



# **NYC CONGESTION ZONE POLICY *A SPATIAL ANALYSIS***

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# BACKGROUND

## CONGESTION PRICING BACKGROUND

Traffic in New York City is notoriously heavy and can cause significant delays for drivers. In an effort to reduce congestion, the city has proposed added tolls at roads and bridges entering Manhattan below 60th street. These tolls can add up quickly and become a significant cost for frequent commuters, but the city reasons new fares will mostly affect wealthier drivers.

Formally named, "The Congestion Zone", toll sensors will be constructed at the area of Manhattan south of Central Park to automatically bill drivers commuting from upper to lower Manhattan. Tolls would range from \$15 dollars for cars, to \$24 dollars for small trucks, and \$36 for large trucks.

There will be certain exemptions granted under this pricing plan. Firstly, any Manhattan resident living in the congestion zone making under \$60,000 will be reimbursed for 50% of their zone entry fares in the form of a tax credit. Additional exemptions include emergency vehicles, and cabs and for hire vehicles will pay a limited fare charge passed onto their customers.

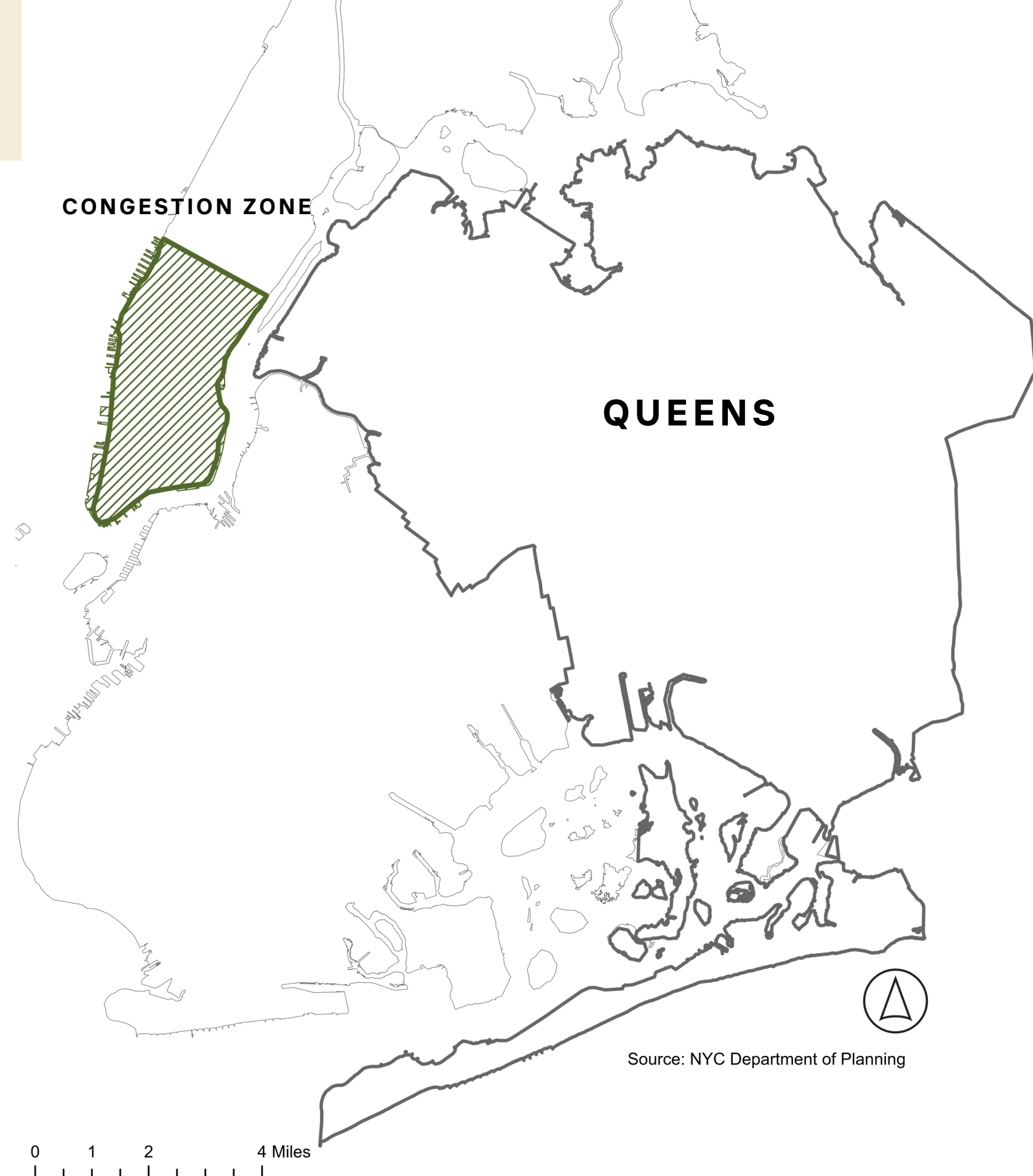
A \$5 discount will be applied to Manhattan entry at its four major tunnels, where toll fees are already in place.

*Starting prospectively in Spring 2024, cars entering Manhattan at 60th Street and below will be charged a \$15 congestion fee.*

With the zone in place, New York will follow in the footsteps of several other global cities such as London, Stockholm, Milan and Singapore that have successfully utilized similar congestion zone schemes as strategies for reducing traffic, improving travel speeds, and reducing air pollution.

However, critics of the proposed congestion pricing strategy argue the policy will disproportionately affect low income drivers in parts of the city outside direct access to mass transit options, and will pass on unrealistic travel costs onto businesses and low-income workers.

One such area of the city relying on automobile travel to Manhattan is Queens, where 29% of its 88,000 workers commute to Manhattan daily, many from census tracts where upwards of 70% of the neighborhood rely on cars to get to work, and are outside of close walking access to train stations.



# RESEARCH QUESTION

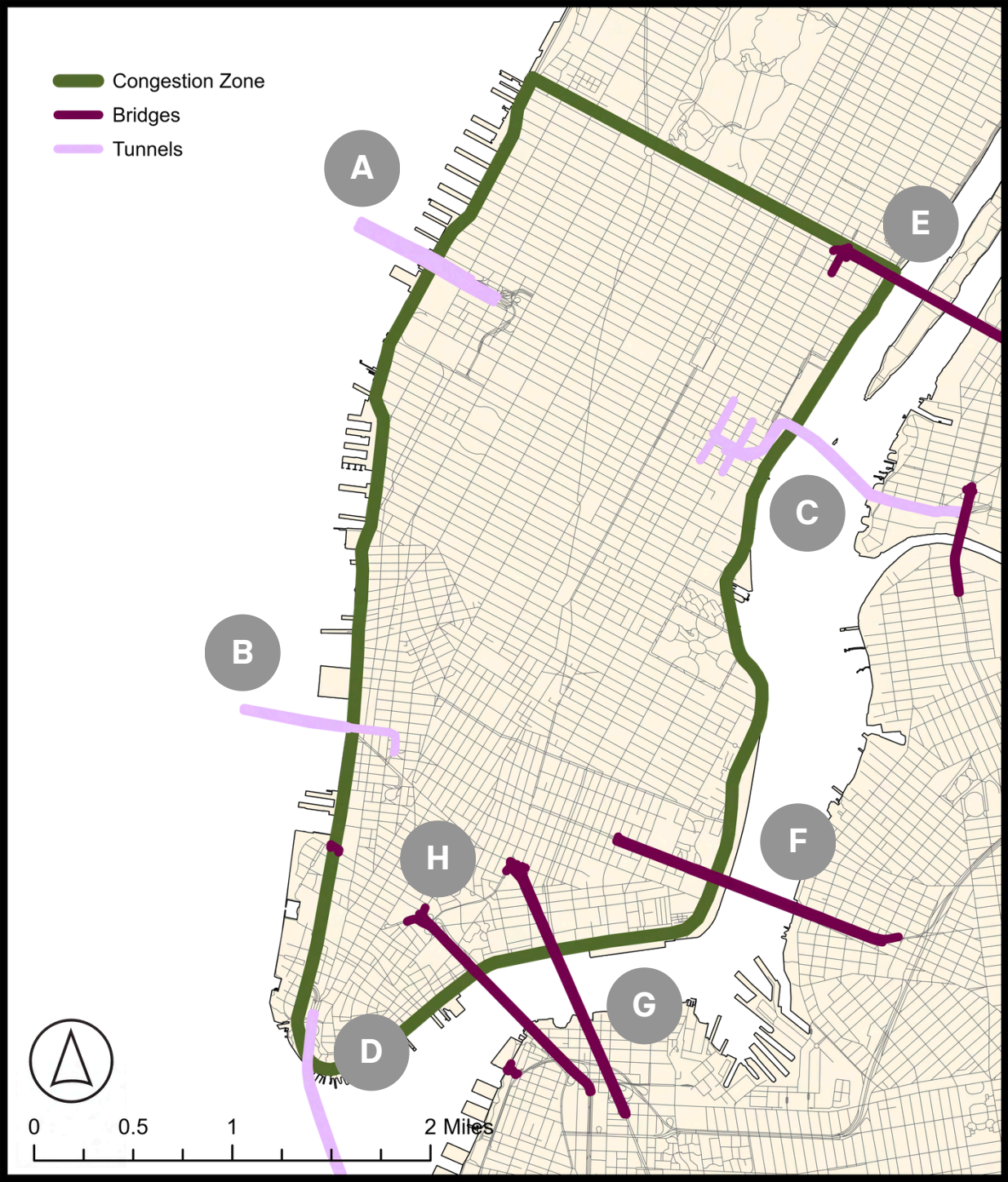
*In which areas of Queens will congestion pricing exacerbate transportation inconveniences for automobile commuters?*

## CURRENT MANHATTAN ENTRANCE FEES

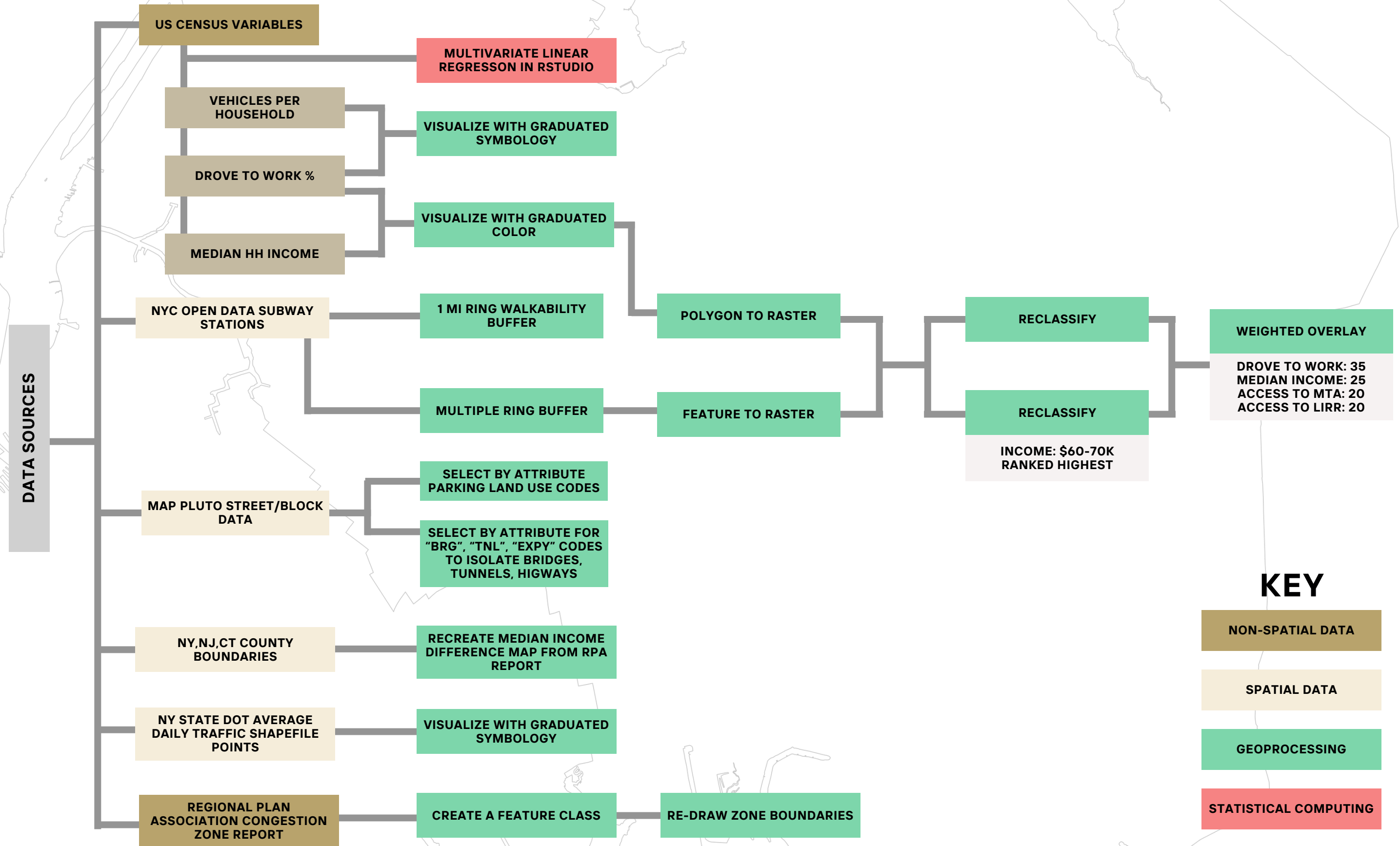
- A Lincoln Tunnel: \$12.50
- B Holland Tunnel: \$12.50
- C Queens-Midtown Tunnel: \$6.12
- D Hugh Carey Tunnel: \$6.12
- E Queensboro Bridge: Free
- F Williamsburg Bridge: Free
- G Manhattan Bridge: Free
- H Brooklyn Bridge: Free

## PROPOSED TUNNEL DISCOUNTS

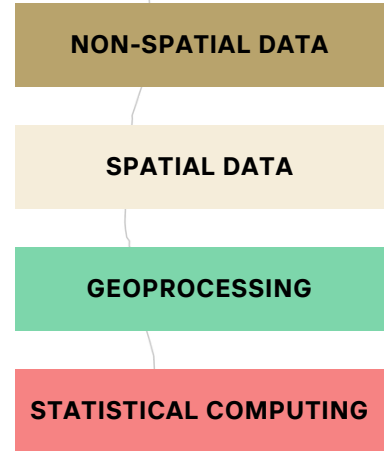
- Lincoln Tunnel: **-\$5.00**
- Holland Tunnel: **-\$5.00**
- Queens-Midtown Tunnel: **-\$5.00**
- Hugh Carey Tunnel: **-\$5.00**
- Queensboro Bridge: NA
- Williamsburg Bridge: NA
- Manhattan Bridge: NA
- Brooklyn Bridge: NA



# METHODOLOGY



## KEY





# **DEFINING THE PROBLEM**

## REASONING CONGESTION PRICING

The proposed congestion pricing rates of \$15 for cars (negotiated down from \$23) are justified by findings that difference in median household income between those who commute into Manhattan and those who work in their home county is positive in all counties surrounding the borough, regardless of the chosen transportation method. According to a report from the Regional Plan Association, car-owning households in NYC report at least double the income of non-car owning households.

Statistical computing using R-Studio of the influence of census variables "Drove to work %" and "% of Households who own 1+ Car" on the dependent variable, "Median Household Income" support these findings. There is positive correlation between automobile commuting and car ownership in Queens with higher median household income, with both independent variable coefficients reporting p-values below .05, indicating statistical significance.

However, a mapping of the difference in income between commute-to-Manhattan workers vs. home county workers shows a lower out-earning difference in New York's outer-boroughs.

*"Workers who commute into Manhattan earn more than their neighbors."*

**- REGIONAL PLAN ASSOCIATION REPORT ON CONGESTION PRICING**

These findings help to shape the goals for higher congestion pricing fees, which the city estimates could save the city over \$100M in health costs as a result of fewer traffic fatalities. Specific goals of the congestion zone include a 10% increase in weekday traffic speeds from lighter street volume, 58,00 fewer auto trips on weekdays, and 750 fewer traffic related injuries and 4 fewer deaths each year. Also included are the environmental benefits of an implemented congestion zone, which are projected to cut Co2 emissions by 7% on weekdays and reduce carbon monoxide, nitrogen oxide, and sulfur dioxide emissions by 4-5%.



**DIFFERENCE IN MEDIAN HOUSEHOLD INCOME BETWEEN THOSE WHO COMMUTE INTO MANHATTAN AND THOSE WHO WORK IN THEIR HOME COUNTY**



# AVERAGE WEEKDAY DAILY TRAFFIC

## ASSESSING TRAFFIC VOLUME

Congestion pricing is intended to affect the 9% of the metro area's 1.9M residents who commute to Manhattan daily for work. It will also target one quarter of Manhattan's "in-commuters" from different regions, primarily residents arriving from areas north and east of the city.

Much of the daily traffic entering Manhattan happens at choke points—along surrounding city highways, but also predominantly in bridges and tunnels, and along channels transporting commuters vertically on Manhattan's edges such as at FDR Drive and the West Side Highway.

"Infrastructure capacity", or the count of available traffic lanes and rail tracks entering Manhattan can be lacking at certain points compared to the amount of commuters trying to bisect the city.

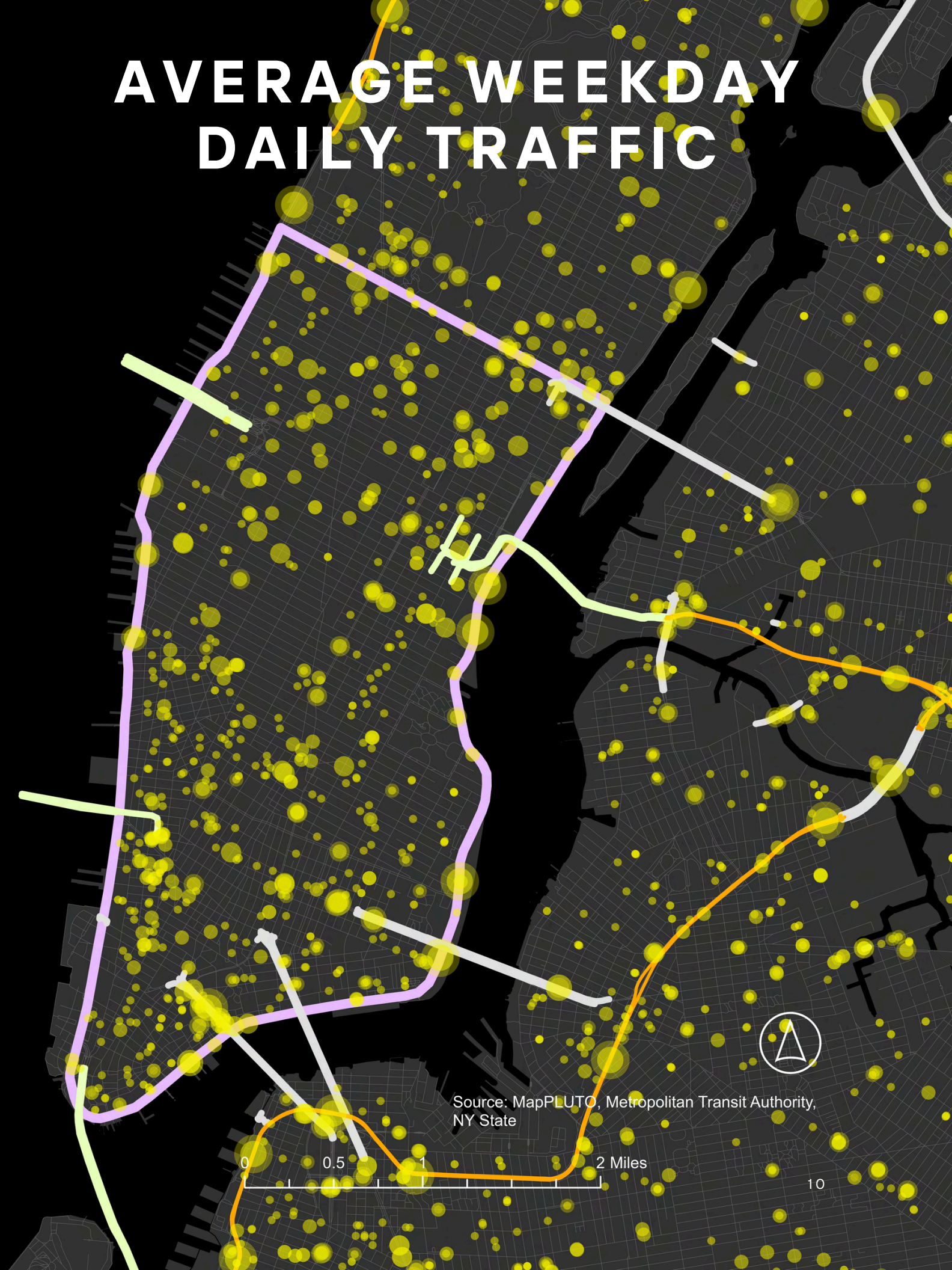
The Manhattan central business district, where a quarter of regional economic activity is concentrated, is the primary source of traffic congestion across the city. Excess congestion increased 53% since 2006, rising to a cost of \$20 billion annually. This figure mostly represents travel time and revenue losses as well as excess fuel and vehicle operating losses, and is estimated to cost the average Queens commuter between \$1,500 - 1,900 a year in traffic delays.

**Legend**

**Traffic Sensor Counts**

- 0 - 6828
- 6829 - 21588
- 21589 - 53617
- 53618 - 111808
- 111809 - 231761

Highways  
Tunnels  
Bridges  
Congestion Zone



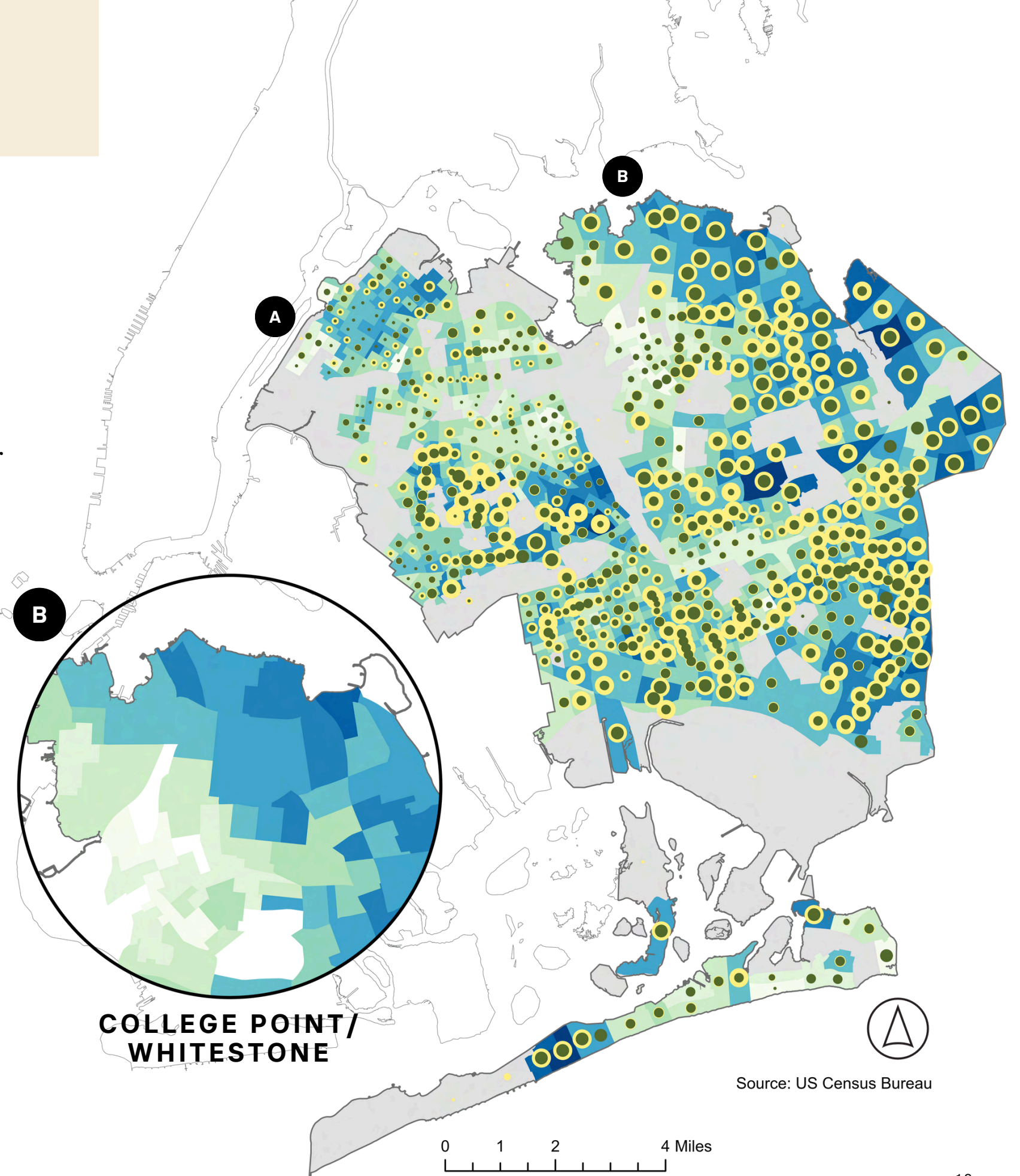
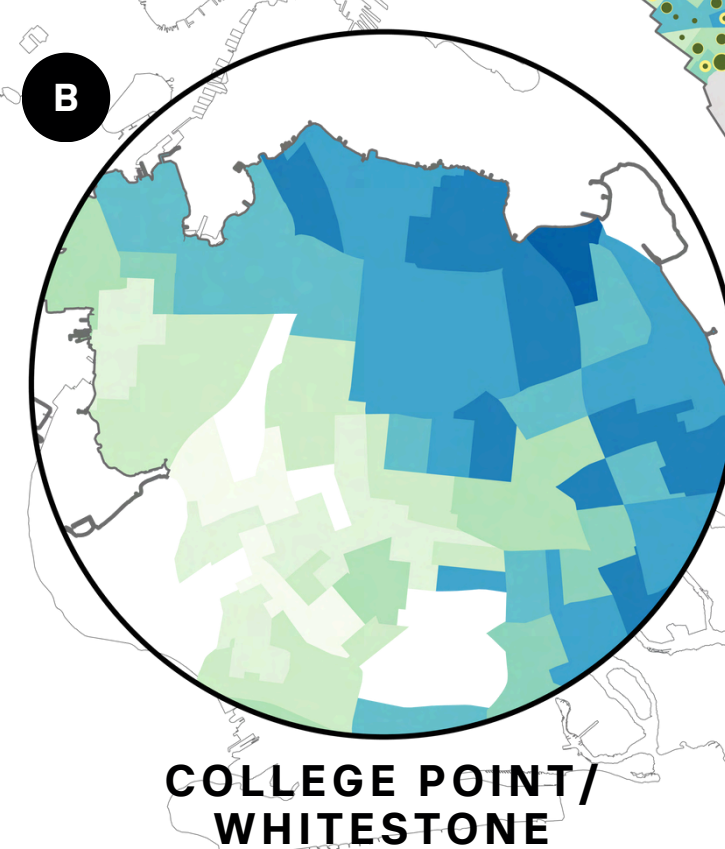
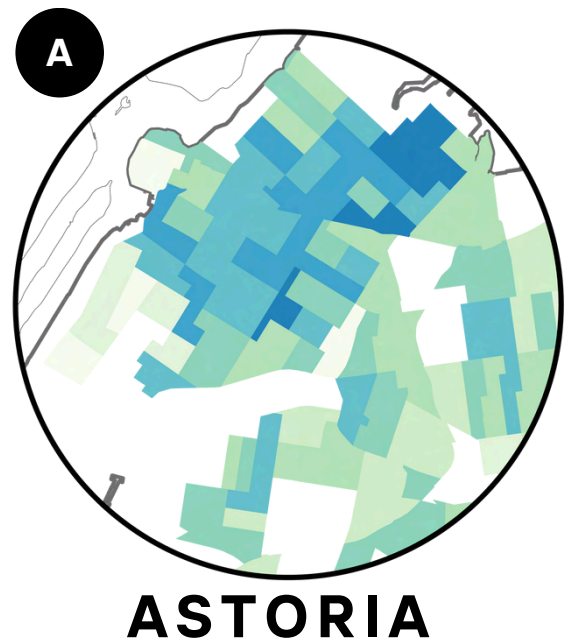
Source: MapPLUTO, Metropolitan Transit Authority, NY State

# COMPARING CAR USE TO INCOME












As congestion pricing soon takes effect, portions of outer-Queens will either see drive to work percentages decrease, or remain steady given the abundance of commuters driving to non-Manhattan boroughs. 34% of Queens workers do work in county, and 29% of residents commute by car to non-Manhattan destinations.

Despite a correlation between both the percentage of residents who drive to work as a means of commuting and the percentage of households who own a car as indicators of median household income in Queens, a spatial analysis does not show wide variation between neighborhoods. For example, the two neighborhoods of Astoria and College Point/Whitestone differ greatly with respect to their proximity to Manhattan and automobile ownership and dependence, yet do not reflect widely different median household income levels.

*While outer-Queens residents are more likely to own cars and use them to commute to work compared to inner residents, these neighborhoods do not experience extremely higher levels of household income*



**Legend**

<b>Drove to work %</b>	<b>% Households with 1+ vehicles</b>	<b>Median Household Income</b>	 \$67,000.01 - \$74,000
• 0.1 - 20.0	• 0.1 - 40.0	 \$19,200 - \$36,100	 \$74,000.01 - \$82,000
• 20.1 - 40.0	• 40.1 - 60.0	 \$36,100.01 - \$51,000	 \$82,000.01 - \$93,000
• 40.1 - 60.0	• 60.1 - 80.0	 \$51,000.01 - \$60,000	 \$93,000.01 - \$107,000
• 60.1 - 80.0	• 80.1 - 100.0	 \$60,000.01 - \$67,000	 \$107,000.01 - \$131,000
• 80.1 - 100.0		 No Data	 \$131,000.01 - \$164,000

Source: US Census Bureau



# **SPATIAL ANALYSIS**

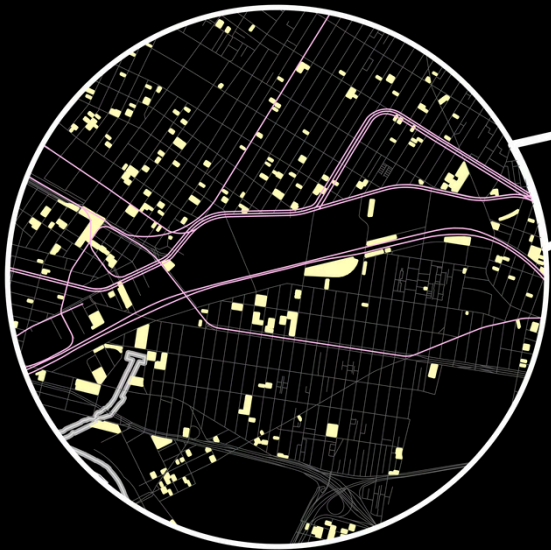
# PARKING FACILITIES

## TRANSIT ALTERNATIVE

One transit alternative outside to avoid increased congestion fares is the “park and ride” strategy, in which commuters drive to nearest train stations in the first leg of their commutes, and take the train the rest of the way.

Most of the parking facilities in Queens are concentrated close to Manhattan, and in some cases could provide an alternative to paying increased congestion prices. However, this affordability is context dependent: outer-borough facilities will charge less for parking, but more for LIRR tickets while closer to Manhattan facilities will likely charge higher parking rates but will offer more affordable MTA fares.

As congestion pricing takes effect, transit studies should account for the possibility that outer-borough train stations not only demand more seating capacity on train cars, but also an increase in parking spaces surrounding stations.



**Legend**

- Train Lines
- Parking Facilities



Source: MapPLUTO, Metropolitan Transit Authority

# AUTOMOBILE DEPENDENCY












A 2017 study by the Community Service Society found that only 4% of outer-borough residents commute to Manhattan by car and half this figure are considered "higher income" earners. Additional findings conclude that 18 times more NYC commuters would gain from transit improvements than would likely pay new tolls.

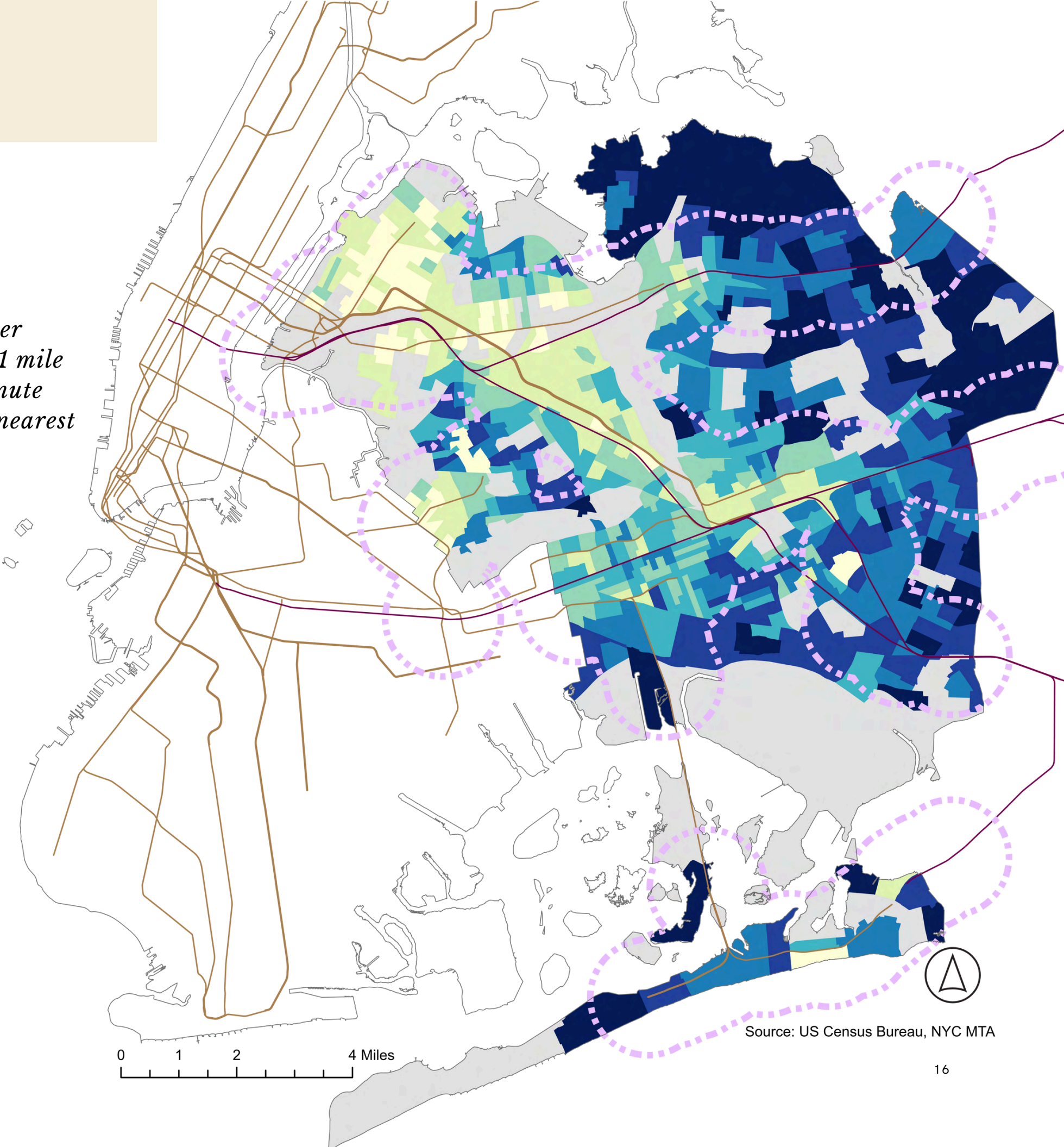
These findings highlight realistic suggestions for use of congestion pricing revenue that would benefit working class commuters, such as improving public transit and offering half-fare MetroCards. However, framing automobile dependency as a wealth advantage may inadvertently imply that residents with marginally higher incomes avoid public transit due to its perceived lack of appeal as a transportation option, and not due to the distance of access these residents live to train stations.

A spatial analysis of Queens census tracts by percentage of those who drive to work reveal that many residents live outside a mile access to the nearest MTA or Long Island Rail Road Station. For some Queens workers, walking to LIRR stations (where one-way fares start at \$11.25 on peak hours) can extend commutes by more than 20-30 minutes.

*Many residents in outer Queens live beyond a 1 mile radius, or 20 - 30 minute walking access to the nearest Long Island Railroad Station*

## Legend

-  1 Mi Buffer
-  LIRR Line
-  MTA Line
- % Drove to work**
-  0.01 - 17.5
-  17.6 - 27.7
-  27.8 - 36.9
-  37.0 - 45.1
-  45.2 - 52.8
-  52.9 - 62.0
-  62.1 - 78.6
-  No Data



Source: US Census Bureau, NYC MTA

## MULTI-CRITERIA DECISION ANALYSIS

The most recent draft of the congestion zone pricing policy stipulates that residents making at or below \$60,000 living within Manhattan's congestion zone will receive 50% of their entry fees reimbursed to them in the form of a tax credit, after a minimum of 10 trips taken a month.

Queens drivers would benefit if this policy were applied to residents of all NYC boroughs, where the margin of income between in-county vs Manhattan commuters is slimmer than in farther out, more affluent counties.

Applying a Multi-Criteria Decision analysis helps to identify neighborhoods in Queens that would benefit from expanding Manhattan's congestion zone toll credit repayment policy across all boroughs. It also pinpoints areas where refinement in the language of congestion pricing policy can more precisely delineate exemptions.

This scheme visualizes a spatially informed decision-making framework that synthesizes variables, median household income, automobile transit, and distance to train stations, and evaluates and ranks geographic locations based on their grades.



# WEIGHTING VARIABLES

## DRIVE TO WORK %

# 35%

With areas in Queens of greater dependence on automobiles being weighted higher than areas where fewer commuters drive to work

## MEDIAN INCOME

# 25%

With areas of lower median individual earnings being weighted higher than more affluent areas of Queens

## MTA STATIONS

# 20%

With areas in Queens farther in distance to MTA stations being weighted higher based on 1 mile buffers around stations

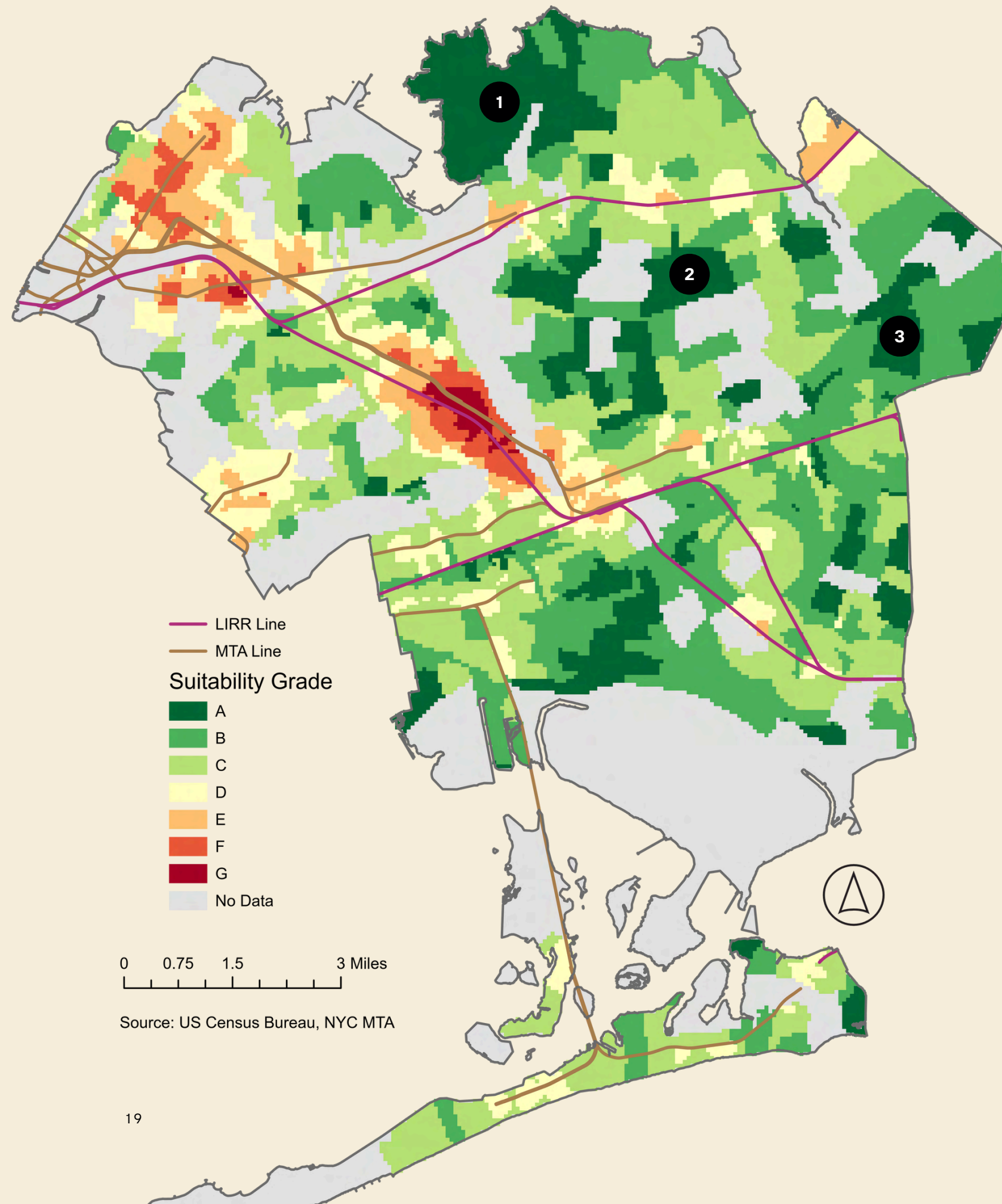
## LIRR STATIONS

# 20%

With areas in Queens farther in distance to LIRR stations being weighted higher based on 1 mile buffers around stations

# MULTI-CRITERIA DECISION ANALYSIS

*Identifying neighborhoods in Queens that would benefit from expanding Manhattan's congestion zone toll credit repayment policy across all boroughs.*



**1**

## COLLEGE POINT

13,704 WORKERS

\$36,000 AVERAGE MEDIAN INDIVIDUAL EARNINGS

29.7% EMPLOYED IN MANHATTAN

60.1% COMMUTE TO WORK BY CAR

**2**

## FRESH MEADOWS

14,719 WORKERS

\$40,328 AVERAGE MEDIAN INDIVIDUAL EARNINGS

25.6% EMPLOYED IN MANHATTAN

62.0% COMMUTE TO WORK BY CAR

**3**

## BELLEROSE MANOR

11,624 WORKERS

\$42,526 AVERAGE MEDIAN INDIVIDUAL EARNINGS

23.4% EMPLOYED IN MANHATTAN

66.9% COMMUTE TO WORK BY CAR

# MEDIAN INDIVIDUAL EARNINGS

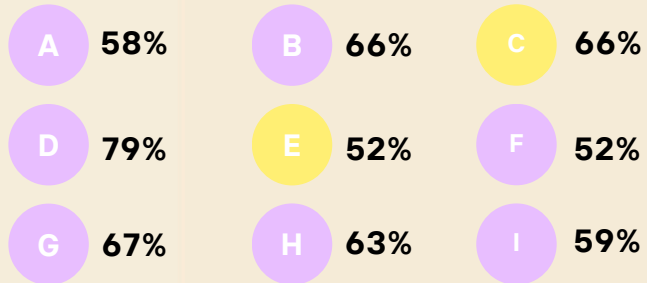
## POLICY PROPOSAL

An analysis of Queens earnings on an individual basis reveals more modest wealth than combined household income illustrates. Plenty of workers in these census tracts earn well below the \$60,000 maximum required of Manhattan residents to qualify for toll reimbursement.

Most other tracts earn just over this \$60,000 threshold, and mostly aggregated in areas of outer-Queens away from near access to train stations.

These findings suggest that the tax reimbursement policy for congestion pricing should not only apply to Manhattan congestion zone residents, or beyond to any New Yorker making at or below \$60,000, but also to any Queens resident making at or below \$70,000.

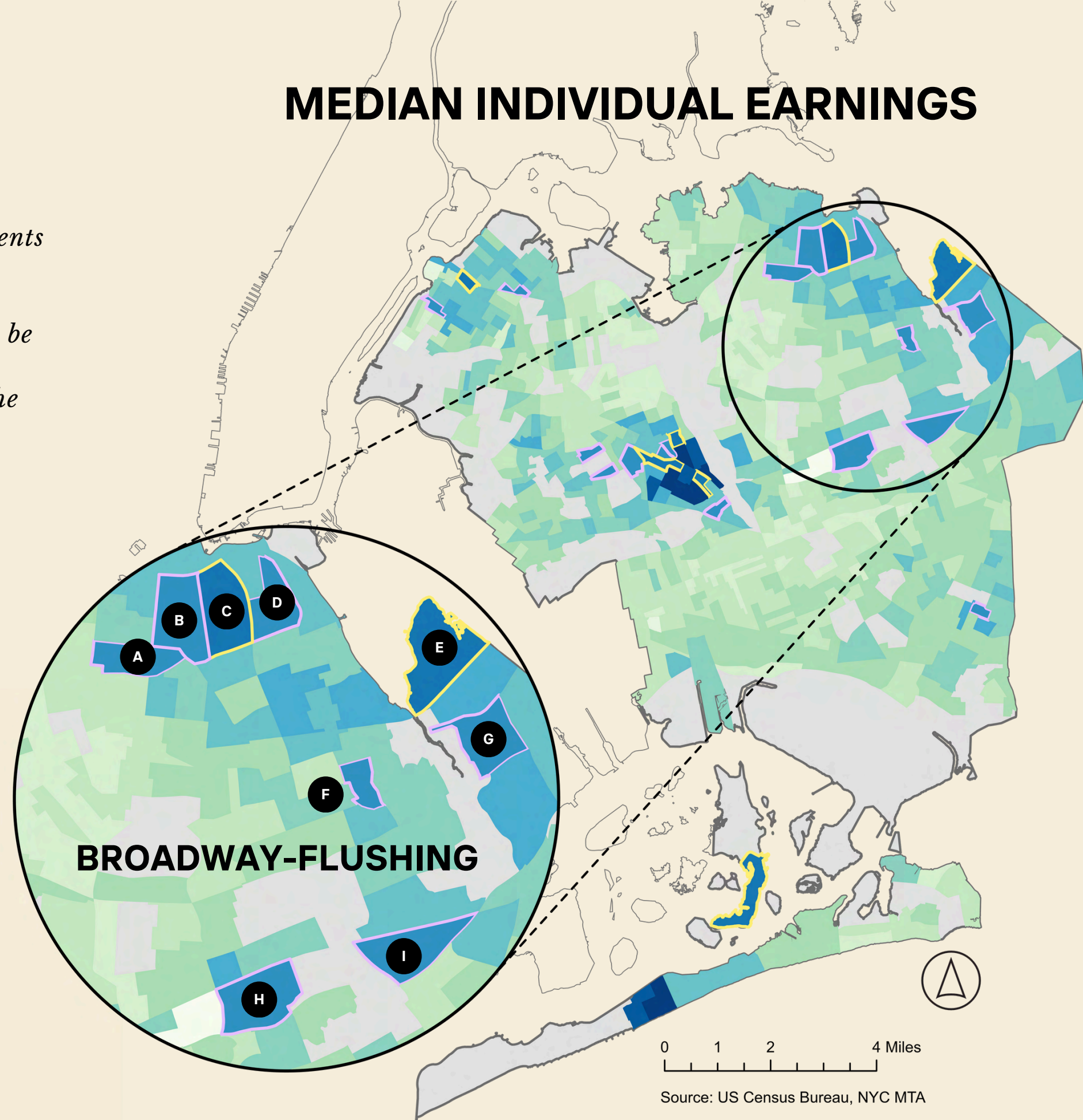
## % DROVE TO WORK



*Current Policy: Residents in the Manhattan congestion zone where income  $\leq$  \$60,000 will be reimbursed with a tax credit equal to 50% of the tolls they paid.*

*Proposal: expand this policy to Queens for residents where income  $\leq$  \$70,000*

### Median Individual Earnings





# RE-CLASSIFY SCHEME

## RECLASSIFY

Utilizing the "Reclassify" geoprocessing tool helps to identify areas that would benefit from NYC expanding its congestion fare reimbursement program to Queens residents earning between \$60,000 - 70,000. Isolating these areas is accomplished by re-classifying this income bracket with the highest weight followed by lowest income.

- 5 INCOME: \$60,000 - 70,000
- 4 INCOME: \$5,000 - 20,000
- 3 INCOME: \$21,000 - 40,000
- 2 INCOME: \$40,000 - 60,000
- 1 INCOME: \$71,000 -

## MCDA

DRIVE TO WORK %

**35%**

MTA STATIONS

**20%**

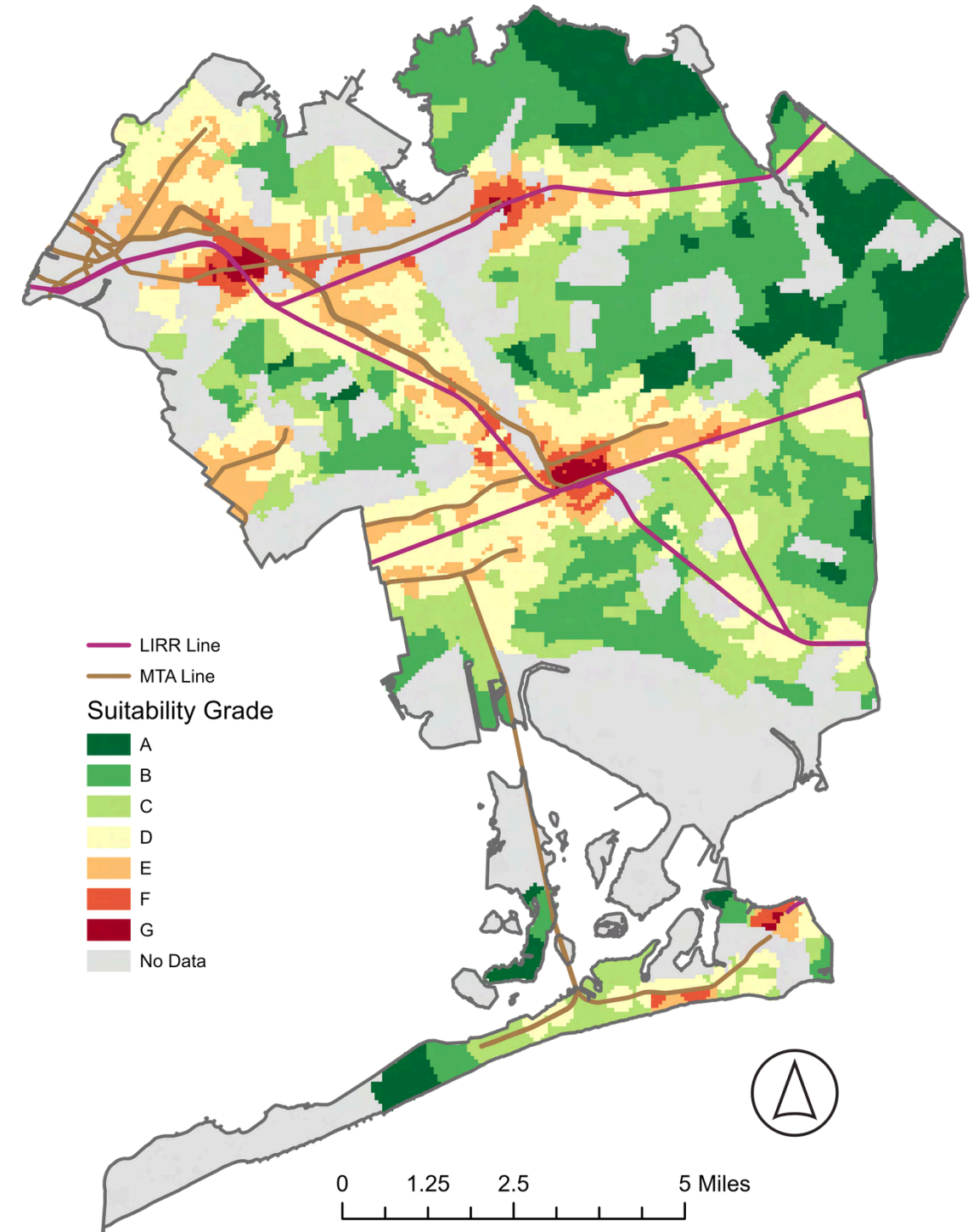
MEDIAN INCOME

**25%**

LIRR STATIONS

**20%**

## SUITABILITY MAP WEIGHTED FAVORABLY FOR EARNINGS: \$60,000 - 70,000



Source: US Census Bureau, NYC MTA



## CONGESTION

Excess traffic congestion in New York City increased 53% since 2006, and costs an estimated \$20 billion annually.

contractors making inconsistent trips to the city, who would likely not meet the city's 10 minimum trip requirement to be eligible for a 50% tax reimbursement.

This spatial analysis finds that the many Queens automobile commuters who live beyond 1 mil radii of train stations are not commuting by car out of luxury, as several congestion zone reports have portrayed. Therefore, solutions for the use of congestion zone revenue should not only focus on the improvement and maintenance of NYC's transit infrastructure but also consider station additions that connect inaccessible parts of Queens to Manhattan's MTA network.

If expanding the policy on congestion pricing exemptions to include reimbursements for Queens commuters is not feasible, it is recommended to evaluate concessions on Long Island Rail Road prices. This evaluation aims to ensure that public transportation remains a viable option for individuals who currently walk longer distances to reach stations. Additionally, considering an increase in parking availability at these stations is crucial to accommodating an anticipated rise in demand.

## CONCLUSIONS

The congestion zone reasons its pricing on the logic that commuters into Manhattan make more money than those who work in county. This focus ignores the dependence on automobiles by middle class workers in outer neighborhoods of Queens where the margin of income difference is slimmer.

Many of the workers in these areas live 1+ miles from a Long Island Railroad station, where one-way fares start at \$11.25 on peak hours.

Opportunity remains to expand the congestion zone policy for toll reimbursement for lower income earners

to all NYC boroughs, but a spatial analysis of Queens automobile dependent census tracts reveals that the policy expansion would also benefit from raising the qualification maximum from \$60,000 to \$65,000 - 70,000.

The zone may achieve its goals of reduced CBD traffic and emissions, and fewer accidents, but these accomplishments may be at the expense of exacerbating transportation inconveniences for middle class automobile dependent workers. A non-majority of Queens residents commute to Manhattan every day for work, but this does not account for the

## LIMITATIONS

Since this project was undertaken, new drafts of the congestion zone policy have been publicized.

A new possible amendment only includes residents who make a maximum of \$50,000 in the tax reimbursement program. Negotiations have also been made to reduce the flat fare for entry into the congestion zone from \$23 to \$15.

## SPECIAL THANKS

Special thanks goes out to Professor Jonathan Stiles, and James Piacentini for their support of my GIS project and for their helpful instruction this semester. The time and dedication they invested in fostering my understanding of GIS concepts and techniques made this learning experience both enriching and rewarding. Special thanks also goes out to Daniel Wexler, Ruju Joshi, and Steven Duncan for their technical support through all assignments.

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