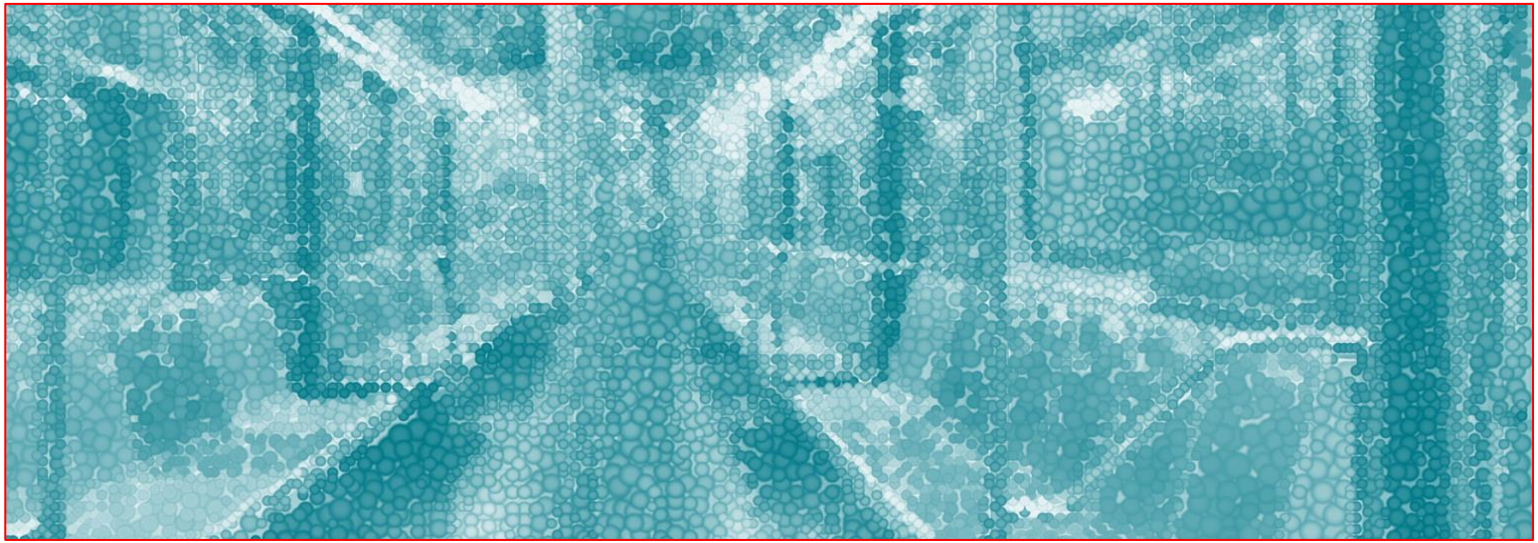
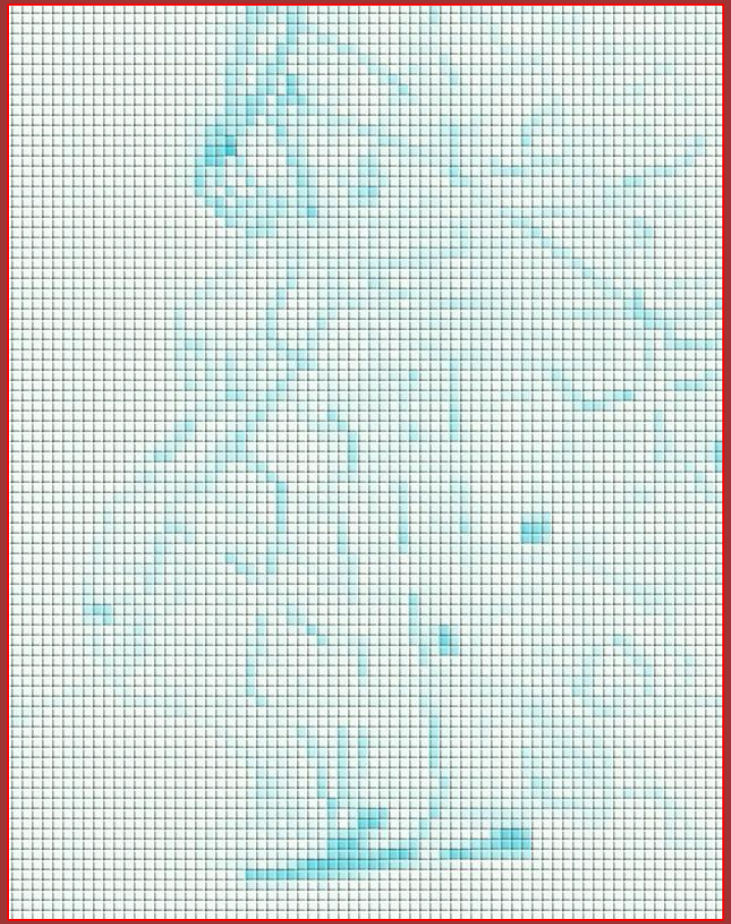


navigating the spatial dynamics of accessible stations and seniors in *Brooklyn*.

AAN2164

ARIMBI ALESSANDRA NARO



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01 *background & research question*
02 *methodology*
03 *study & findings*
04 *conclusion & recommendation*
05 *limitation*
06 *sources*

defining the problem

The lack of adequate accessible stations in ***New York City*** is proven by current data which reveals that as of 2022, merely 126 out of the 472 stations in the city are equipped with essential facilities like elevators or ramps.[1]

This significantly ***limits the mobility of individuals*** within the senior demographic. Furthermore, even in accessible stations, a case occurred in 2018, when an individual with disability became stranded in an elevator due to lack of maintenance and information regarding its operational status which was out of service at the time.[2]

Data reveals that ***Brooklyn*** is particularly affected by this issue, with the highest number of neighborhoods lacking accessible stations, where 26 out 44 neighborhoods does not have at least one accessible stations.[3]

Moreover, the other problem that was identified was even if the elderly population and people with disabilities live within close proximity with the stations, they are unable to access it due to lack of elevator or ramps, having only stairs as a way to access the station.[4]

research questions

RQ1: What are the spatial patterns in demographic distribution in ***Brooklyn***?

RQ2: Which areas in Brooklyn has the ***highest*** concentration of senior populations?

RQ3: Which areas in ***Brooklyn*** has ***accessible*** stations, and how do these stations connect with the ***senior*** population and their facilities?

RQ4: Where are the bus stops and bus lines in ***Brooklyn***? Do they cover the gaps within the lack of coverage of Accessible Station?

RQ5: What are the optimal locations for new accessible subway stations to improve accessibility for the senior population in ***Brooklyn***?

Sources: 1.) Fitzsimmons, Emma G. "New York City Subway Faces a Major Accessibility Problem." The New York Times, June 22, 2022. https://www.nytimes.com/2022/06/22/nyregion/nyc-subway-accessibility-disabilities-elevators.html
2.) 60 Minutes. "The New York City Subway Accessibility Problem." CBS News. https://www.cbsnews.com/news/the-new-york-city-subway-accessibility-problem-60-minutes/.
3.) NYC Comptroller. "Service Denied: Accessibility and the New York City Subway System." NYC Comptroller's Office. https://comptroller.nyc.gov/reports/service-denied-accessibility-and-the-new-york-city-subway-system/.
4) Lapin, Tamar. "Over Half of NYC Neighborhoods Leave Disabled People Stranded." New York Post, July 17, 2018. https://nypost.com/2018/07/17/over-half-of-nyc-neighborhoods-leave-disabled-people-stranded/.

The scope of the project is the *Brooklyn* Borough (Kings County) area. There will be neighborhood that is highlighted due to its high concentration of senior and populations with disability.

The project will center on exploring the correlation between elderly population and their access to public transportation, particularly the subway, in New York.

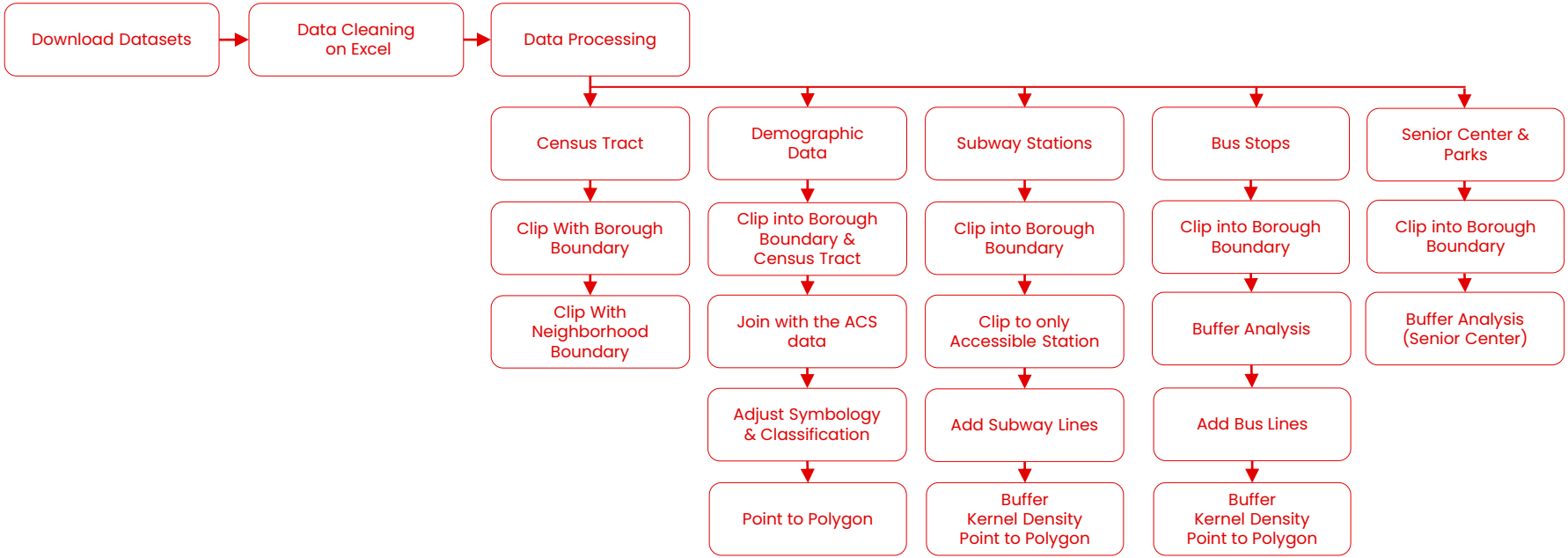
Brooklyn has been selected as the focal point due to having one of the highest number of neighborhoods lacking at least one accessible station.

BROOKLYN

OTHER BOROUGH

SOURCE: NYC DCP, 2022

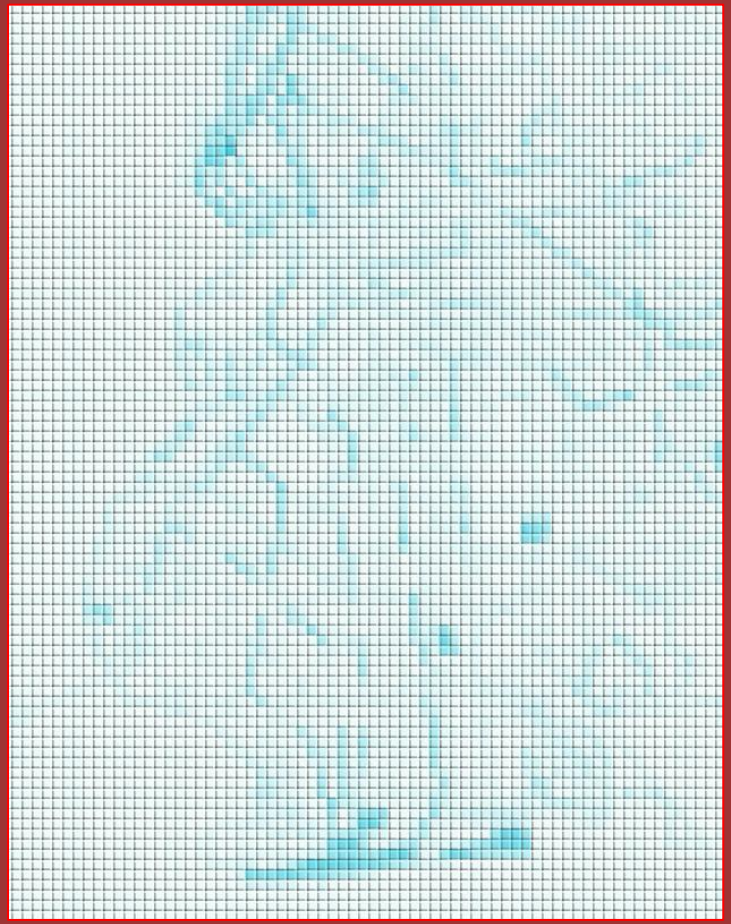
0 2.5 5 10 15 20 Miles



The project will focus on the *Brooklyn Neighborhoods (using NTA data)* as the areal units of analysis. The study aims to evaluate various socio-economic variables and infrastructures to understand the challenges faced by the elderly in utilizing public transportation. Variables for analysis will include the population density, median household income, racial demographics, the percentage of the population above the age of 65, the percentage of the senior population living in poverty, the percentage of senior individuals with disability, and the percentage of senior workers who commute using public transportation. Additionally, the number of subway stations, bus stops, senior centers, and parks will be considered.

Data for this project will be sourced from National Public Data, particularly the U.S. Census, to obtain neighborhood boundaries. *Spatial data* will also be extracted from State or Local Public Data sources such as NYC DCP, NYC Parks, NYCHA and MTA, including locations of Subway Stations, Bus Stops, Senior Centers, and Parks. Furthermore, *non-spatial data* in the form of 5-year estimates from the American Community Survey (ACS) will be used, specifically data on age, income, race, and disability.

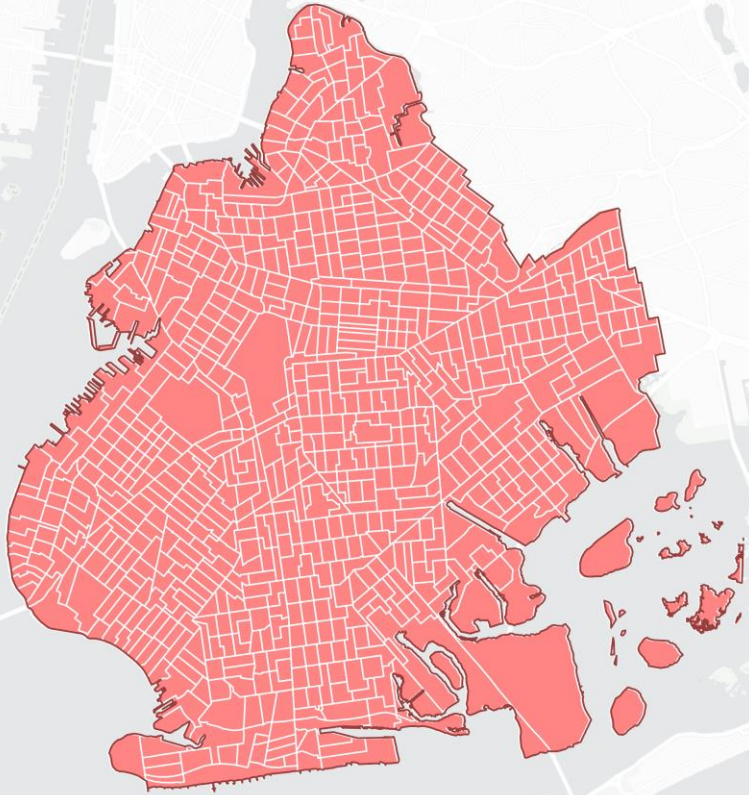
mappings & findings



RQ1: What are the spatial patterns in demographic distribution in *Brooklyn*?

Brooklyn Census Tract

SOURCE: NYC DCP, 2022



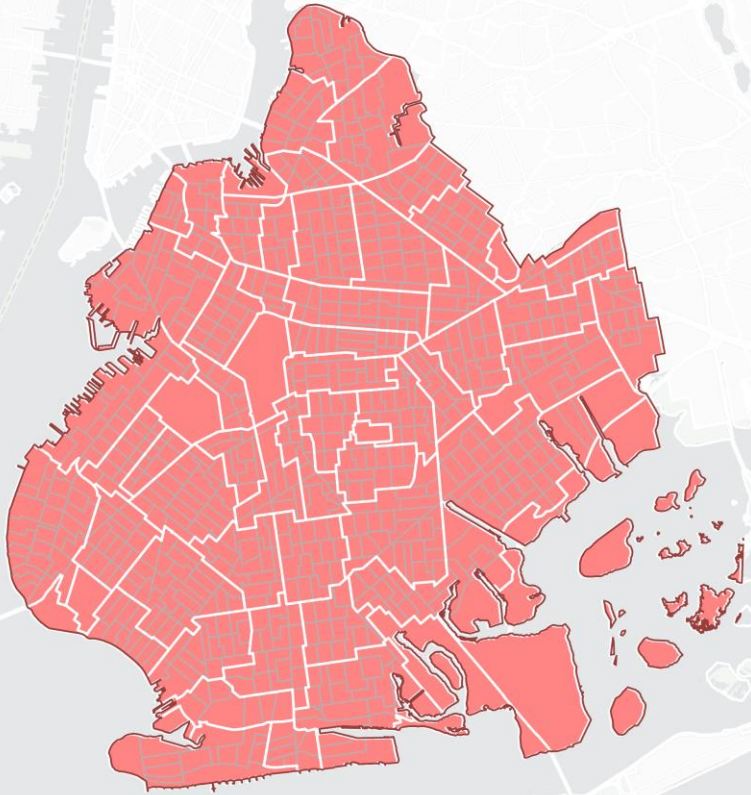
Brooklyn Borough Boundary

Brooklyn Borough

0 0.5 1 2 3 4 Miles

Brooklyn Neighborhood Boundary

SOURCE: NYC DCP, 2020

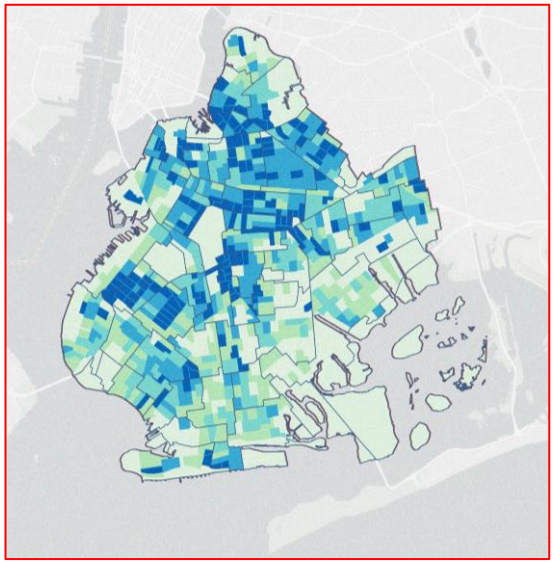


Brooklyn Borough Boundary
Neighborhood Boundary
Brooklyn Borough

0 0.5 1 2 3 4 Miles

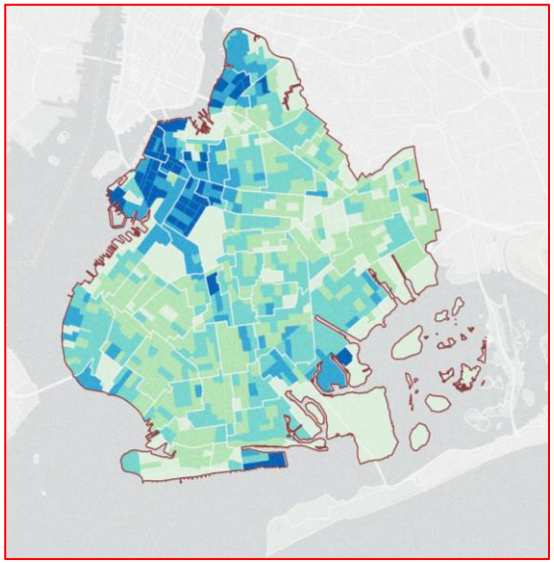
Demographic in the *Brooklyn* Borough

Population Density (Per Square Ft)



Brooklyn Borough Boundary
Brooklyn Neighborhood Boundary
Population Density
0.000 - 0.01228
0.01229 - 0.01695
0.01696 - 0.02167
0.02168 - 0.02703
0.02704 - 0.07223

Median Household Income



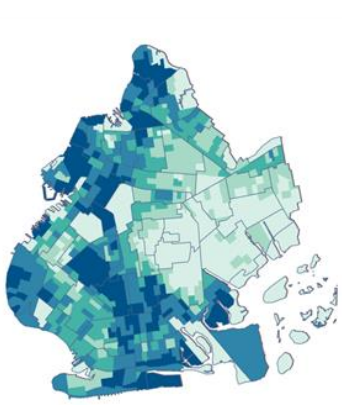
Brooklyn Borough Boundary
Neighborhood Boundary
Median Household Income
$0 - $38,137.00
$38,138.00 - $73,066.00
$73,067.00 - $109,130.00
$109,131.00 - $158,594.00
$158,595.00 - $250,000.00

These maps, utilizing graduated colors, depict *population density* in Brooklyn, with Bedford-Stuyvesant, Crown Heights, and Borough Park exhibiting the highest population density. Furthermore, the *median household income* map highlights the Carroll Gardens area as having the highest median household income in the borough.

0 0.5 1 2 3 4 Miles

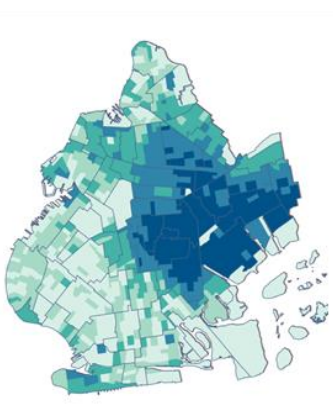
SOURCE: ACS, 2022

Race in the *Brooklyn* Borough



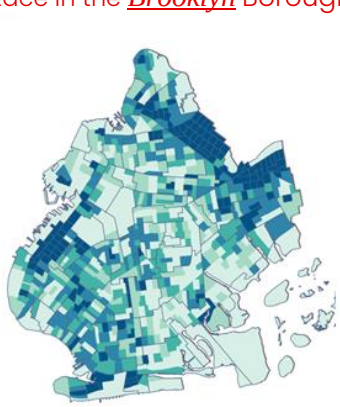
WHITE

Brooklyn Borough Boundary
Brooklyn Neighborhood Boundary
Percentage of White Population
0 % - 9 %
10 % - 30 %
31 % - 52 %
53 % - 76 %
77 % - 100 %



BLACK

Brooklyn Borough Boundary
Brooklyn Neighborhood Boundary
Percentage of Black Population
0 % - 1 %
2 % - 6 %
7 % - 39 %
40 % - 74 %
75 % - 100 %

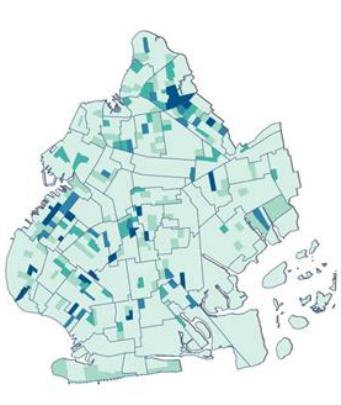


HISPANIC/ LATIN

Brooklyn Borough Boundary
Brooklyn Neighborhood Boundary
Percentage of Hispanic Population
0 % - 2 %
3 % - 5 %
6 % - 9 %
10 % - 18 %
19 % - 54 %

ASIAN

Brooklyn Borough Boundary
Brooklyn Neighborhood Boundar
Percentage of Asian Population
0 % - 1 %
2 % - 5 %
6 % - 10 %
20 % - 30 %
40 % - 90 %



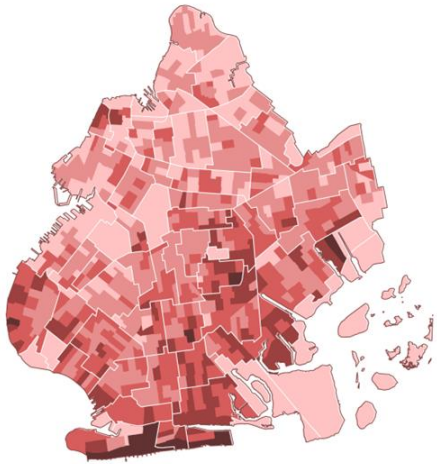
AMERICAN INDIAN/ ALASKA

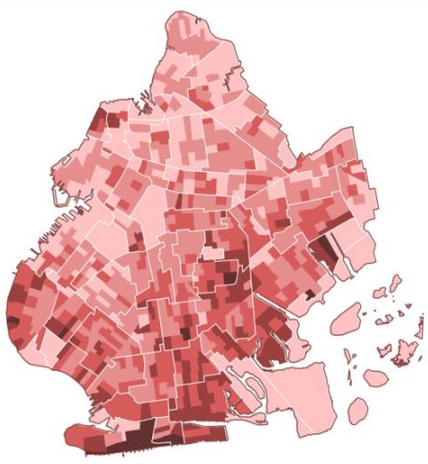
Brooklyn Borough Boundary
Brooklyn Neighborhood Boundary
Percentage of American Indian or Alaska Native Population
0 %
1 %
2 %
3 % - 4 %
5 % - 15 %

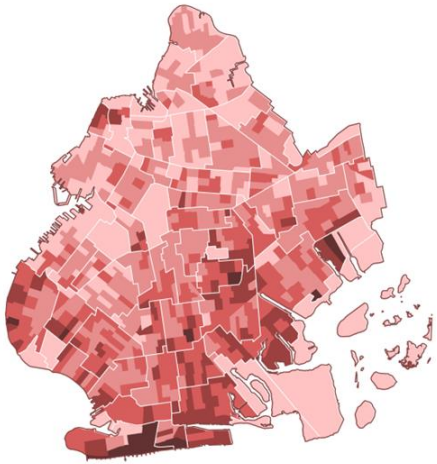
Utilizing a graduated color map, the racial distribution in Brooklyn reveals distinct patterns: a high percentage of population residing in the western part of the borough, encompassing neighborhoods such as Bay Ridge, Dyker Heights, Carroll Gardens, and Williamsburg, the Black population concentrated in Bedford-Stuyvesant and Canarsie, Bushwick hosting the majority of the Hispanic and Latin population, Gravesend and Bath Beach showing a higher Asian population; and the American Indian/Alaskan population lives in various neighborhood across the borough.

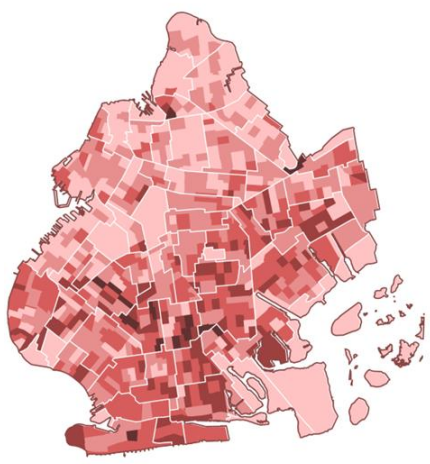
SOURCE: ACS, 2022

Population Above 65 years old in the *Brooklyn* Borough





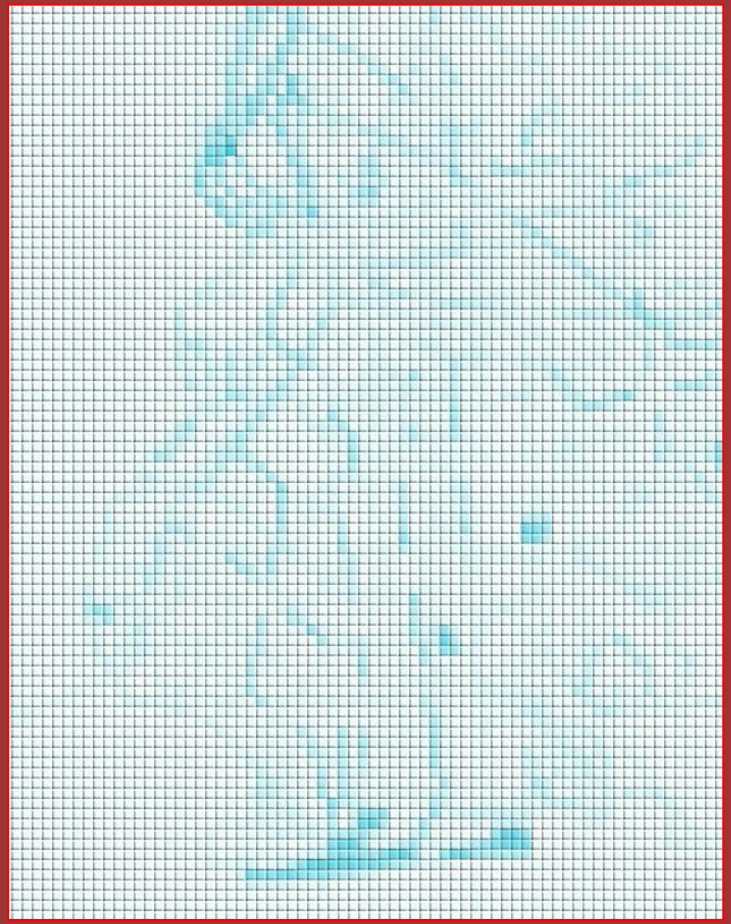




The graduated color maps depicting the senior population above 65, seniors above 65 living under the poverty line, seniors above 65 with disabilities, and seniors commuting to work reveal a notable concentration of older adults in the southern region of Brooklyn. The concentration gradually increases as one moves southward from the middle of the borough.

0 0.5 1 2 3 4 Miles

SOURCE: ACS, 2022

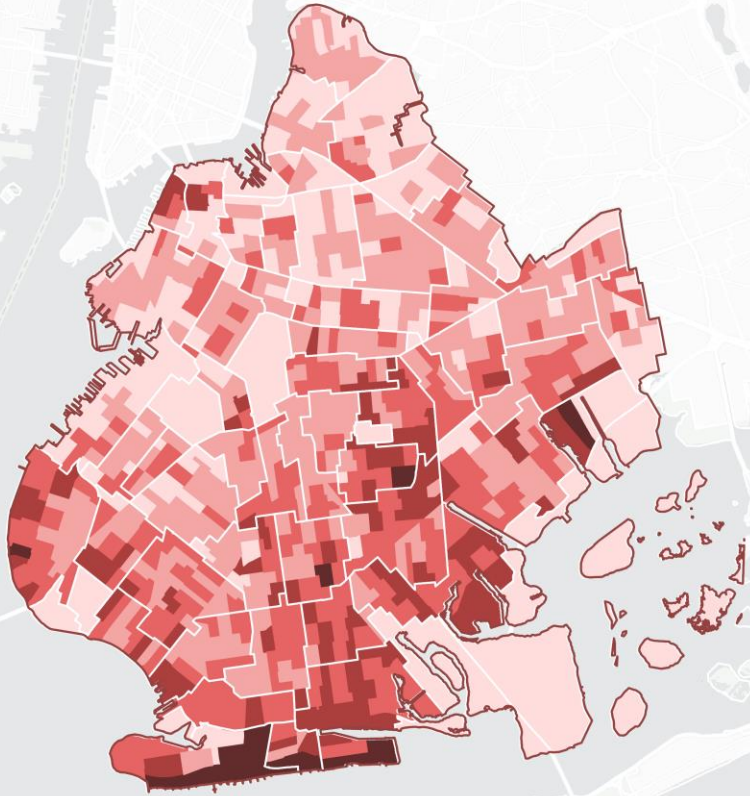


RQ2: Which areas in Brooklyn has the ***highest*** concentration of senior populations?

Percentage of Senior Populations above 65 Years Old in *Brooklyn*, 2022

SOURCE: ACS, 2022

This ***graduated color*** map indicates that the neighborhoods with the highest concentration of senior population is ***Coney Island - Brighton Beach.***



Brooklyn Borough Boundary

Percentage of Population with Age Above 65

- 0 % - 8 %
- 9 % - 15 %
- 16 % - 22 %
- 23 % - 34 %
- 35 % - 61 %

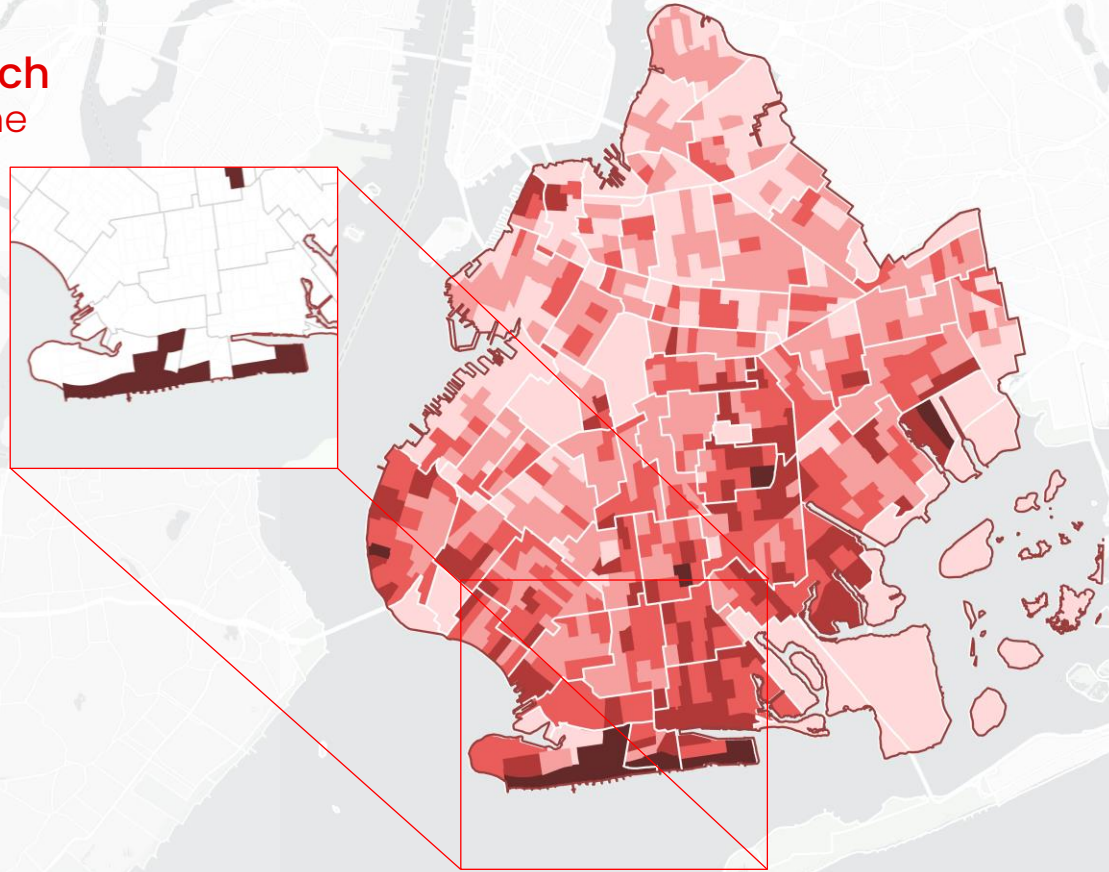
Neighborhood Boundary

0 0.5 1 2 3 4 Miles

Coney Island - Brighton Beach

Neighborhood in *Brooklyn* with the Highest Percentage of Senior Populations, 20

SOURCE: ACS, 2022



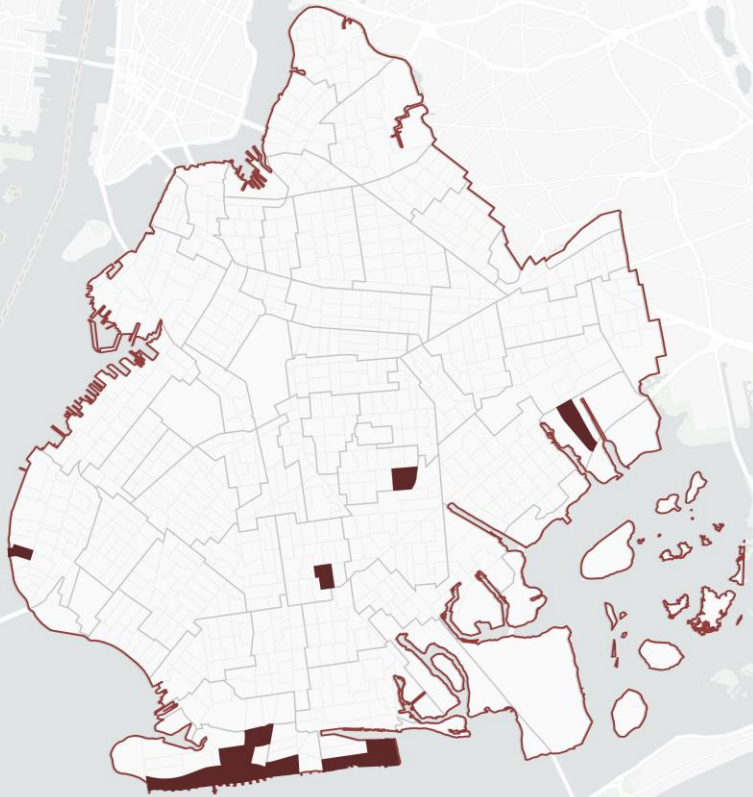
0 0.5 1 2 3 4 Miles

Image Source: 1. Manon from Pexels. "People Swimming on the Beach." Pexels, https://www.pexels.com/photo/people-swimming-on-the-beach-6376748/.
2. "Brighton Beach - Coney Island Bound Platform." Wikimedia Commons, https://upload.wikimedia.org/wikipedia/commons/c/cf/Brighton_Beach_-_Coney_Island_Bound_Platform.jpg.
3. "Brighton Beach." TripAdvisor, https://media-cdn.tripadvisor.com/media/photo-s/02/d9/59/51/brighton-beach.jpg.

Other Tracts in *Brooklyn* with Highest Percentage of Senior Populations, 2022

SOURCE: ACS, 2022

Several other neighborhoods with tracts featuring the highest percentages of senior populations include *East Flatbush-Farragut, Spring Creek-Starrett City, Midwood, and Bay Ridge.* These neighborhoods stand out as areas with a notable concentration of seniors in the borough.



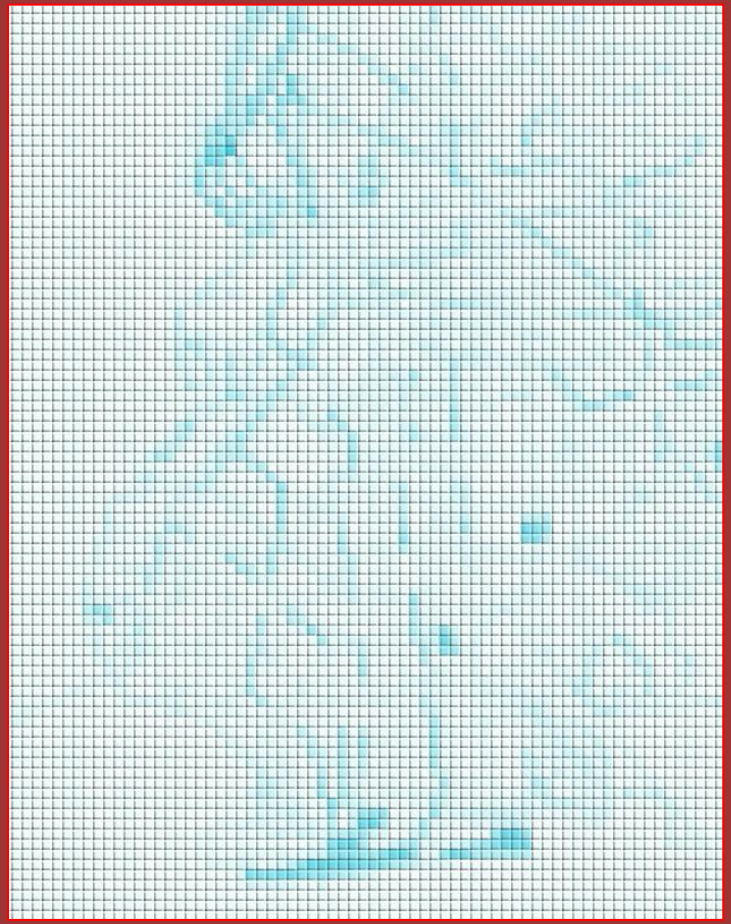
Brooklyn Borough Boundary

Brooklyn Neighborhood Boundary

Percentage of Population with Age Above 65 selection

35 % - 61 %

0 0.5 1 2 3 4 Miles



RQ3: Which areas in ***Brooklyn*** has ***accessible*** stations, and how do these stations connect with the ***senior*** population and their facilities?

Subway Lines in *Brooklyn*, 2022

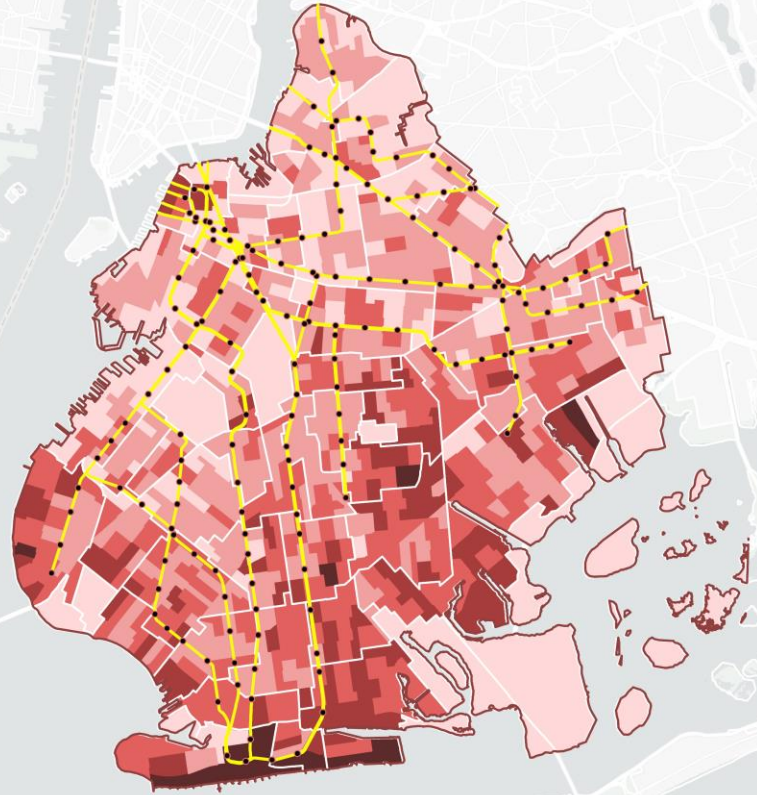
SOURCE: MTA, 2017

This map displays the *subway lines* within the Brooklyn borough, revealing that there are specific neighborhoods, such as those in the *Canarsie Area*, which lack convenient access to these subway stations. This highlights disparities in transportation infrastructure and accessibility within Brooklyn. These are also locations with notable concentration of senior populations.

Subway Stations in *Brooklyn*, 2022

SOURCE: MTA, 2017

Brooklyn has a total of *170 subway stations* spread across various neighborhoods. However, it is visible that there are certain neighborhoods within Brooklyn that do not have access to these subway stations, particularly neighborhood located in the Canarsie Area.



Subway Stations within 5-minute Walking Distance in *Brooklyn*, 2022

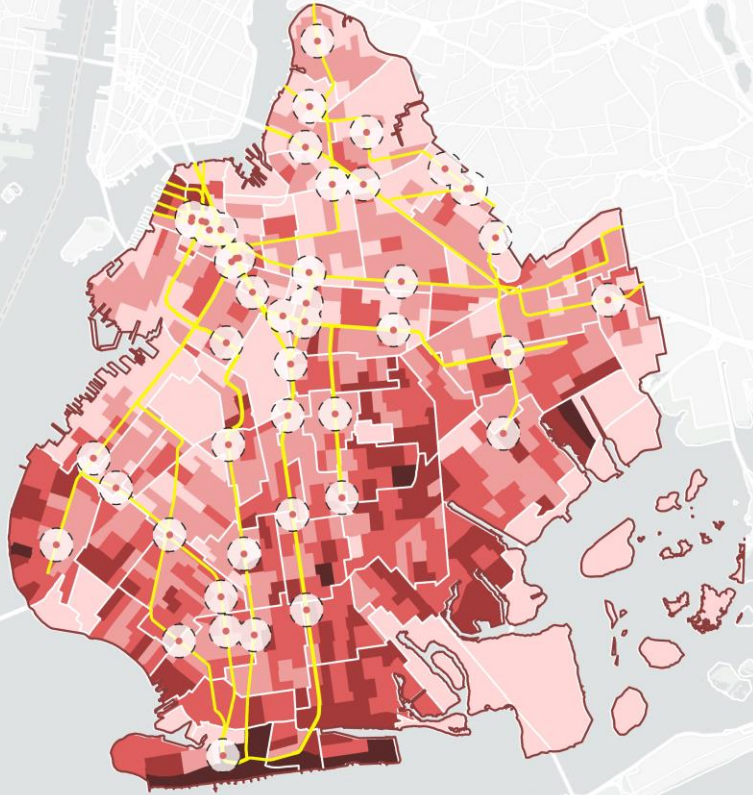
SOURCE: MTA, 2017

The buffer analysis shows subway stations within *a 5-minute walking distance*, highlighting a significant portion of *Brooklyn* that remains uncovered by the MTA system. This underscores the need for improved public transportation infrastructure to better serve and connect these underserved areas within the borough.

Accessible Subway Stations in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

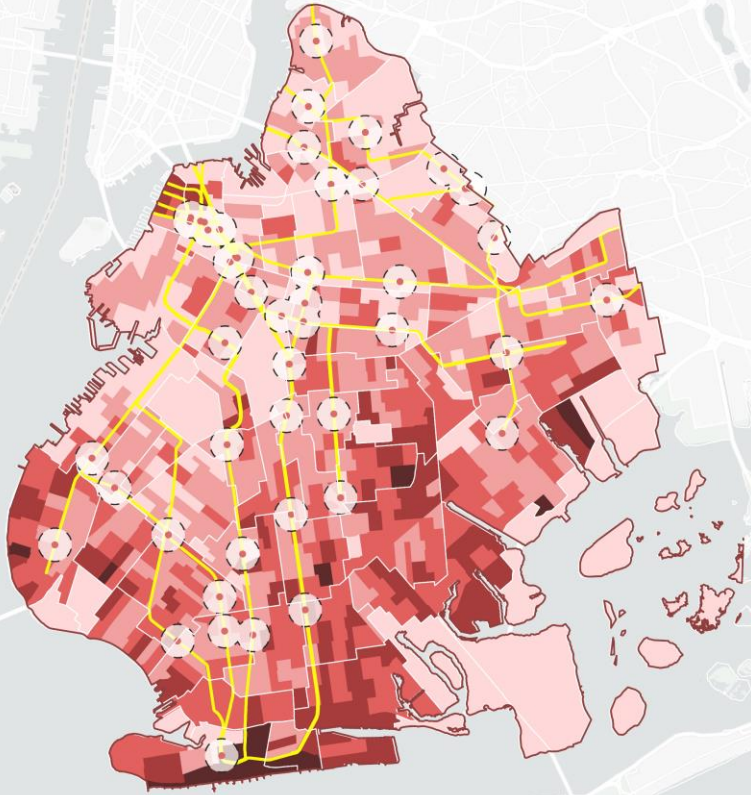
Clipping the data to only accessible subway stations reveals a lack of such stations, resulting in accessibility ***gaps in numerous neighborhoods***. This issue is particularly concerning for senior populations, as many areas with a high concentration of seniors lack any accessible stations, further limiting their mobility and access to public transportation.



Accessible Subway Stations and Senior Population Under Poverty Line in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

This map combines accessible subway stations, their 5-minute buffers, subway lines, and graduated color map of areas with *senior population under poverty line* to analyze transportation accessibility for seniors in Brooklyn.



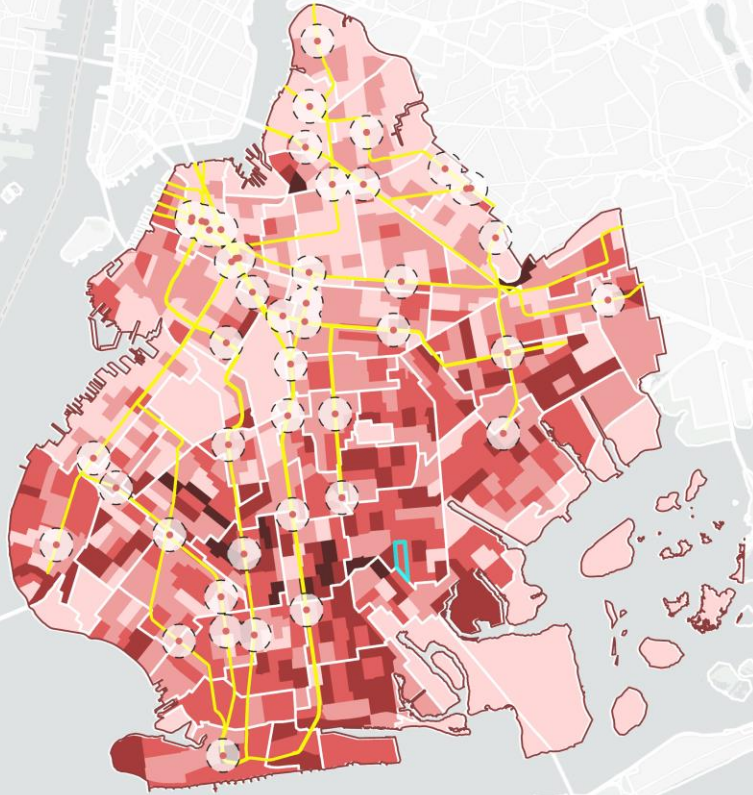
Neighborhood Boundary
Accessible Station
Accessible Station within 5-Minute Walking Distance
Subway Lines
Population above 65 years old with Poverty
0 % - 8 %
9 % - 15 %
16 % - 22 %
23 % - 32 %
33 % - 50 %

0 0.5 1 2 3 4 Miles

Accessible Subway Stations and Senior Population who Commutes in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

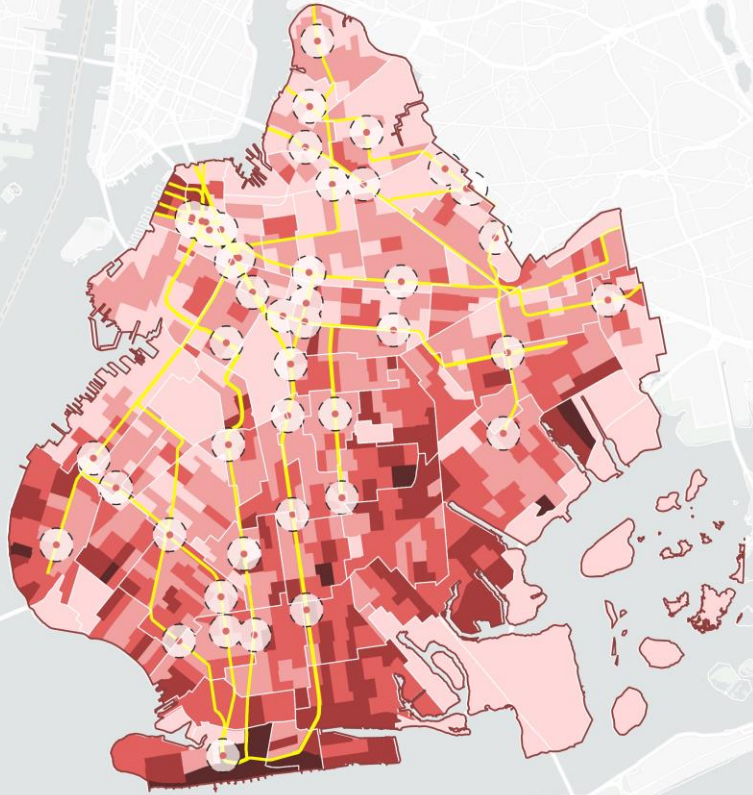
This map combines accessible subway stations, their 5-minute buffers, subway lines, and graduated color map of areas with *senior population who commutes* to analyze transportation accessibility for seniors in Brooklyn.



Accessible Subway Stations and Senior Population with Disability in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

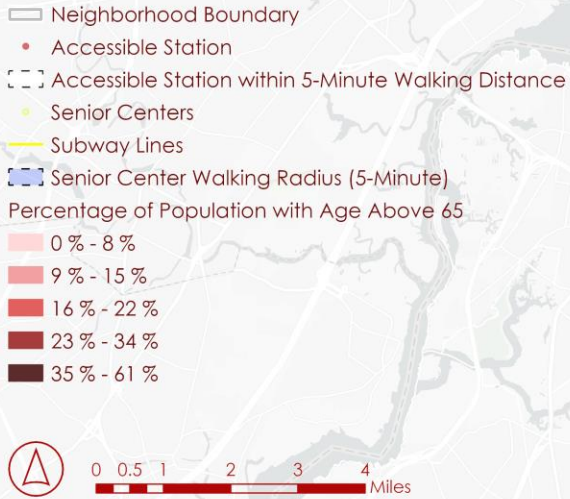
This map combines accessible subway stations, their 5-minute buffers, subway lines, and graduated color map of areas with a ***senior population with disability*** to analyze transportation accessibility for seniors in Brooklyn.

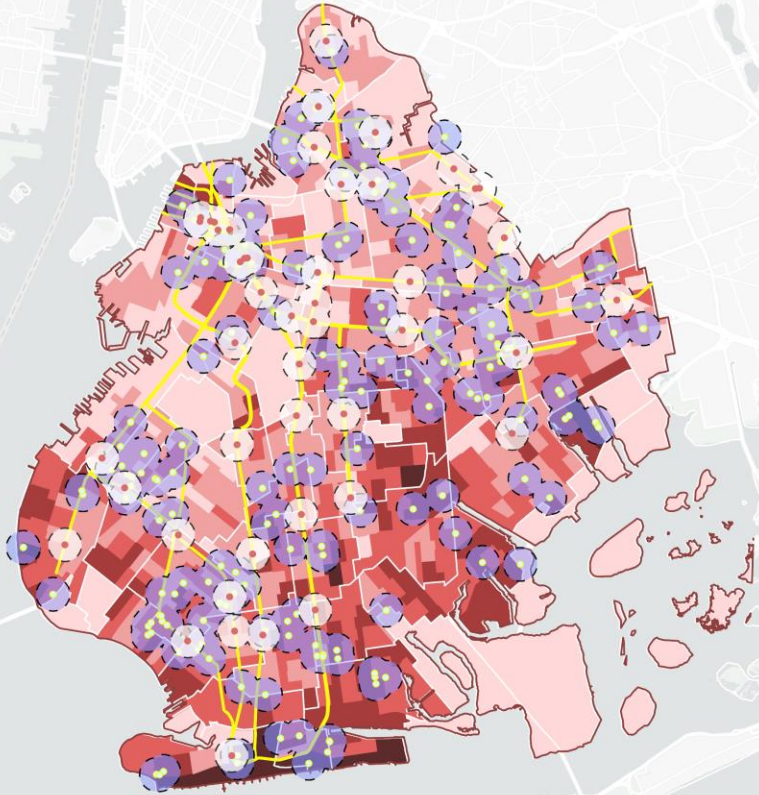


Accessible Subway Stations and Senior Centers in *Brooklyn*, 2022

SOURCE: MTA(2022) & NYCHA (2017)

This map combines accessible subway stations, their 5-minute buffers, subway lines, a graduated color map showing areas with senior population, and the locations of senior centers within a 5-minute walking distance. This analysis aims to see the transportation accessibility for seniors in Brooklyn while also considering *the proximity of senior centers* to accessible stations, highlighting potential areas for improvement and accessibility.

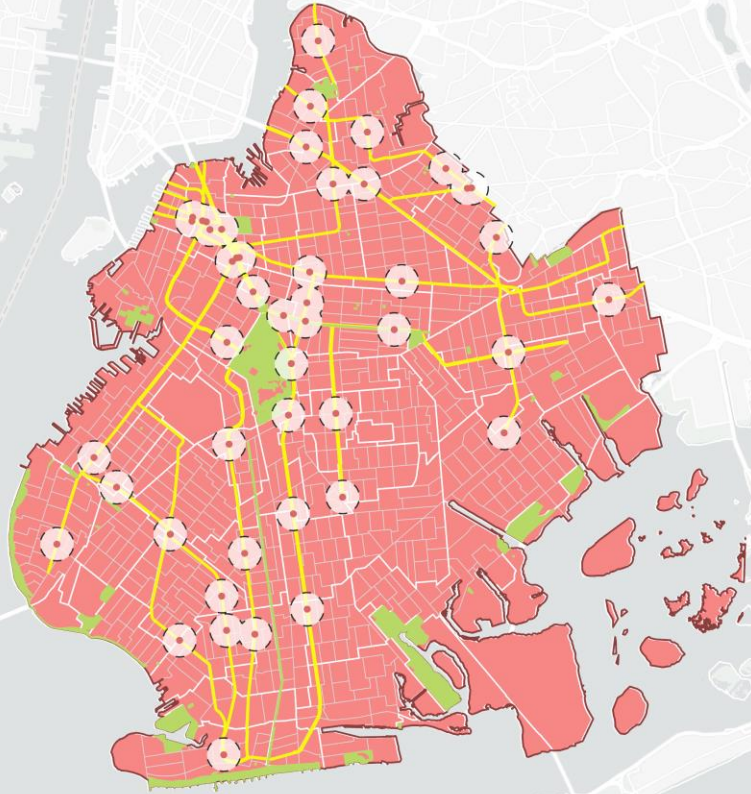




Accessible Subway Stations and Parks in *Brooklyn*, 2022

SOURCE: MTA (2022) & NYC PARKS (2017)

This map combines accessible subway stations, their 5-minute buffers, subway lines, a graduated color map showing areas with senior population, and the locations of parks in Brooklyn. This analysis aims to see the transportation accessibility for seniors in Brooklyn while also considering *the proximity of parks* to accessible stations, highlighting potential areas for improvement and accessibility.



Neighborhood Boundary
Accessible Station
Accessible Station within 5-Minute Walking Distance
Subway Lines
NYC Parks

0 0.5 1 2 3 4 Miles

Accessible Subway Stations, Senior Centers, and Parks in *Brooklyn*, 2022

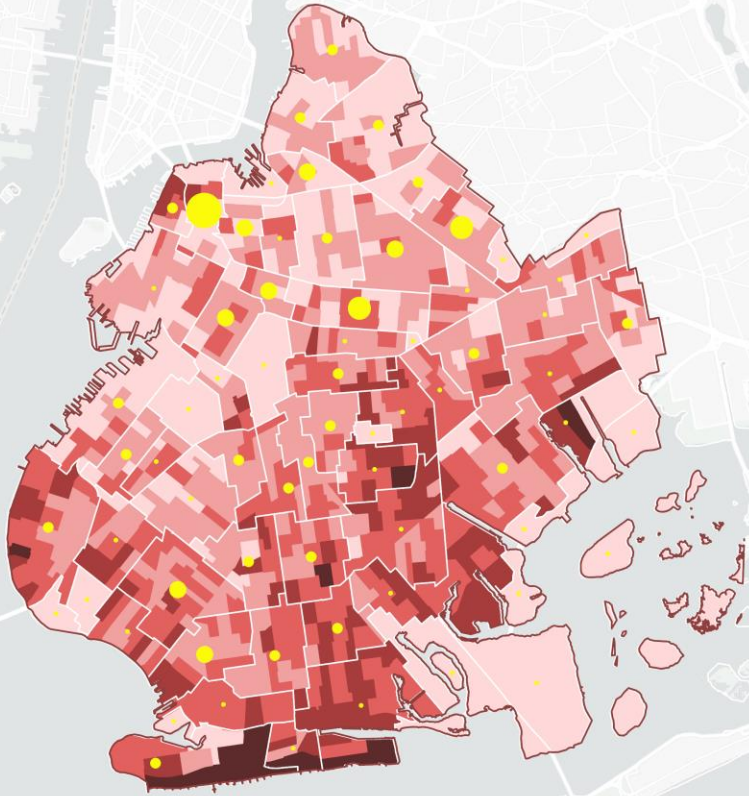
SOURCE: NYCHA, NYC PARKS, (2017) MTA & ACS (2022)

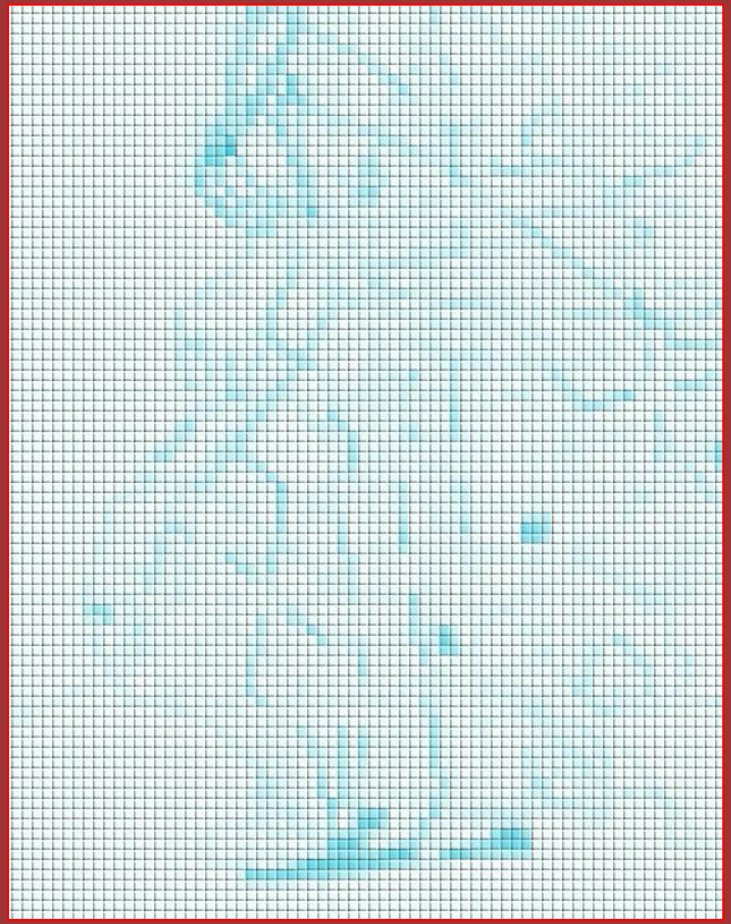
This map utilizes both 5-minute buffer zones and graduated colors to analyze all the previously mentioned variables. It aims to ***identify the existing gaps*** in senior center distribution, facilities, and the availability of accessible subway stations.

Availability of Accessible Subway Stations on Neighborhood in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

This map utilizes *proportional symbols and spatial join* to show the count of points of accessible subway stations within individual neighborhoods, with the maximum number being 3 stations per neighborhood and the minimum being 0 stations.



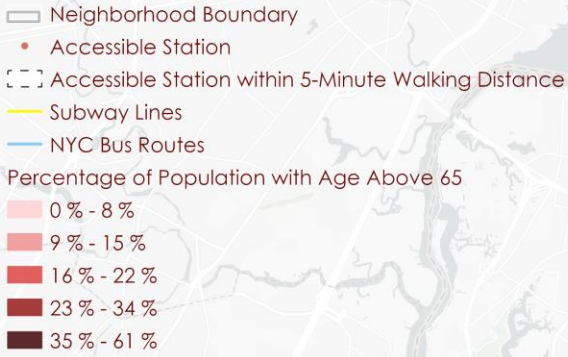


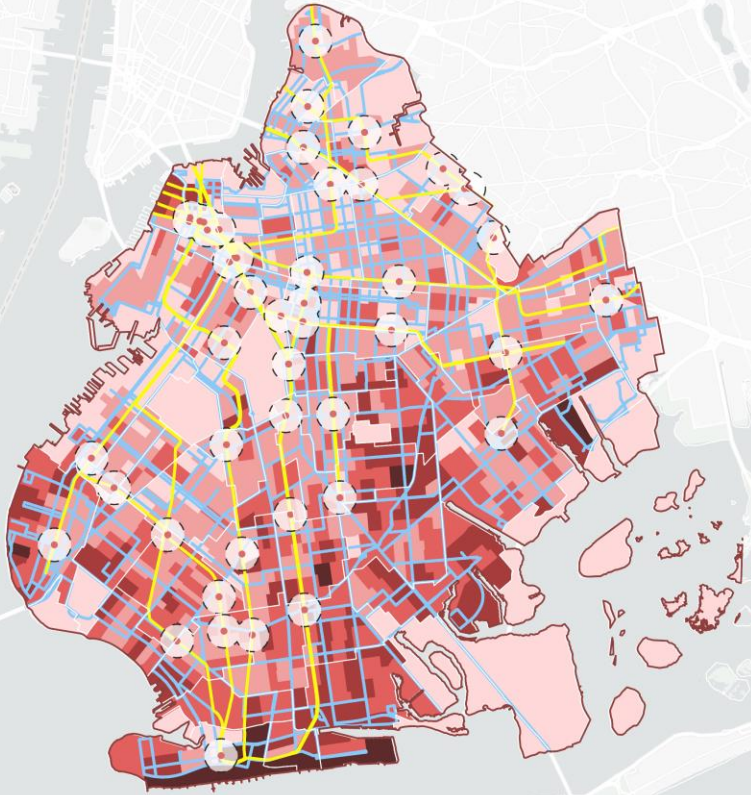
RQ4: Where are the bus stops and bus lines in *Brooklyn*? Do they cover the gaps within the lack of coverage of Accessible Station?

Accessible Subway Stations & Bus Lines in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

This map integrates accessible subway stations, their 5-minute buffers, subway lines, bus lines, and a graduated color map showing areas with senior populations. This map reveals that the bus lines helps to address the previously existing gaps in access towards accessible stations.

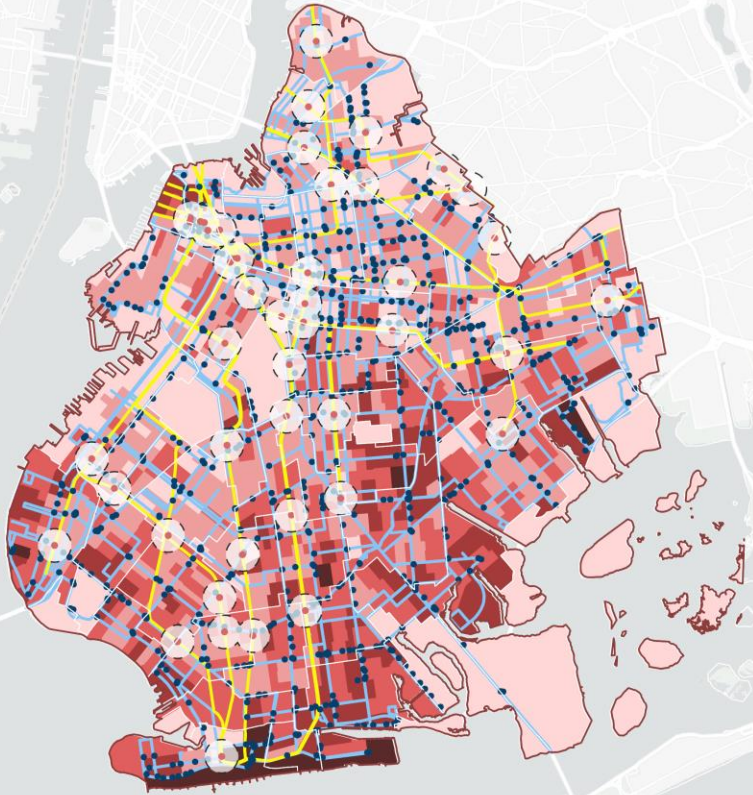




Accessible Subway Station within 5-Minute Walking Distance & Bus Stops in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

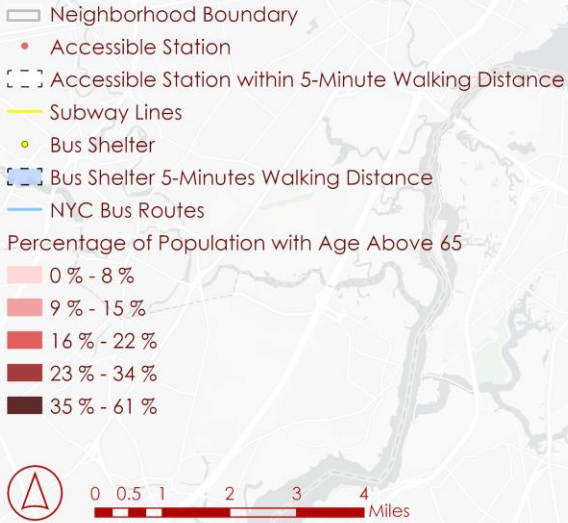
This map integrates accessible subway stations, their 5-minute buffers, subway lines, bus lines, bus stops and a graduated color map showing areas with senior populations. This map reveals that the robust bus system in Brooklyn plays a role in mitigating the previously existing gaps in access towards accessible stations.

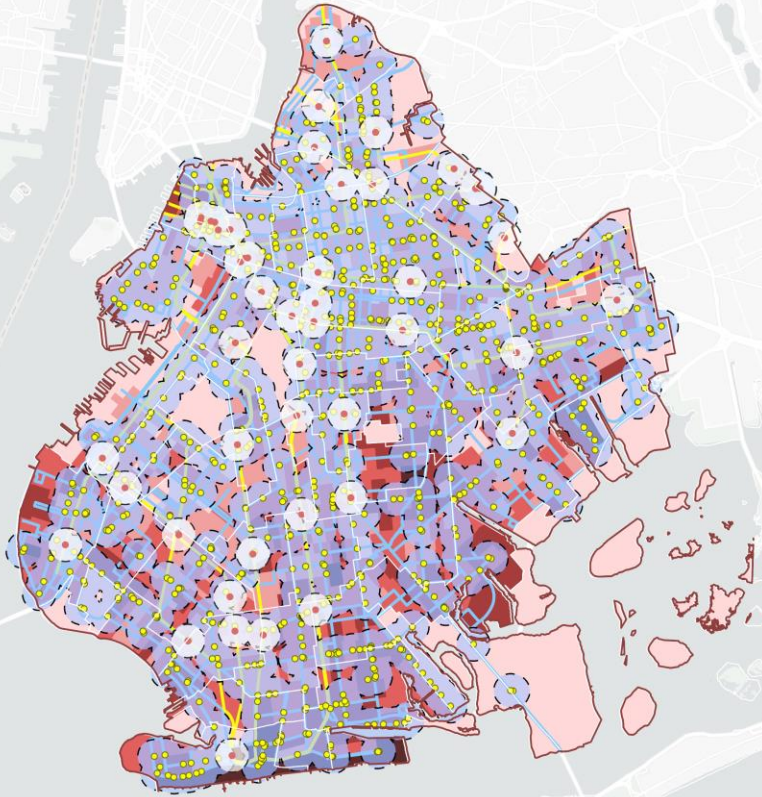


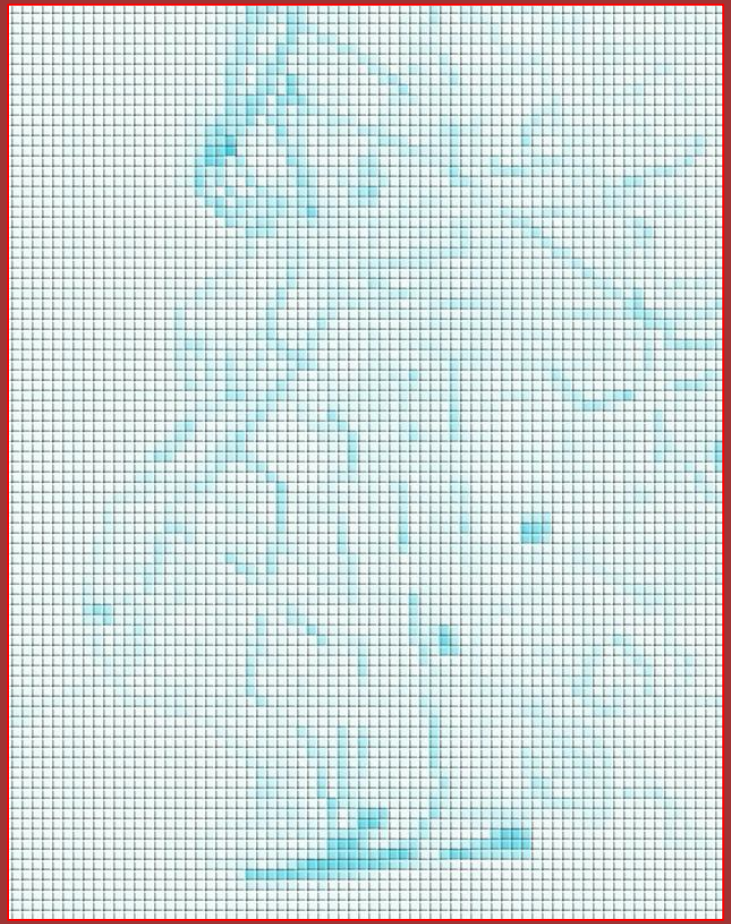
Accessible Subway Station & Bus Stops within 5-minute Walking Distance in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

The overlap of 5-minute buffers around bus stops and subway stations shows the bus system's role in filling accessibility gaps. However, in many cases, for senior, transferring between buses can be inconvenient, thus, the availability of additional accessible stations in areas with high concentrations of seniors is till needed.







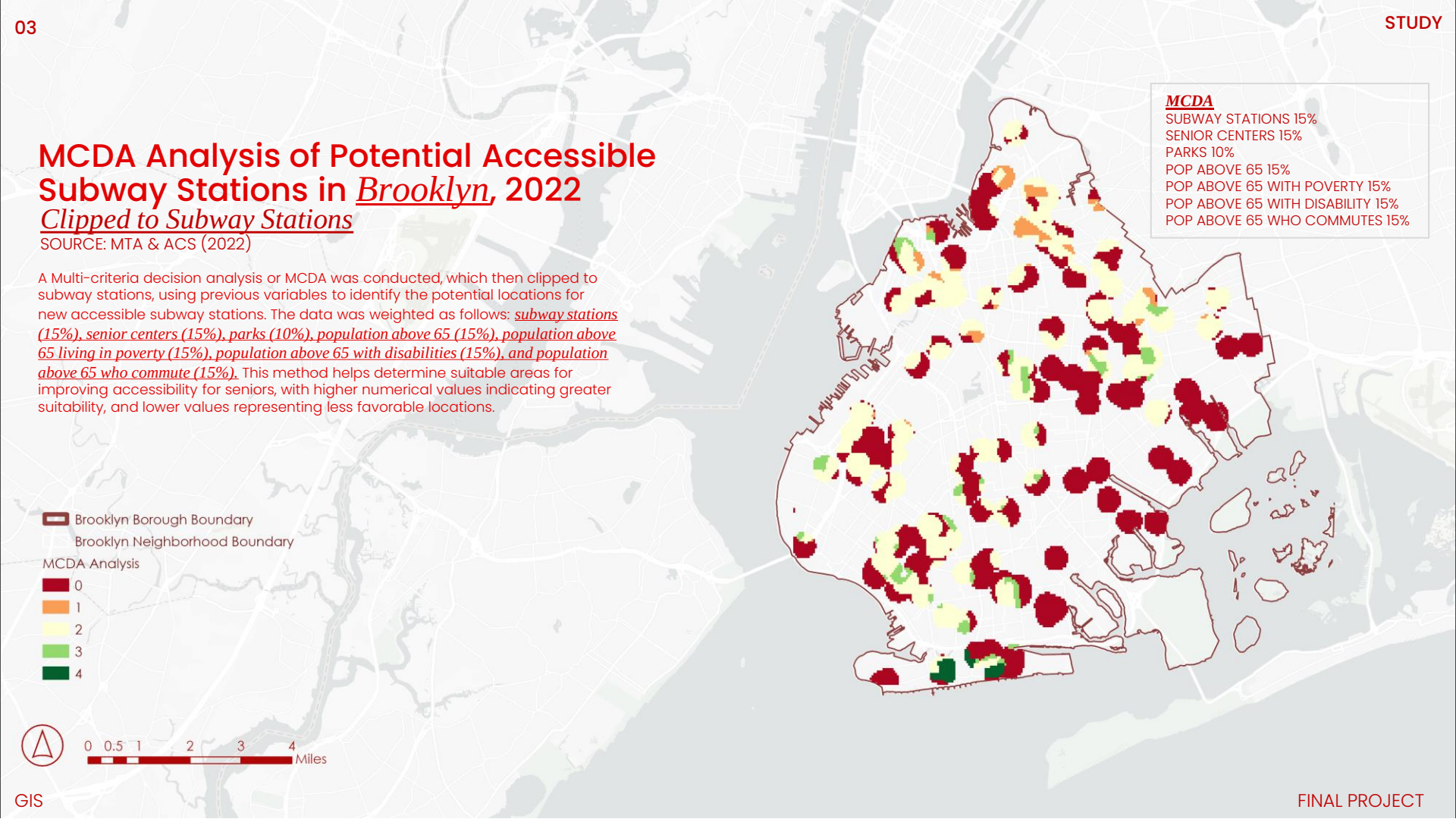
RQ5: What are the optimal locations for new accessible subway stations to improve accessibility for the senior population in *Brooklyn*?

MCDA Analysis of Potential Accessible Subway Stations in *Brooklyn*, 2022

Clipped to Subway Stations

SOURCE: MTA & ACS (2022)

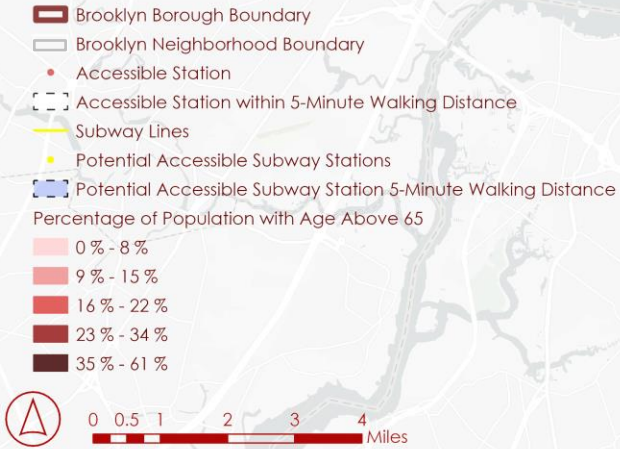
A Multi-criteria decision analysis or MCDA was conducted, which then clipped to subway stations, using previous variables to identify the potential locations for new accessible subway stations. The data was weighted as follows: *subway stations (15%), senior centers (15%), parks (10%), population above 65 (15%), population above 65 living in poverty (15%), population above 65 with disabilities (15%), and population above 65 who commute (15%).* This method helps determine suitable areas for improving accessibility for seniors, with higher numerical values indicating greater suitability, and lower values representing less favorable locations.

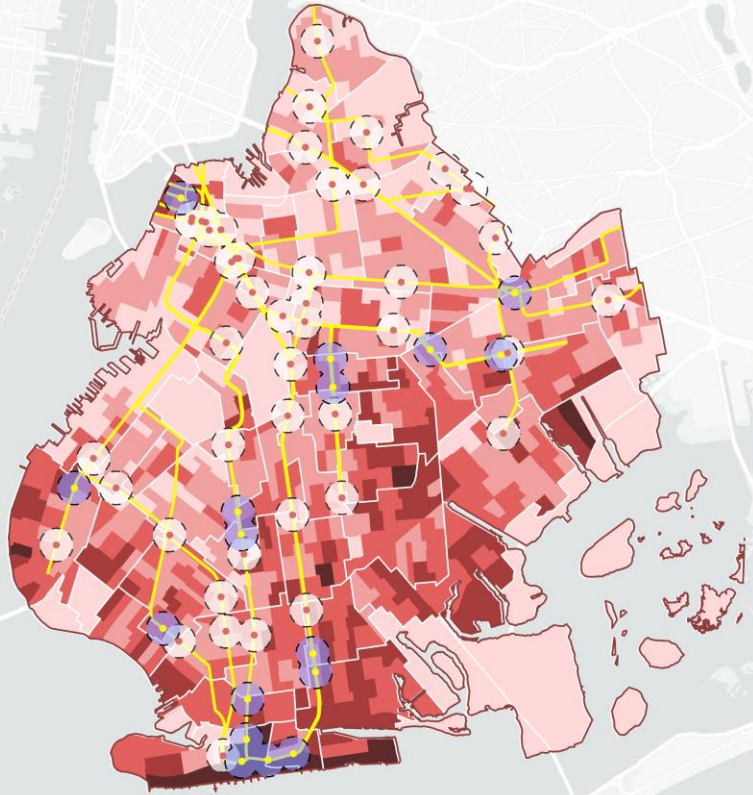


Potential Accessible Subway Stations in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

Based on the Multi-Criteria Decision Analysis or MCDA, several subway stations in Brooklyn have been identified as potential candidates for upgrading to accessible stations. These stations include *Brighton Beach, Ocean Pkwy, W 8th St - NY Aquarium, Neptune Ave, Ave X, Neck Rd, Ave U, 20th Ave, Ave I, 18th Ave, Bay Ridge Ave, Winthrop St, Sterling St, Sutter Ave, Rutland Road, Junius St, and Alabama Ave*. The selection of these stations is based on the MCDA's weighted criteria, which assess various factors, such as proximity to senior centers, parks, and the population above 65, to determine their suitability for accessibility improvements.

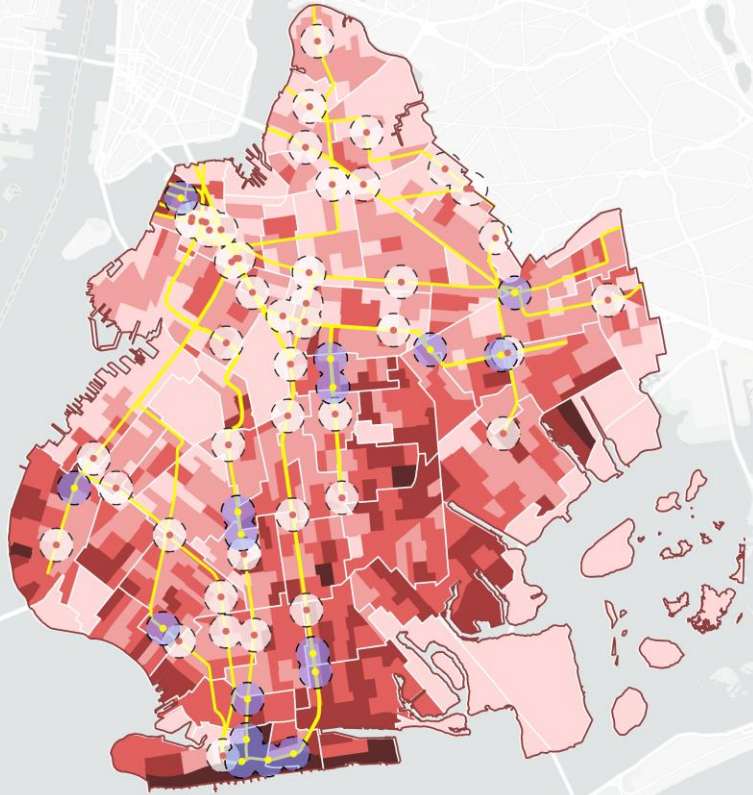




Potential Accessible Subway Stations in *Brooklyn*, 2022

SOURCE: MTA & ACS (2022)

POTENTIAL ACCESSIBLE STATION
BRIGHTON BEACH
OCEAN PKWY
W 8TH ST - NY AQUARIUM
NEPTUNE AVE
AVE X
NECK RD
AVE U
20TH AVE
AVE I
18TH AVE
BAY RIDGE AVE
WINTHROP ST
STERLING ST
SUTTER AVE
RUTLAND ROAD
JUNIUS ST
ALABAMA AVE



01 The neighborhood in Brooklyn that has the highest senior population is the *Coney Island – Brighton Beach* neighborhood, with tracts having high senior percentage ranging from 38-61%

02 The lack of adequate accessible stations in *New York City* is proven by current data which reveals that as of 2022, only 33 of all the stations in Brooklyn are accessible stations. These accessible stations does not cover a lot of areas with a concentrated senior population, including those with various needs or in proximity to senior centers.

02 While the current data reveals the lack of accessible subway stations, the bus routes and stops in *Brooklyn* does cover the gaps in connecting people to accessible station. Although in many cases, for the senior population, transferring between buses can be inconvenient, thus, the availability of additional accessible stations in areas with high concentrations of seniors is till needed.

04 Analysis combining ACS data and the existing availability of accessible stations in Brooklyn indicates potential areas for improvement. Enhancing several stations to be more accessible can significantly enhance transit services for the senior population in these areas.

Limitations & Next Steps

The utilization of data from ***multiple years*** in the context of GIS mapping might contribute to inconsistencies. There is also an absence of data from the ACS.

In ***future study***, implementing regression analysis can be conducted to illustrate the relationships between the variables.

Furthermore, developing a land-use map would be recommended to identify the ***predominant function*** associated with current existing accessible stations.

Sources

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ACS, NYC Parks, NYC DCP, MTA & NYCHA Data obtained from https://opendata.cityofnewyork.us/ are used in the creation of the maps.

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