for all of the methods of transportation, and a road network for walking. To find the locations of all of the stops, I gathered data for the bus, subway, and train stops which I then combined into a single dataset. To build the road network, I first needed a road map of the city with walking times for each segment.

Fortunately, there was a study done by Columbia University that calculated the "walkability" of each census tract. Using their data and the average walking speed of New York City as 3.4 mph, I was able properly assign speeds to each road segment based on which census tract it was in.

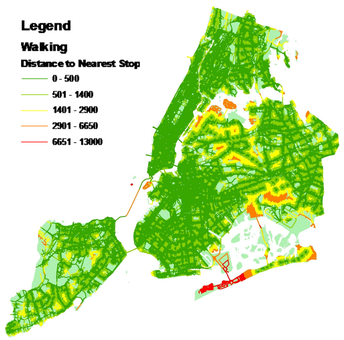


With the stops and roads with speeds, a network could be built to find the times taken to walk to each stop.

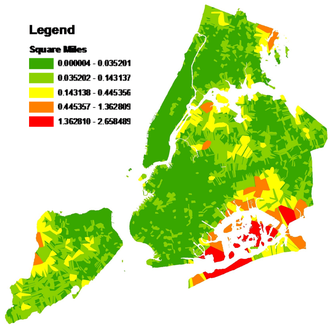
NETWORK ANALYSIS

Building the network was by far the most difficult aspect of the project. With the roads and walking speeds, I created a walking network with the impedance as the time in minutes taken to walk each segment.

With the ArcGIS network analyst tools, the nearest stop to each road segment could be found and joined to the segment. The next step was to determine where the clusters are within the city that have low proximity to public transportation. There are multiple methods of doing so:

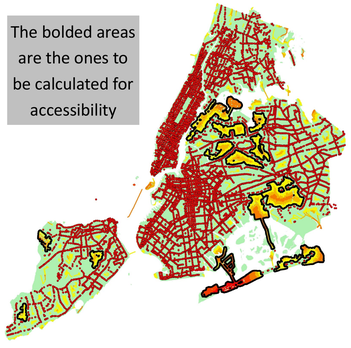


The road segments displayed according to their proximity to the nearest stops. This allows the clusters of roads that are the furthest from stops to be seen.



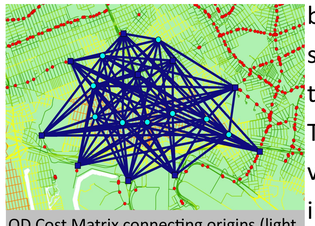
Proximity to nearest stop displayed in Thiessen polygons that are created by areas that share the same stop as its nearest. This allows the stops that is nearest to the most road segments to be seen.

Thirteen areas were selected as the areas that, according to the maps above, have the highest average walking times to the nearest stop, and in turn the lowest accessibility.



The bolded areas are the ones to be calculated for accessibility

Using the network analyst tools, the average walking time within each area from the road segments to the nearest stops could be found. The OD Cost Matrix allowed for a set of origin points to be randomly selected and a set of destination points to be chosen from the nearest stops to the segments. ArcGIS calculated the time taken to get from each origin to each destination. The average of all of the times for the individual routes was used as the average walking time within the area.



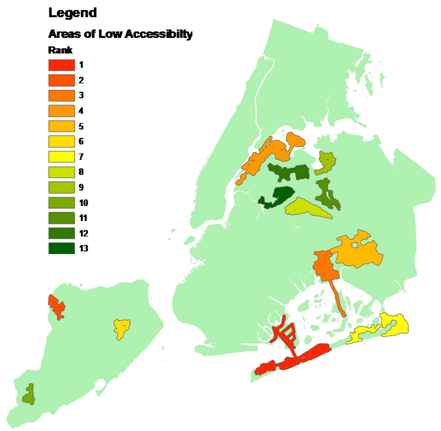
OD Cost Matrix connecting origins (light blue) to destinations (dark blue)

ACCESSIBILIY

The average walking times to the nearest stop gave the relative accessibility to public transportation for each area. The accessibilities of the areas were ranked and then displayed to visually demonstrate where in New York City there is the least access to any method of public transportation.

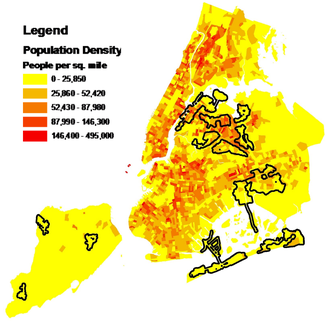
Average Walking Times (minutes):

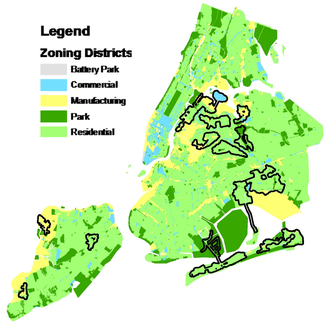
1. 16.825
2. 19.05
3. 19.874
4. 20.74
5. 21.315
6. 23.80
7. 28.24
8. 28.66
9. 30.12
10. 30.27
11. 31.54
12. 32.27
13. 76.30



CONCLUSION

Once the areas of lowest accessibility were determined, I wanted to find out what the reason was. I compared the final areas with maps of population density and zoning to see if those areas correlated with low population or non-residential zones, respectively.





The areas with the lowest accessibility suffered from both a relatively low population density and either industrial or park zoning. The combination of these factors may have contributed to the decision to limit expansion of the bus, subway, and train systems throughout history into those areas

The results also may also in part be due to some of the areas' proximity to water, which limits the number of stops and overall need for transportation in those areas.