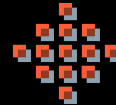# REPLICA

About Replica

Replica is a company that provides data about the built environment, starting with mobility. We work primarily with government agencies. We are here at CB8 as a courtesy at the Task Force's request.

Our Products:

Places

High-fidelity **activity-based travel models**, with data outputs down to the network-link level.

Trends

Nationwide model, delivered weekly, with census-tract-level fidelity covering mobility and consumer spend.

About Replica

Replica in Action

Replica has served over 60 clients throughout the U.S., including:
- MTA
- New Jersey Transit
- Caltrans
- NY State Division of the Budget
- Illinois DOT
- DC Department of Transportation

New York MTA

Uses Places data, in collaboration with NYC DOT and private-sector partners, to study and implement congestion pricing policies in Manhattan.

Chicago Regional Transportation Authority

Used Trends to estimate the daytime population of each census tract at different points in the pandemic in order to understand changes in commuting and remote work.

New Jersey Transit

Uses Trends data to track the outcomes of pandemic-related policies and study travel patterns between specific trip pairs in the agency's service area.

RideKC Development Corporation

Uses Places to support transit-oriented development and inform decisions that connect mobility, economic development, and access to job opportunities.

About Replica

How It Works

Replica generates its data by running large-scale, computationally intensive **simulations**.

These simulations allow us to deliver granular data outputs that match behavior in aggregate, but don't surface the actual movements (or compromise the privacy) of any one individual.

Raw Data Inputs

Census Data

Consumer Marketing Data

Geo & Land Use Data

Mobile Location Data

Credit Transaction Data

Integrated Pipeline

1 Create a synthetic population that matches the characteristics of a given region

2 Train a number of behavior models specific to that region

3 Run simulations of those models applied to the synthetic population to create a "replica" of transportation and economic patterns

4 Calibrate the outputs of the model against observed "ground-truth" to improve quality

About Replica

Approach to Privacy

Replica is built with an uncompromising belief that better insights should not come at the expense of personal privacy.

Our methodological approach enables us to provide highly granular output data while remaining faithful to a series of privacy-first technical commitments.

At Replica, we:

- Only procure de-identified data from our source vendors. We never receive, use, or output personally identifiable information.

- Never share raw locational data with our customers — or any other third-parties.

- Build models from different data sources independently so that we abstract out potentially identifying details of any individual before combining these models into our aggregate outputs.

- Never join data sources on keys containing sensitive data.

- Incorporate proven techniques, like statistical noise injection, into our algorithms to ensure that (1) it is impossible to ascertain if an individual's information is part of our source data by inspecting our modeled outputs; (2) it is impossible to learn which specific locations were visited by an individual whose information was part of our source data by inspecting our modeled outputs.

About Replica

Today's Presentation

- The goal of this presentation is to give an overview of mobility in CB8 and travel between CB8 and the CBD. It begins to answer many of the important questions sourced by the task force.

- Some questions from CB8 are <u>not yet answerable with Replica data</u> at a reasonable level of accuracy. These included questions regarding:

    - specific parking garages and parking practices

    - block- or segment-specific travel patterns (other than major choke points like the Queensborough Bridge); and

    - future scenario planning

- Today's presentation primarily displays data from a <u>typical weekday in the Fall 2019 season</u> — in this way, it represents a pre-COVID baseline of travel in New York City

CB8 Mobility Overview

Note: Data in following presentation represents a typical weekday in Fall 2019
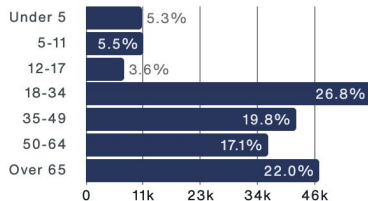
CB8 Overview

Who Lives in CB8?

- 210K people, 110k households

- 40% of CB8 residents are older than 50

- 50% of CB8 residents are part of households making more than $150K

- 35% of residents are part of a household that has a car
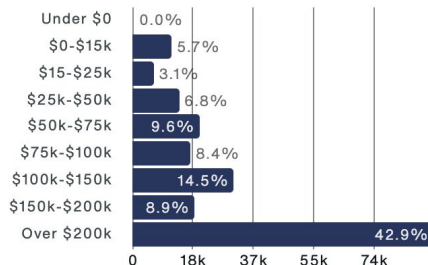
Average age
43.2 yrs

Median age
40.0 yrs

Number of people in each age group

Age group	Percentage
Under 5	5.3%
5-11	5.5%
12-17	3.6%
18-34	26.8%
35-49	19.8%
50-64	17.1%
Over 65	22.0%

Most common car availability
63.5% – No vehicles

Number of people with access to each number of cars at home

Vehicles	Percentage
No vehicles	63.5%
One vehicle	30.8%
Two vehicles	3.5%
No data	1.6%
Three or more v...	0.6%

Average household income
$266k

Median household income
$160k

Number of people in each household income group

Income group	Percentage
Under $0	0.0%
$0-$15k	5.7%
$15-$25k	3.1%
$25k-$50k	6.8%
$50k-$75k	9.6%
$75k-$100k	8.4%
$100k-$150k	14.5%
$150k-$200k	8.9%
Over $200k	42.9%

Largest group by race and ethnicity
75.8% – White Non-Hispanic/Latino

Number of people in each race and ethnicity group

Group	Percentage
White Non-Hisp...	75.8%
Asian Non-Hisp...	10.2%
Hispanic or Lati...	9.4%
Two races Non-...	2.3%
Black Non-Hisp...	2.1%
Other Non-Hisp...	0.1%
American Indian...	0.1%
Native Hawaiian...	0.0%
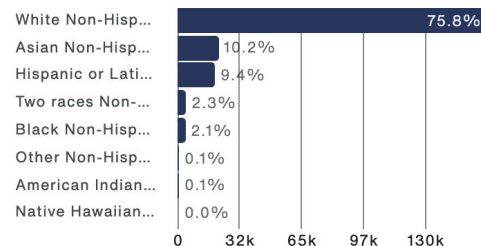
Which CB8 residents own a car

- Overall, 35% of residents live in a household with a car

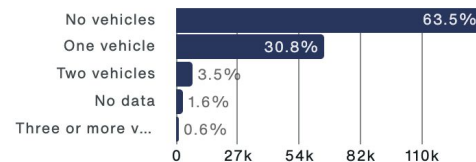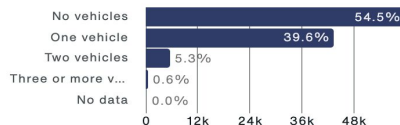## >$150K Household Income

- 107k people
- 370k trips

- 45% of people live in a household with a car

Most common car availability
54.5% – No vehicles

Number of people with access to each number of cars at home

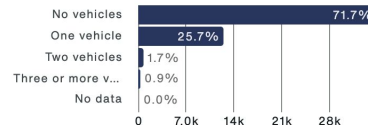|	
No vehicles	54.5%
One vehicle	39.6%
Two vehicles	5.3%
Three or more v...	0.6%
No data	0.0%

0   12k   24k   36k   48k

$75k-$150k Household Income

- 49k people
- 170k trips

- 28% of people live in a household with a car

Most common car availability
71.7% – No vehicles

Number of people with access to each number of cars at home

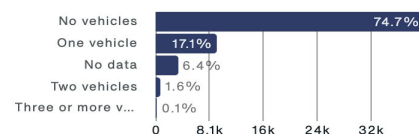|	
No vehicles	71.7%
One vehicle	25.7%
Two vehicles	1.7%
Three or more v...	0.9%
No data	0.0%

0   7.0k   14k   21k   28k

<$75K Household Income

- 54k people
- 180k trips

- 19% of people live in a household with a car

Most common car availability
74.7% – No vehicles

Number of people with access to each number of cars at home

No vehicles	74.7%
One vehicle	17.1%
No data	6.4%
Two vehicles	1.6%
Three or more v...	0.1%

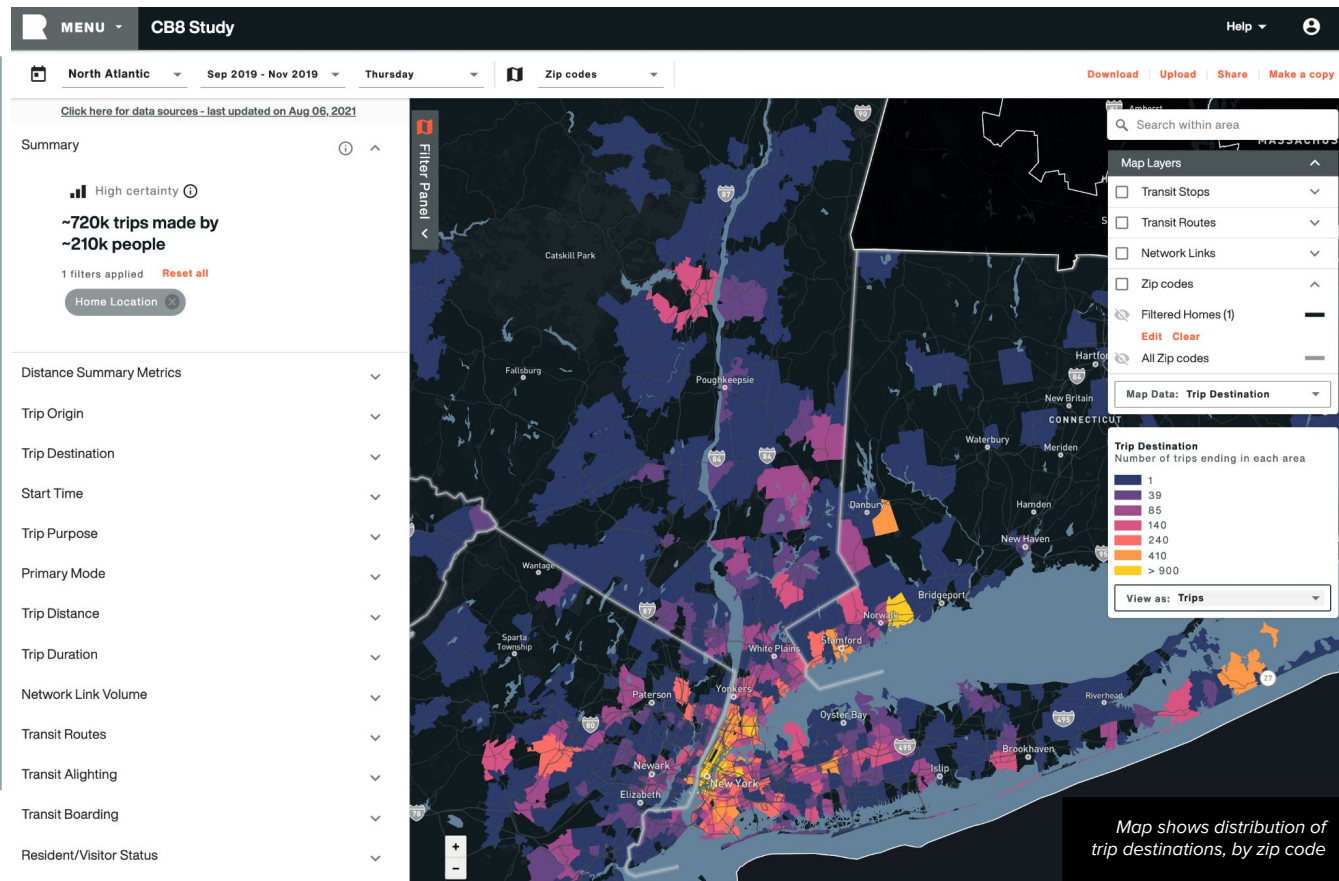0   8.1k   16k   24k   32k

CB8 Overview

Mobility of CB8 residents

On a typical weekday in Fall 2019, the 210k residents of CB8:

- Took just under 750,000 trips

- Made more than 80% of their trips via public transit or walking

- Had an average trip of 8.6 mi, and a median trip of 1.4 mi

Map shows distribution of trip destinations, by zip code
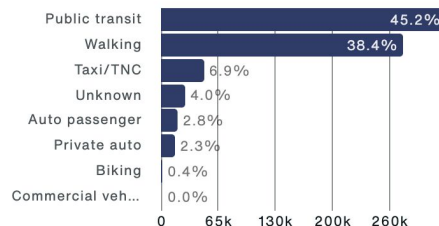
CB8 Overview

Mode Breakdown

- 5% of trips made by private auto (including passenger trips)

- 5.6% of trips of higher-income households vs. 4.8% of lower-income households (8.6% vs. 5.5% when looking at work trips only)

All Residents

Most common mode
45.2% – Public transit

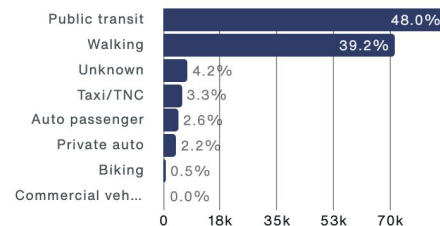Number of trips using each primary mode

Mode	%
Public transit	45.2%
Walking	38.4%
Taxi/TNC	6.9%
Unknown	4.0%
Auto passenger	2.8%
Private auto	2.3%
Biking	0.4%
Commercial veh…	0.0%

0   65k   130k   200k   260k

<$75K Household Income

Most common mode
48.0% – Public transit

Number of trips using each primary mode

Mode	%
Public transit	48.0%
Walking	39.2%
Unknown	4.2%
Taxi/TNC	3.3%
Auto passenger	2.6%
Private auto	2.2%
Biking	0.5%
Commercial veh…	0.0%

0   18k   35k   53k   70k

$75k-$150k Household Income

Most common mode
46.5% – Public transit

Number of trips using each primary mode

Mode	%
Public transit	46.5%
Walking	37.6%
Taxi/TNC	7.4%
Unknown	3.8%
Auto passenger	2.7%
Private auto	1.7%
Biking	0.3%
Commercial veh…	0.0%

0   16k   32k   48k   63k
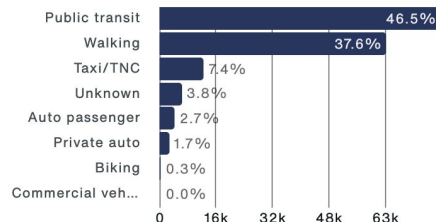
>$150K Household Income

Most common mode
43.2% – Public transit

Number of trips using each primary mode

Mode	%
Public transit	43.2%
Walking	38.4%
Taxi/TNC	8.6%
Unknown	3.9%
Auto passenger	2.9%
Private auto	2.7%
Biking	0.3%
Commercial veh…	0.0%

0   32k   63k   95k   130k
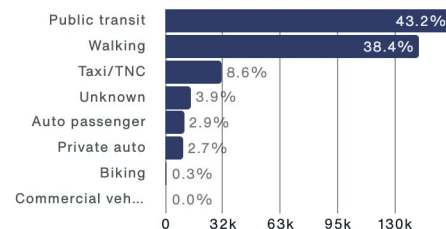
CB8 Overview

Where residents go

Of the 720,000 total trips the residents of CB8 make each day:

- 290k start and end within CB8 (40%)

- 160k end in the CBD (22%)

- 40K end elsewhere in Manhattan (5%) (*outside the CBD and outside CB8*)

- 30k end in Brooklyn and Queens (4%)

- 17k end in the Bronx (2%)

- 7.5K end in New Jersey (1%)

- 4k end in Westchester (<1%)

- 6.2k end in Nassau (<1%)

- 160k begin outside CB8 and end in CB8 (22%) (*return trips home*)

- 5.5k North of Westchester/West of NJ (<1%)

- *Note: Some trips neither start nor end in CB8, because CB8 residents move elsewhere*

Of the 37,000 total private auto and passenger trips the residents of CB8 make each day:

- 6k start and end within CB8 (16%)

- 5.5k end in the CBD (14%)

- <1K end elsewhere in Manhattan (3%) (*outside the CBD and outside CB8*)

- 1.5k end in Brooklyn and Queens (4%)

- 1k end in the Bronx (3%)

- 2.5K end in New Jersey (7%)

- 1.5k end in Westchester (4%)

- 2.9k end in Nassau (8%)

- 10k begin outside CB8 and end in CB8 (27%) (*return trips home*)

- 5.3k North of Westchester/West of NJ (14%)

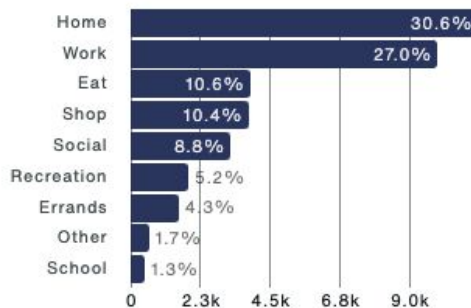- *Note: Some trips neither start nor end in CB8, because CB8 residents move elsewhere*

Why do residents take a car?

Most common trip purpose
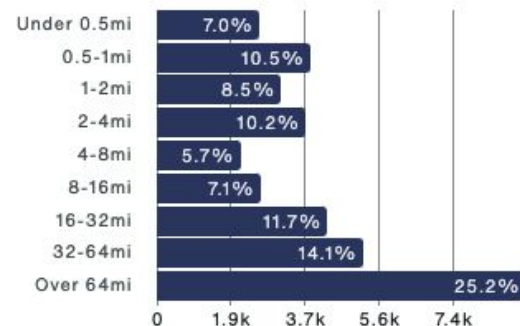**30.6% – Home**

Number of trips for each purpose

Purpose	Percentage
Home	30.6%
Work	27.0%
Eat	10.6%
Shop	10.4%
Social	8.8%
Recreation	5.2%
Errands	4.3%
Other	1.7%
School	1.3%

0   2.3k   4.5k   6.8k   9.0k

Show More

Average trip distance
42.4 mi

Median trip distance
18.4 mi

Number of trips by total distance traveled

Distance	Percentage
Under 0.5mi	7.0%
0.5-1mi	10.5%
1-2mi	8.5%
2-4mi	10.2%
4-8mi	5.7%
8-16mi	7.1%
16-32mi	11.7%
32-64mi	14.1%
Over 64mi	25.2%

0   1.9k   3.7k   5.6k   7.4k

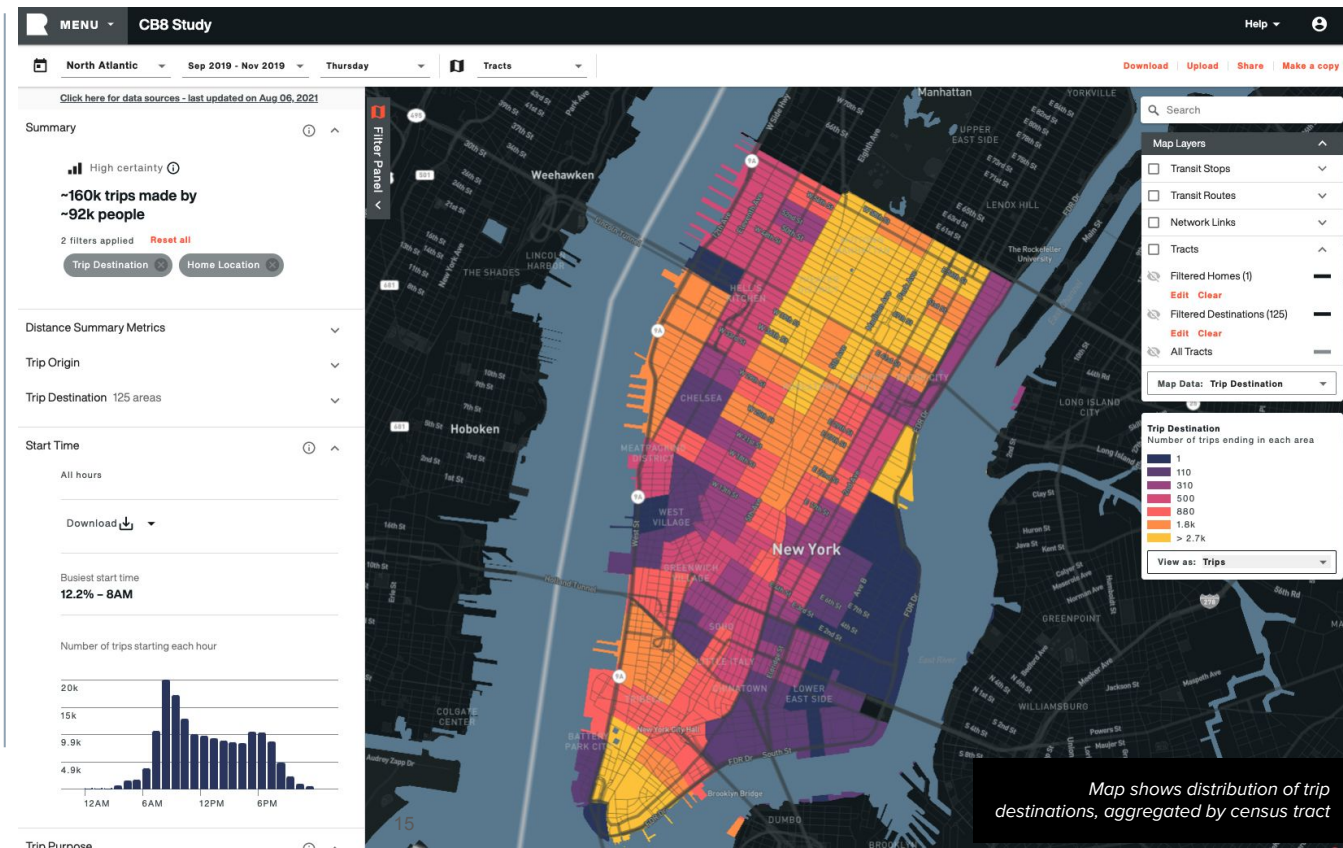# CB8 residents' trips to the CBD

CB8 Trips to the CBD

- On a typical weekday, 92k CB8 residents make a total of 160k trips that end in the CBD

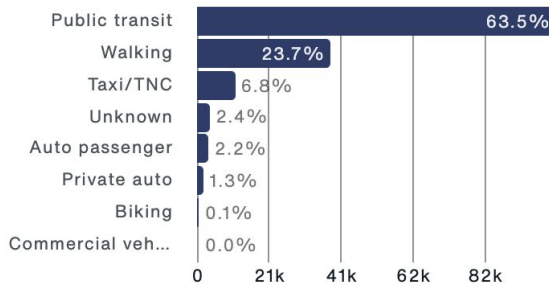*Map shows distribution of trip destinations, aggregated by census tract*

How and why do they go?

- More than 60% of trips are taken via public transit
- Just 3.5% are via private auto (including both drivers and passengers)
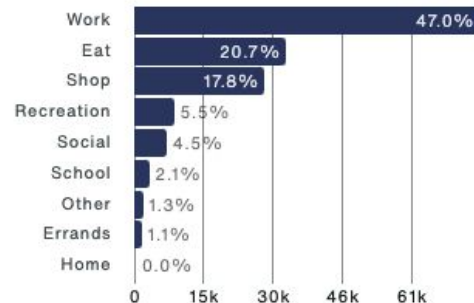
Most common mode
63.5% – Public transit

Number of trips using each primary mode

Mode	Percent
Public transit	63.5%
Walking	23.7%
Taxi/TNC	6.8%
Unknown	2.4%
Auto passenger	2.2%
Private auto	1.3%
Biking	0.1%
Commercial veh...	0.0%

0   21k   41k   62k   82k

Most common trip purpose
47.0% – Work

Number of trips for each purpose

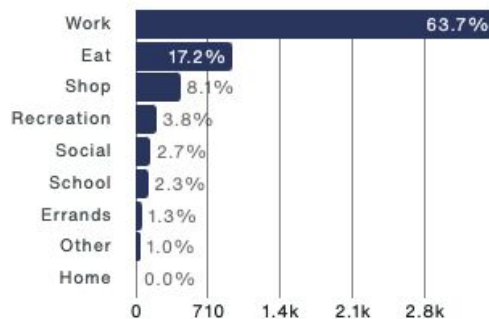| Purpose	Percent
Work	47.0%
Eat	20.7%
Shop	17.8%
Recreation	5.5%
Social	4.5%
School	2.1%
Other	1.3%
Errands	1.1%
Home	0.0%

0   15k   30k   46k   61k

CB8 Auto Trips to the CBD

- 5,500 residents of CB8 traveled by private car to the CBD, counting both drivers and passengers

- These 5,500 residents travel in 2,000 unique vehicles

- *This data excludes taxis/Ubers*

Most common trip purpose
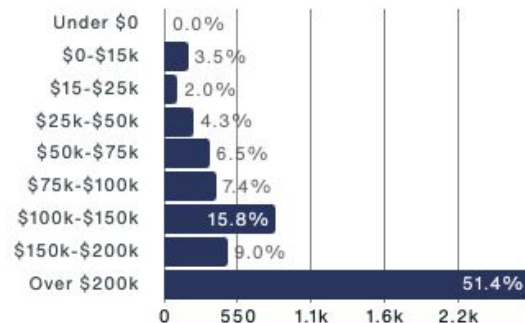
63.7% – Work

Number of trips for each purpose

Purpose	%
Work	63.7%
Eat	17.2%
Shop	8.1%
Recreation	3.8%
Social	2.7%
School	2.3%
Errands	1.3%
Other	1.0%
Home	0.0%

0   710   1.4k   2.1k   2.8k

Show More

Average household income   Median household income

$339k   **$211k**

Number of people in each household income group

| Income group	%
Under $0	0.0%
$0-$15k	3.5%
$15-$25k	2.0%
$25k-$50k	4.3%
$50k-$75k	6.5%
$75k-$100k	7.4%
$100k-$150k	15.8%
$150k-$200k	9.0%
Over $200k	51.4%

0   550   1.1k   1.6k   2.2k

All Trips to
the CBD

Auto → CBD

All Trips to the CBD

- On a typical weekday, over 5.5M trips, made by more than 2.5M people, end in the CBD

- 1M (20%) of those trips are taken by a vehicular mode (private auto, auto passenger, taxi, commercial vehicle)
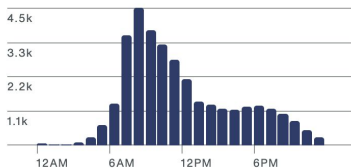

Map shows distribution of trip origins, aggregated by census tract
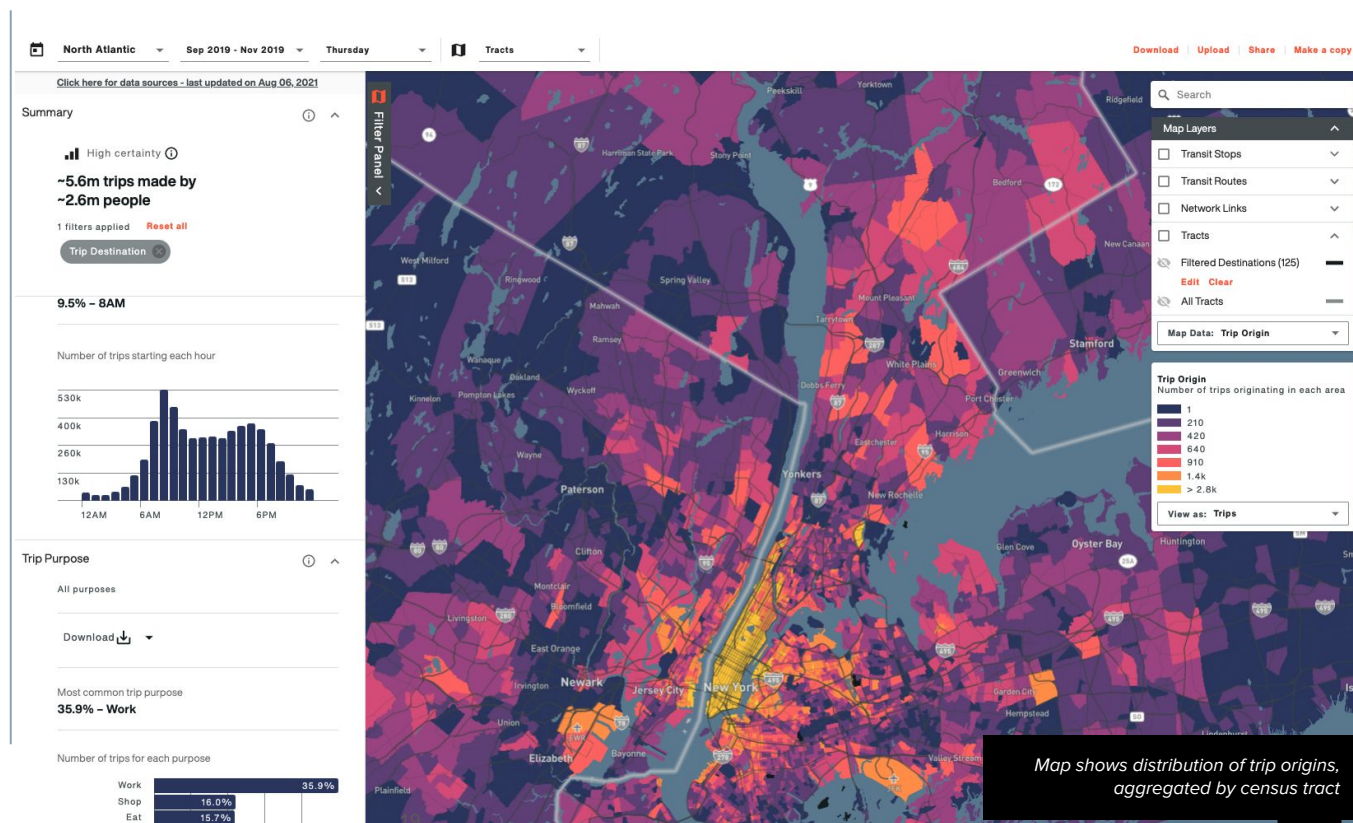
Auto → CBD

Passing thru CB8

Busiest start time
13.1% – 8AM

Number of trips starting each hour

- 1M vehicular trips end in the CBD each weekday

- Of these, 120K pass through CB8

- Of these 120K:
  - ~86,000 stay on the FDR Drive and do not enter the street grid.

  - 34,000 trips go through CB8's local streets/avenues

  - Of the 34,000 trips:
    - Roughly 50% are Taxis or TNCs (Uber/Lyft)
    - Roughly 25% are private vehicles
    - The remaining 25% are Commercial Vehicles (trucks)

    - These trips are clustered in the morning commute peak (*see left)*

    - Of the 34,000 trips, 2,400 are private vehicles with a destination between 50th and 60th street, East of 5th
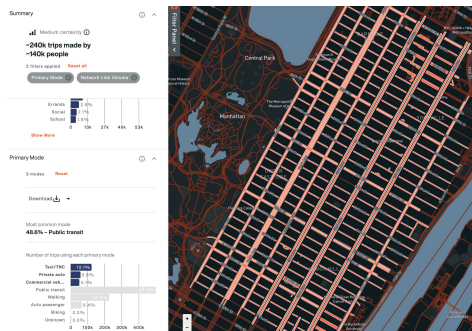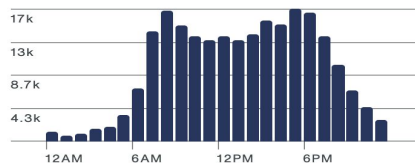
Vehicles in CB8

Vehicles in CB8

Using Replica, it's possible to filter for all vehicle trips that used any of the roads within CB8

- In total, roughly 240k vehicle trips started, ended, or passed through CB8 streets **excluding the FDR Drive**
  - 120k Taxi and TNC trips
  - 60k private automobile trips
  - 60k commercial vehicle trips (freight)

- Of these 240k vehicle trips:
  - 34k are through trips to the CBD (~14%)
  - 55k (<25%) were made by residents of CB8
  - 34k started and ended within CB8 (coincidentally, the same # as through trips, but not the same trips)
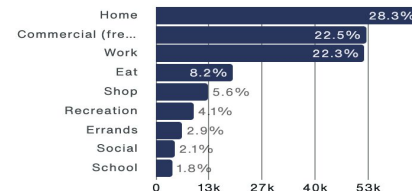
Busiest start time
7.3% – 5PM

Number of trips starting each hour

Most common trip purpose
28.3% – Home

Number of trips for each purpose

Vehicles in CB8

Trip Purpose

- Just under 200,000 people go to jobs in CB8
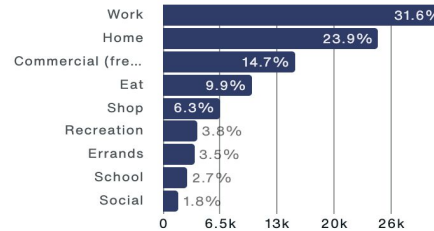
- Of these, roughly 30,000 drive or take a taxi/ride hail

Trips by a vehicle

All Trips

Trips Ending in CB8

Most common trip purpose
31.6% – Work

Number of trips for each purpose

Purpose	%
Work	31.6%
Home	23.9%
Commercial (fre...	14.7%
Eat	9.9%
Shop	6.3%
Recreation	3.8%
Errands	3.5%
School	2.7%
Social	1.8%

0 6.5k 13k 20k 26k

Most common trip purpose
29.5% – Home

Number of trips for each purpose

Purpose	%
Home	29.5%
Work	23.2%
Shop	14.2%
Eat	9.6%
Social	6.6%
School	4.9%
Recreation	4.5%
Errands	3.6%
Commercial (fre...	2.0%

0 50k 99k 150k 200k

Show More

Trips Starting in CB8

Most common trip purpose
39.0% – Home

Number of trips for each purpose

Purpose	%
Home	39.0%
Commercial (fre...	17.3%
Work	15.7%
Eat	8.5%
Shop	6.4%
Recreation	3.7%
Social	2.5%
Errands	2.4%
Other	2.0%

0 8.1k 16k 24k 32k
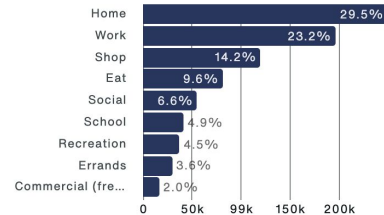
Most common trip purpose
34.4% – Home

Number of trips for each purpose

Purpose	%
Home	34.4%
Work	16.5%
Shop	14.5%
Eat	11.0%
Social	7.2%
Recreation	4.6%
School	4.2%
Errands	2.8%
Commercial (fre...	2.3%

0 58k 120k 170k 230k
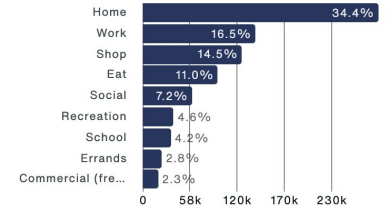
Show More

Vehicles in CB8

Where do these auto trips start and end?

Note: these include private autos as well as taxi/ride hail trips and commercial vehicles.

- Of the 240K total vehicle trips that started, ended, or passed through CB8, the number of trips that **start** in each county is:

  - New York: 160k
    - 100k start in CB8 itself
    - 12k start in CB7 (UWS)
  - Queens: 17k
  - Bronx: 9k
  - Nassau: 7k
  - Westchester: 6.8k
  - Kings: 5.1k
  - Bergen: 3.8k

- Of the 240K total vehicle trips that started, ended, or passed through CB8, the number of trips that **end** in each county is:

  - New York: 150k
    - 100k end in CB8 itself
    - 10k end in CB11 (East Harlem)
  - Queens: 16k
  - Bronx: 14k
  - Nassau: 9k
  - Westchester: 7.6k
  - Bergen: 3.8k
  - Kings: 3.7k

Queensborough Bridge

QB Bridge

Queens-borough Bridge Trips

- Each weekday, approximately 150k trips are made across the QBB, by 120,000 unique people

  - 62k eastbound trips
  - 88k westbound trips

- 56k (46%) of those trip takers do not live within the 5 boroughs

- 4,400 (4%) of those trip takers live in CB8, making a total of 5,600 daily trips. These trips peak in the PM rush hour (*see right*).

- The 4,400 residents of CB8 who use the QBB on a typical day have a median household income of $180K (vs. $160K for the district as a whole)

Busiest start time
9.3% – 6PM

Number of trips starting each hour