Optimization of New York City Subway System

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Background

New York City, honored as an international metropolis, has the largest rapid transit subway system in the world. However, due to continual and accelerating city expansion, the existing transit system gradually does not meet the demands and needs to be extended and optimized.

Introduction

New York City Subway System is constituted by 36 lines, 27 services and 472 subway stations, which run through the five boroughs of New York City, Bronx, Brooklyn, Manhattan, Queens and Staten Island.

As the increasing immigrants and residential dispersion, New York City is experiencing great extent of city expansion. As we check the subway map, there are some residential area and industrial area far away from subway's service area especially the area in the northwest side of Staten Island and east side of Queens.

Consequently, according to the map pattern, we proposed the hypothesis that new subway stations in East Queens to extend the previous line. In addition, a new subway line can be designed to connect The Bronx and East Queens running through the East River.

We employed some techniques like Network Analysis, Accessibility Analysis to confirm that our hypothesis is right. The position of new subway stations is located to extend the previous line and the 37th subway line is delineated.

We sincerely hope that residents in New York City can access more improved infrastructure and enjoy the convenience.

Data

The data which used in the present report include subway stations, subway lines, census information, land use situation, pedestrian network, community districts. They are downloaded in [NYC open data] at [https://opendata.cityofnewyork.us].

The data of subway information is provided by Metropolitan Transportation Authority (MTA) in 2013, and the data of census information is provided by Department of City Planning in 2010. In this project, we will mainly use the data about subway station, subway route, census and land use.

Table 1. Indicators Weights and Description

Indicators	Rank order	Resulting weights	Description
Population Density	2	0.4	More efficient public transport is required for higher population density
Land Use Area	1	0.6	More efficient public transport is required for larger commercial and residential areas

Table 2. Land Use Category Weights

Indicators	Category	Rank order	Resulting weights
Land Use Area	Commercial & Office Buildings	2	0.16
	Industrial & Manufacturing	6	0.09
	Mixed Residential & Commercial Buildings	1	0.2
	Multi-Family Elevator Buildings	3	0.15
	Multi-Family Walk-up Buildings	4	0.12
	One & Two Family Buildings	5	0.1
	Open Space & Outdoor Recreation	7	0.05
	Parking Facilities	7	0.05
	Public Facilities & Institutions	7	0.05
	Transportation & Utility	10	0.03
	Vacant Land	11	0

Methodology

Figure 1. Methodology Structure

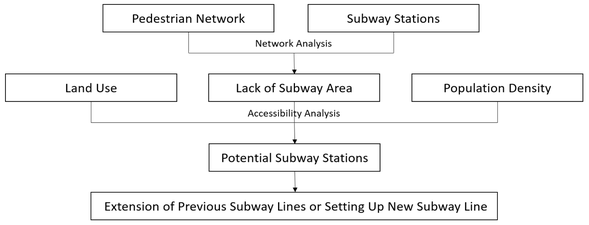


Figure 2. Lacking Subway Districts and Land Use Area

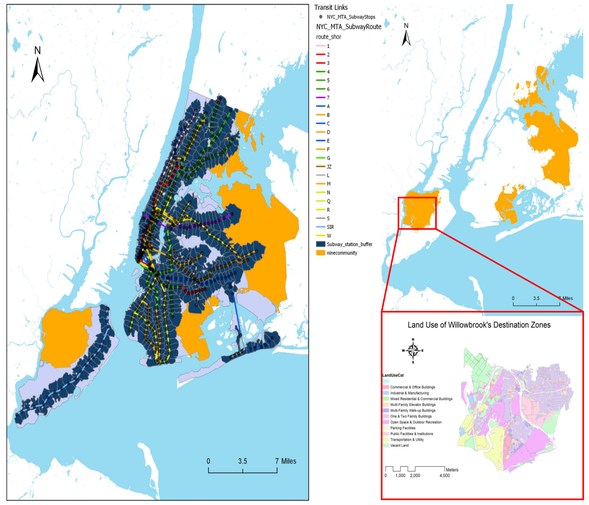
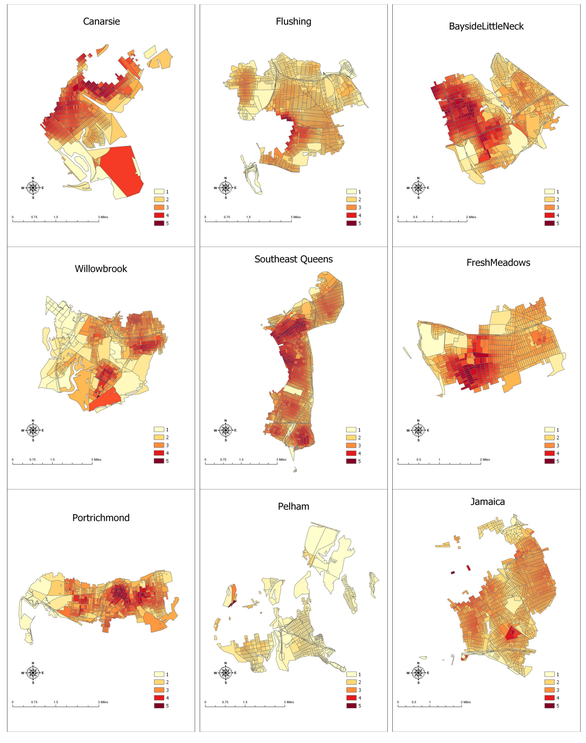
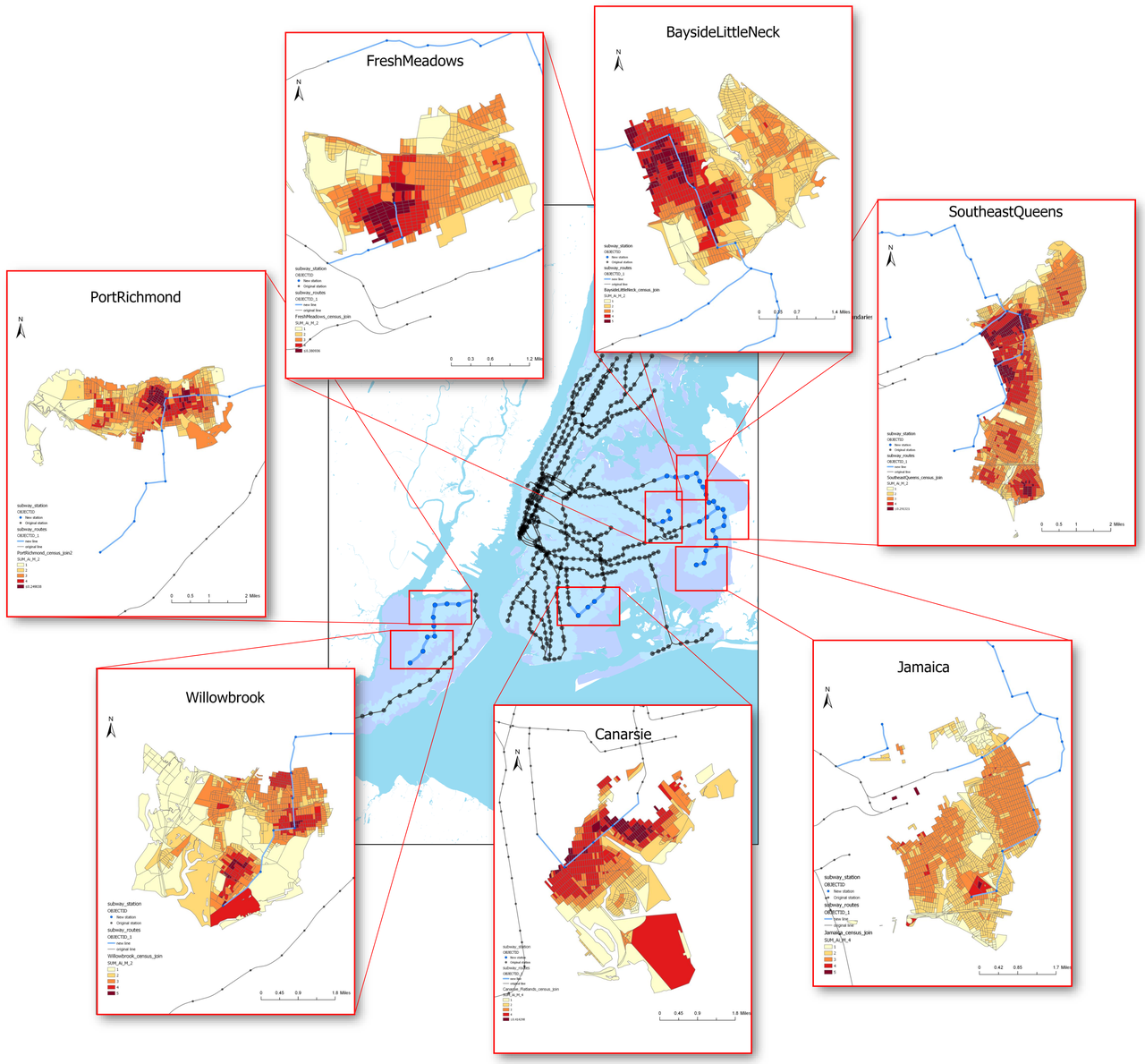


Figure 3. Accessibility Value of Lacking Subway Neighborhoods



Results



Conclusion

The service of New York City Subway System does not meet the current travel demands of residents. The system needs to be optimized.

The extension and optimization of New York Subway System can be concluded as these lists below.(1) There are 36 subway stations newly designed in the New York city planning subway map, 24 stations in Queens, 9 stations in Staten Island, 3 stations in Brooklyn, totally 529 subway stations. (2) As for subway line, in Staten Island, an extension line is delineated cross through 9 stations to connect the island from the southwest side to northeast side. In Queens, three subway lines are elongated eastward and even a new subway line is delineated from north to south in the east side of Queens. The subway line is also lengthened in the southeast side of Brooklyn.

References

[1] Mei, Z. X., Ou, Y. J., & Chen, S. M. (2011). Accessibility Evaluation of Guangzhou Subway Network Based on Space Syntax Model and GIS. In Applied Mechanics and Materials (Vol. 90, pp. 3292-3297). Trans Tech Publications.

[2] Zhu, W. J., & Kan, X. D. (2012). Coordination analysis for urban underground space and rail transit based on space syntax. In Applied Mechanics and Materials (Vol. 170, pp. 1388-1391). Trans Tech Publications.

[3] Alam, B., Thompson, G., & Brown, J. (2010). Estimating transit accessibility with an alternative method: evidence from Broward County, Florida. Transportation Research Record: Journal of the Transportation Research Board, (2144), 62-71.