# A Pilot Study of **Sidewalk Equity** in Seattle Using Crowdsourced Sidewalk Assessment Data


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**ASSETS' 22 WORKSHOP**

The Future Of Urban Accessibility


DESIGN USE BUILD

MAKEABILITY LAB

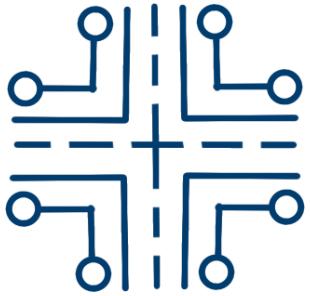
CREATE

PAUL G. ALLEN SCHOOL OF COMPUTER SCIENCE & ENGINEERING

UNIVERSITY of WASHINGTON

# Sidewalks are critical public infrastructure

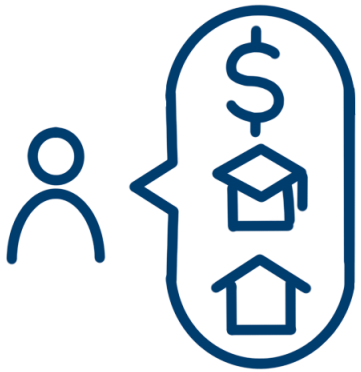
# Sidewalk Disparities



**WHERE**
sidewalks are

**HOW**
they are connected

**WHAT**
their conditions are

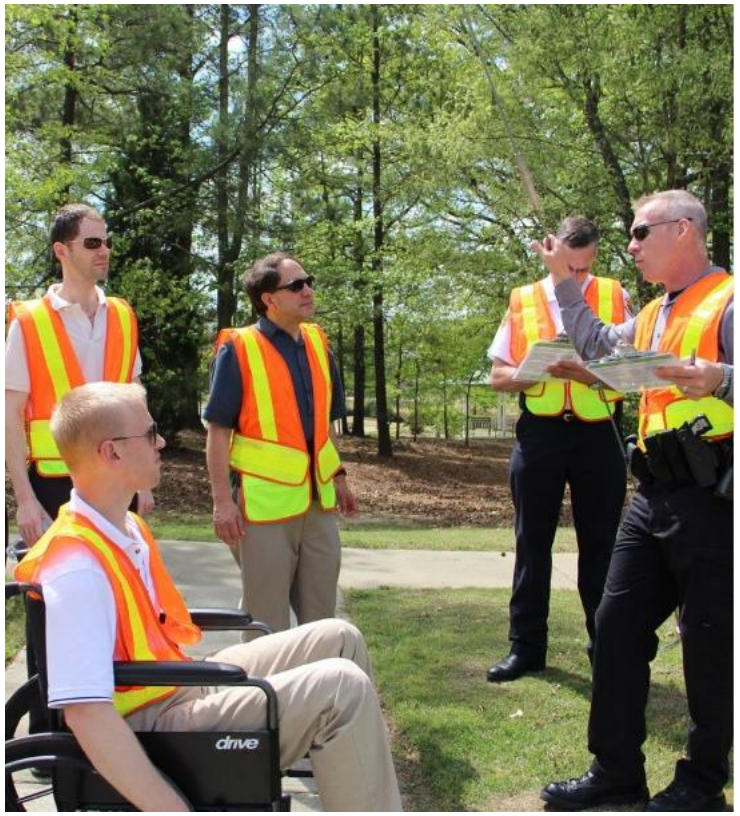


**RELATIONSHIP**
to socio-economic factors

How might we use crowdsourced sidewalk assessment data to examine sidewalk condition patterns in a city?

How do sidewalk quality scores relate to neighborhood socioeconomic characteristics?

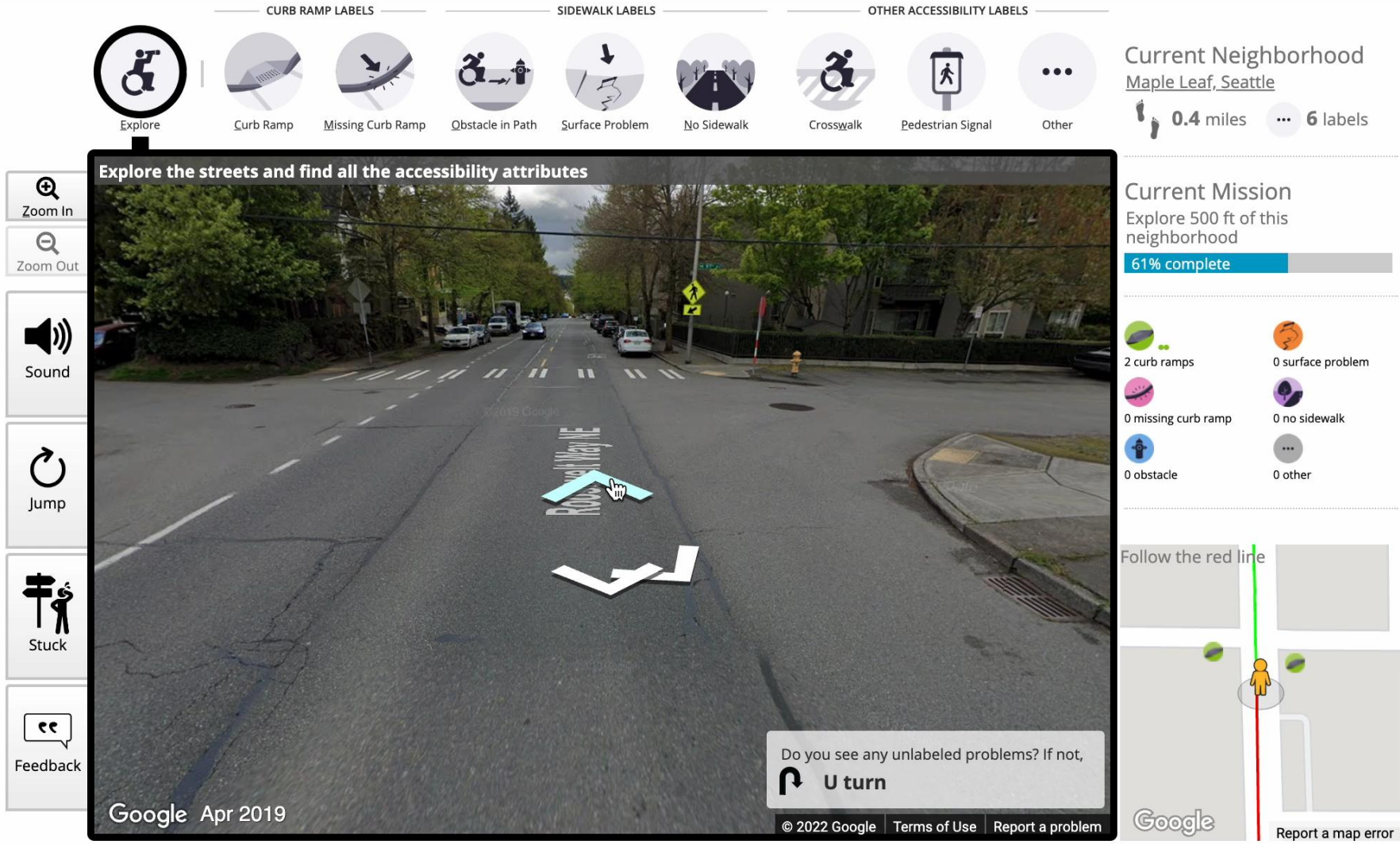
# Traditional accessibility audits




**Walkability Audit**
Wake County, North Carolina


**Walkability Audit**
Wake County, North Carolina


**Safe Routes to School Walkability Audit**
Rock Hill, South Carolina


PROJECT SIDEWALK
Retake Tutorial
Start Validating
How to Label
Help
Data
Seattle
Sign in
en-US
CURB RAMP LABELS
SIDEWALK LABELS
OTHER ACCESSIBILITY LABELS
Explore
Curb Ramp
Missing Curb Ramp
Obstacle in Path
Surface Problem
No Sidewalk
Crosswalk
Pedestrian Signal
Other
Zoom In
Zoom Out
Sound
Jump
Stuck
Feedback
Explore the streets and find all the accessibility attributes
Do you see any unlabeled problems? If not,
U turn
Google Apr 2019
© 2022 Google
Terms of Use
Report a problem
Current Neighborhood
Maple Leaf, Seattle
0.4 miles
6 labels
Current Mission
Explore 500 ft of this neighborhood
61% complete
2 curb ramps
0 surface problem
0 missing curb ramp
0 no sidewalk
0 obstacle
0 other
Follow the red line
Google
Report a map error

**SIDEWALK DATA COLLECTION**

# Label Types

Curb Ramps

Missing Curb Ramps

Obstacles

Surface Problem

Missing Sidewalk

**SIDEWALK DATA COLLECTION**

# Severity Rating

**Severity 1**

**Severity 2**

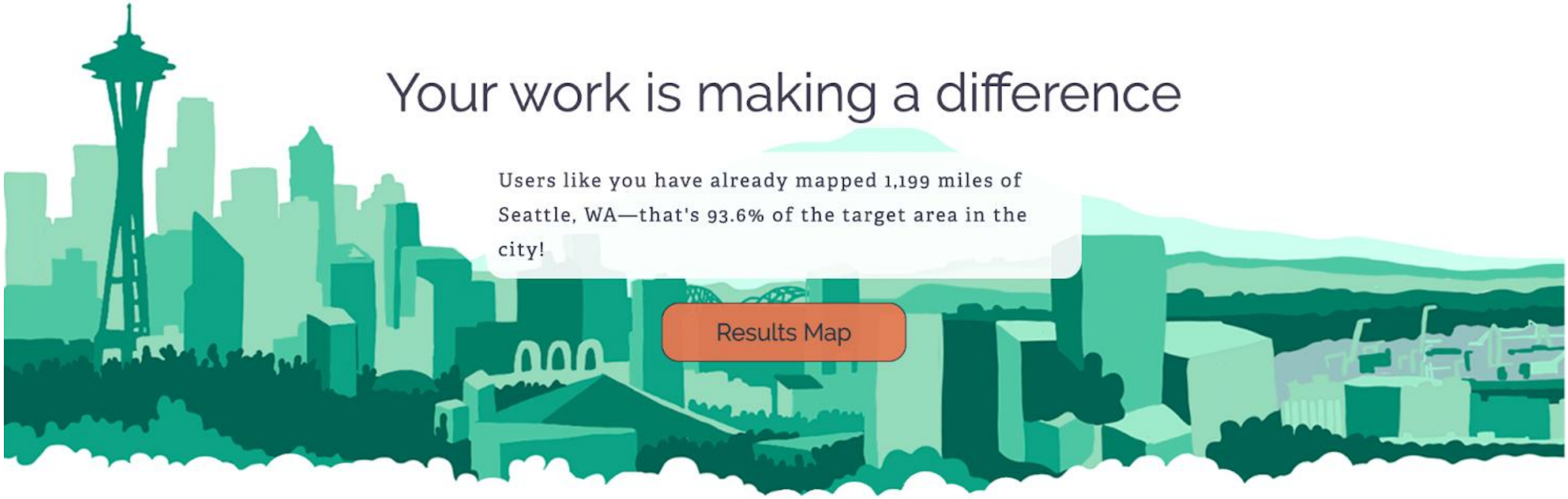
**Severity 3**

**Severity 4**

**Severity 5**

SIDEWALK DATA COLLECTION

# Project Sidewalk in Seattle




**93.6%** target area mapped

**1,198.9** miles covered

**209,351** labels

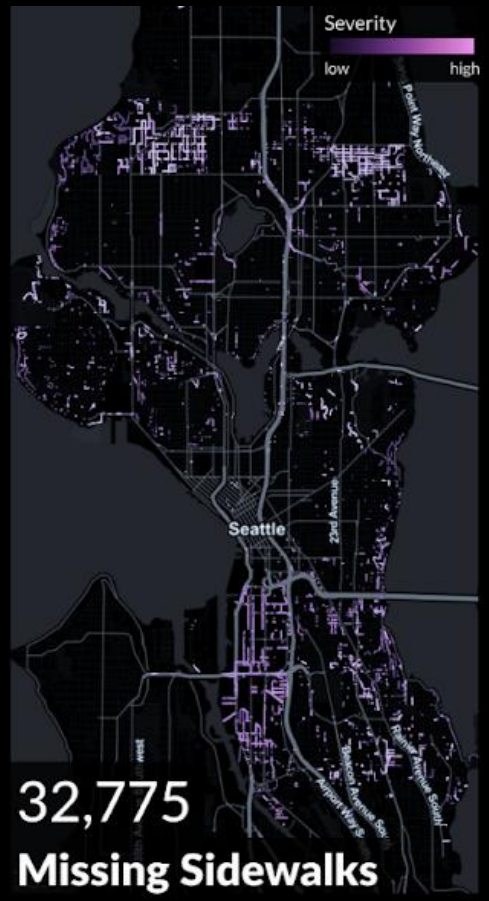
**187,220** validations

SIDEWALK DATA COLLECTION

# Project Sidewalk in Seattle







METHOD

# Access Score Model

- Label Type (positive/negative)
- Severity Rating (1-5)
- Count

### Significance Vector

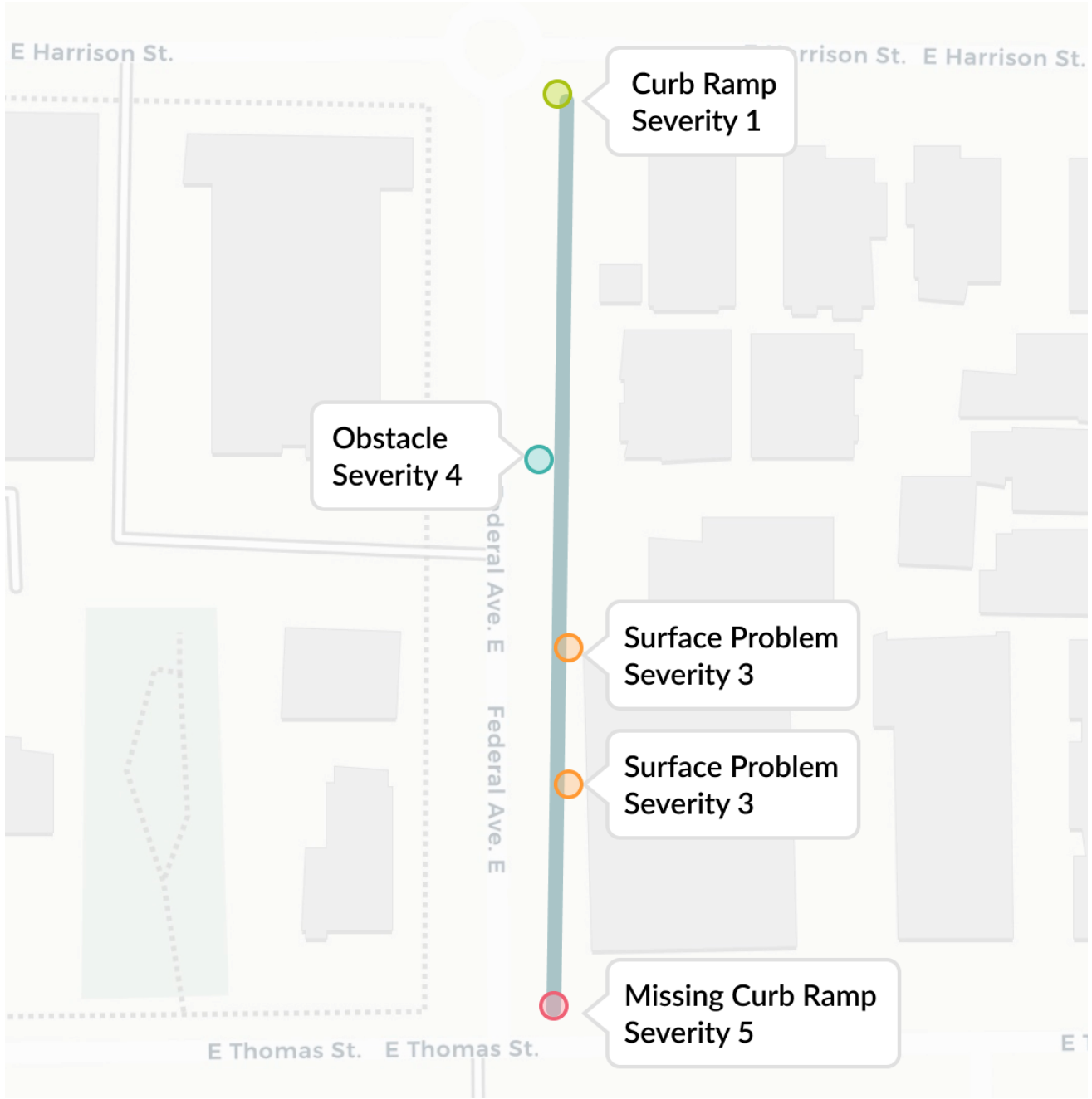
$xa$ = (1.0, -1.0, -0.6, -0.8)

### Accessibility Feature Vector

$ws$ = (1, 1, 2, 1)

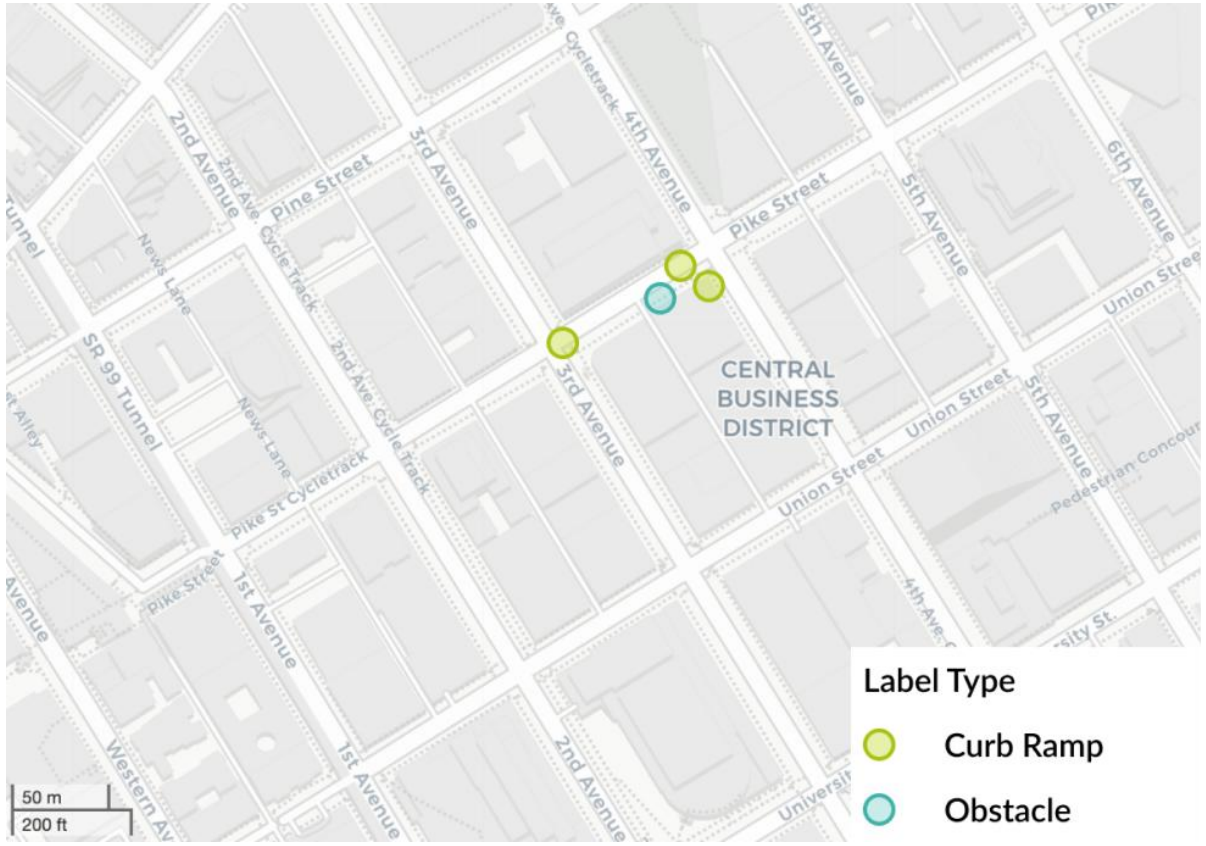
### AccessScore: Sidewalk Segment

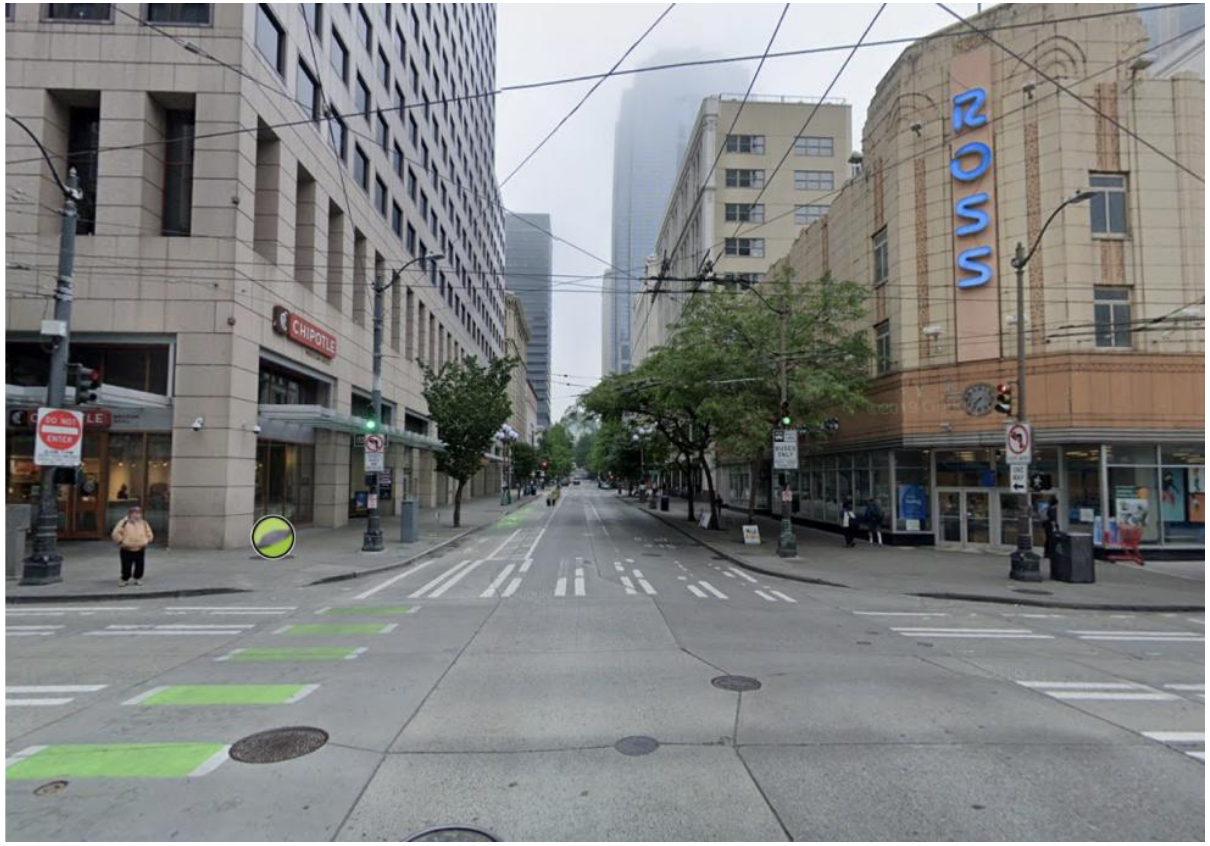
$$AS_{sidewalk} = \frac{1}{1 + e^{-(ws \cdot xa)}} = 0.12$$



METHOD

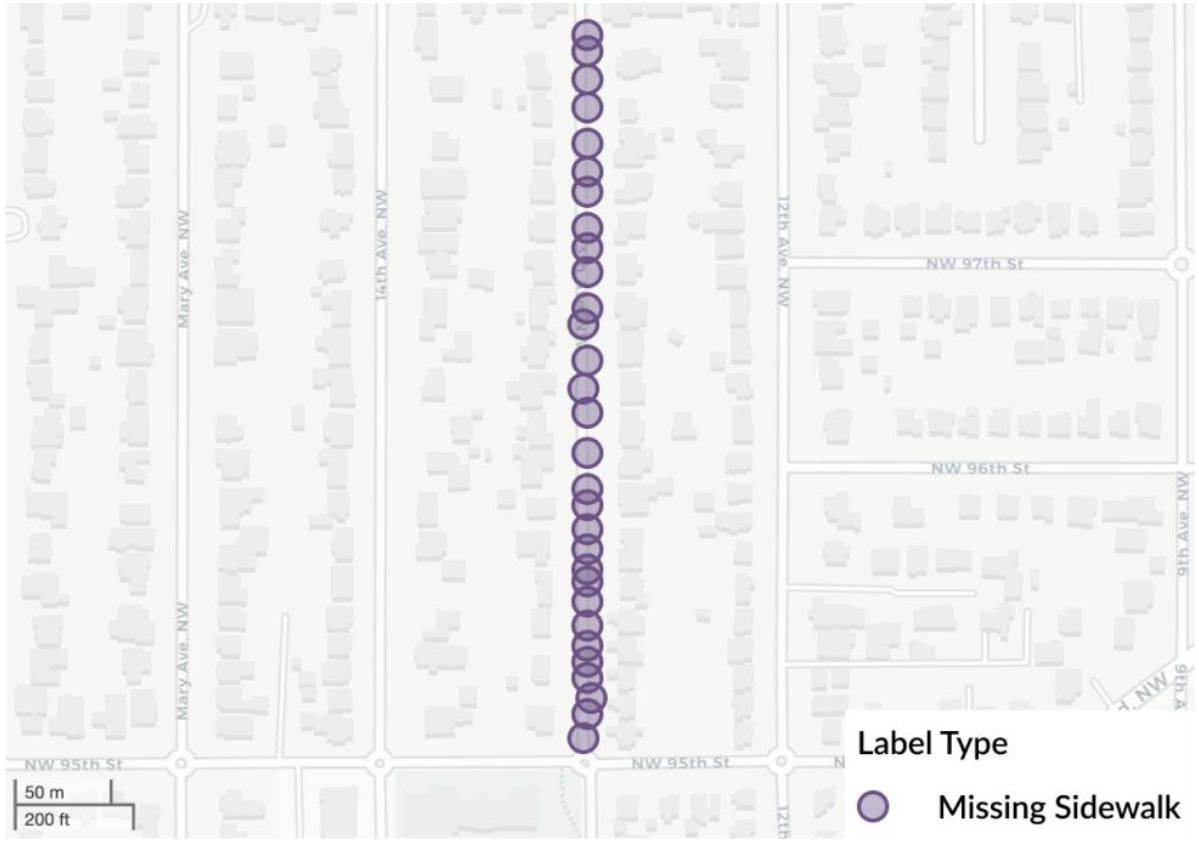
# High Access Score Street



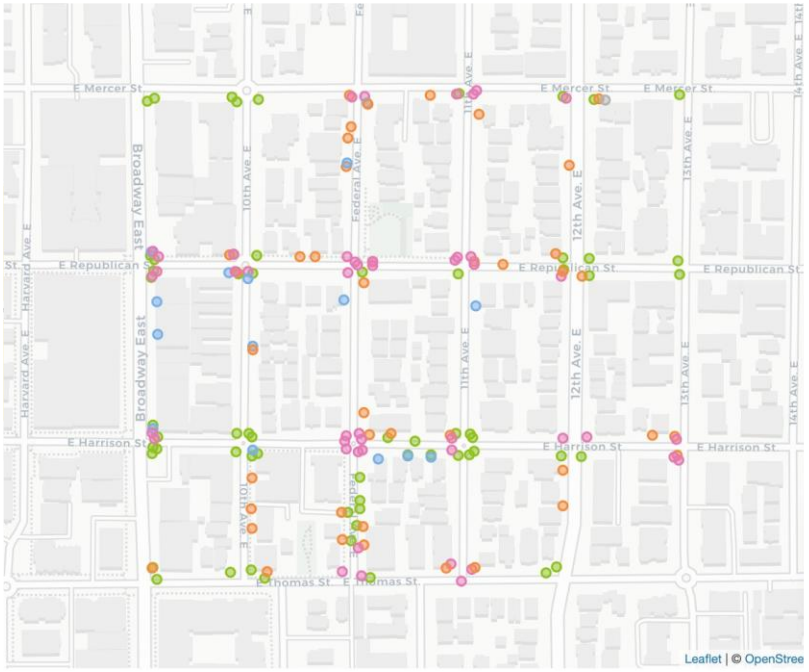
METHOD

# Low Access Score Street

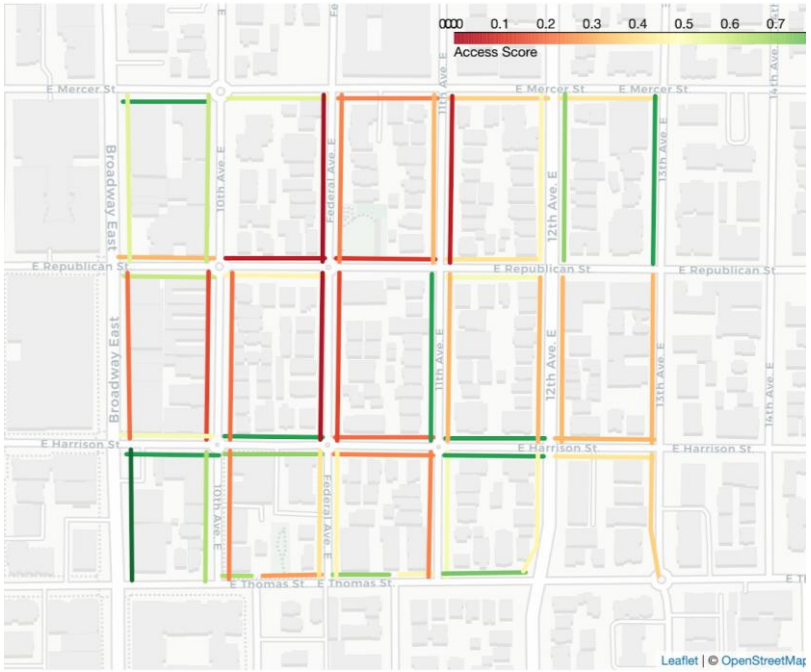



METHOD

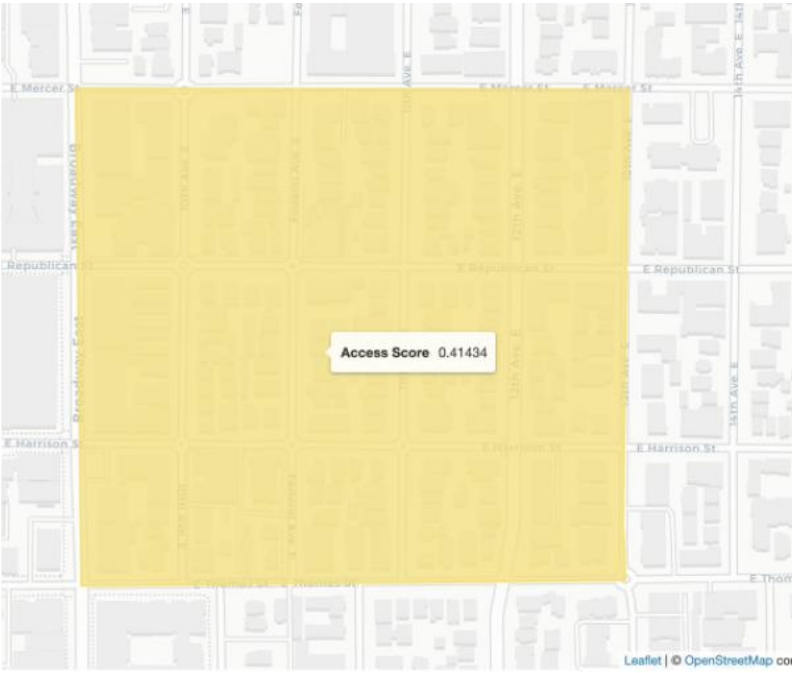
# Access Score




Labels




Sidewalk Access Score

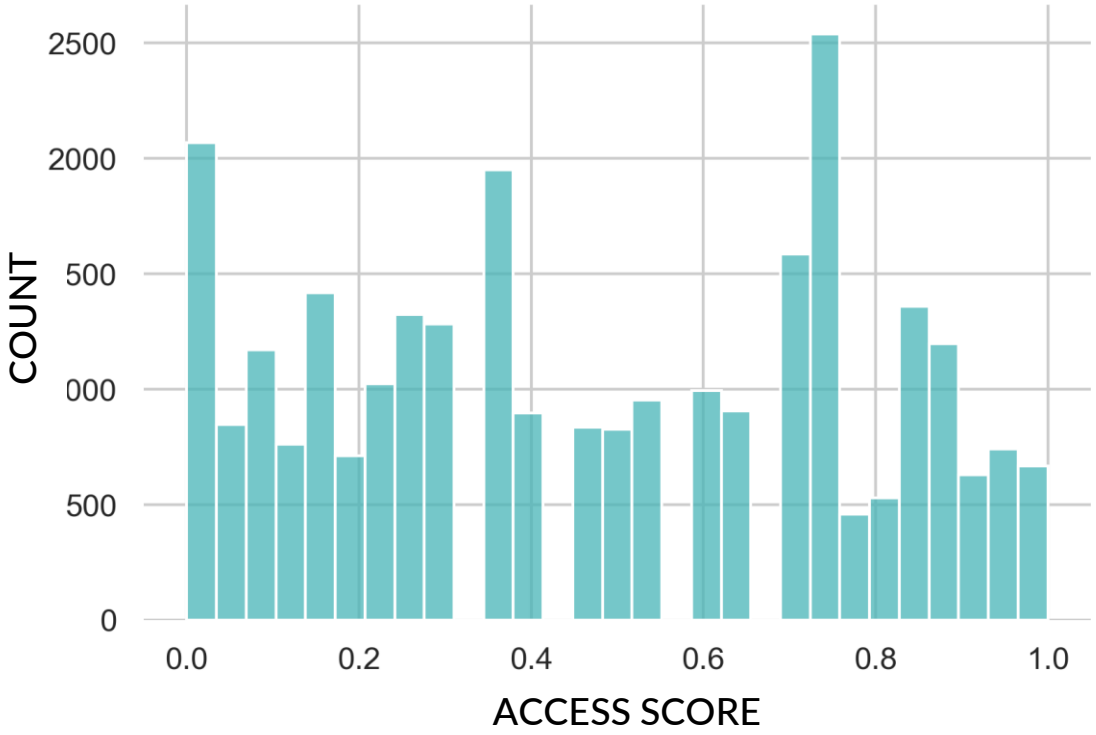


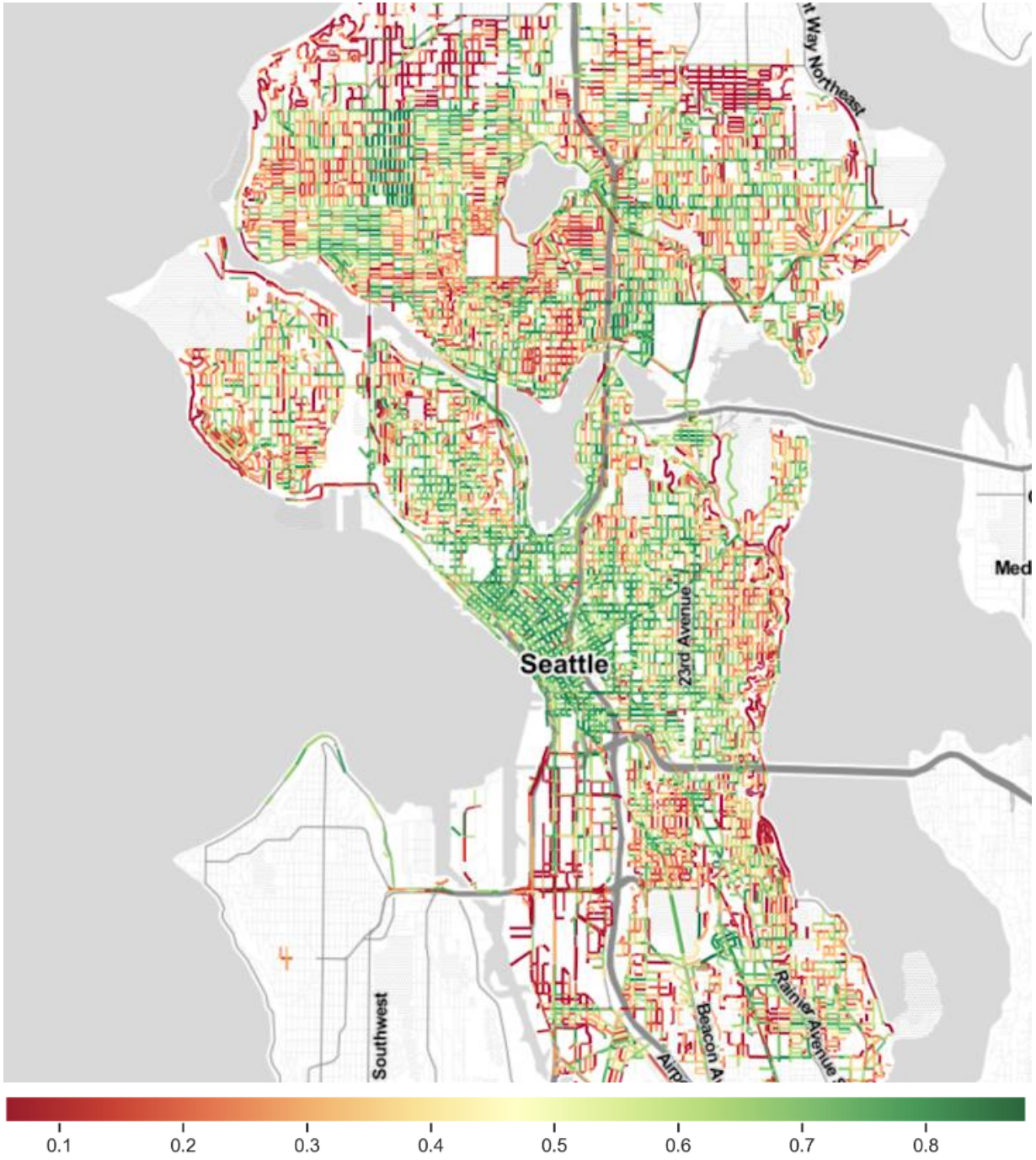

Neighborhood Access Score

FINDINGS

# Spatial Distribution

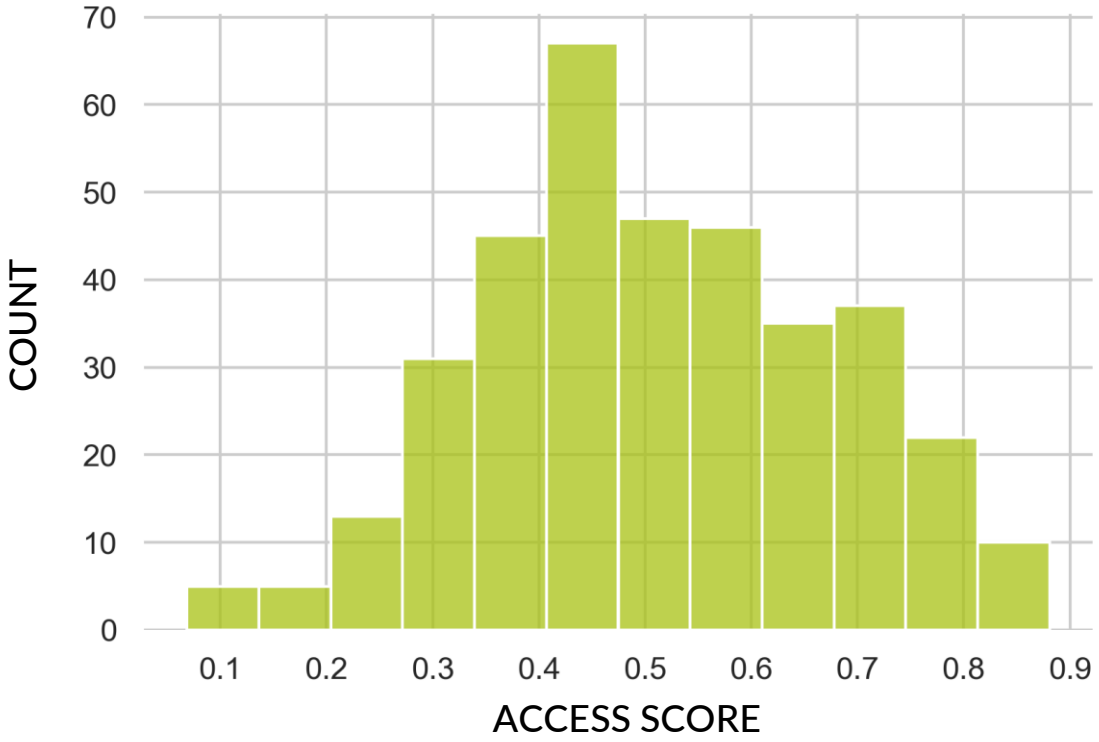
# Per Sidewalk Segment

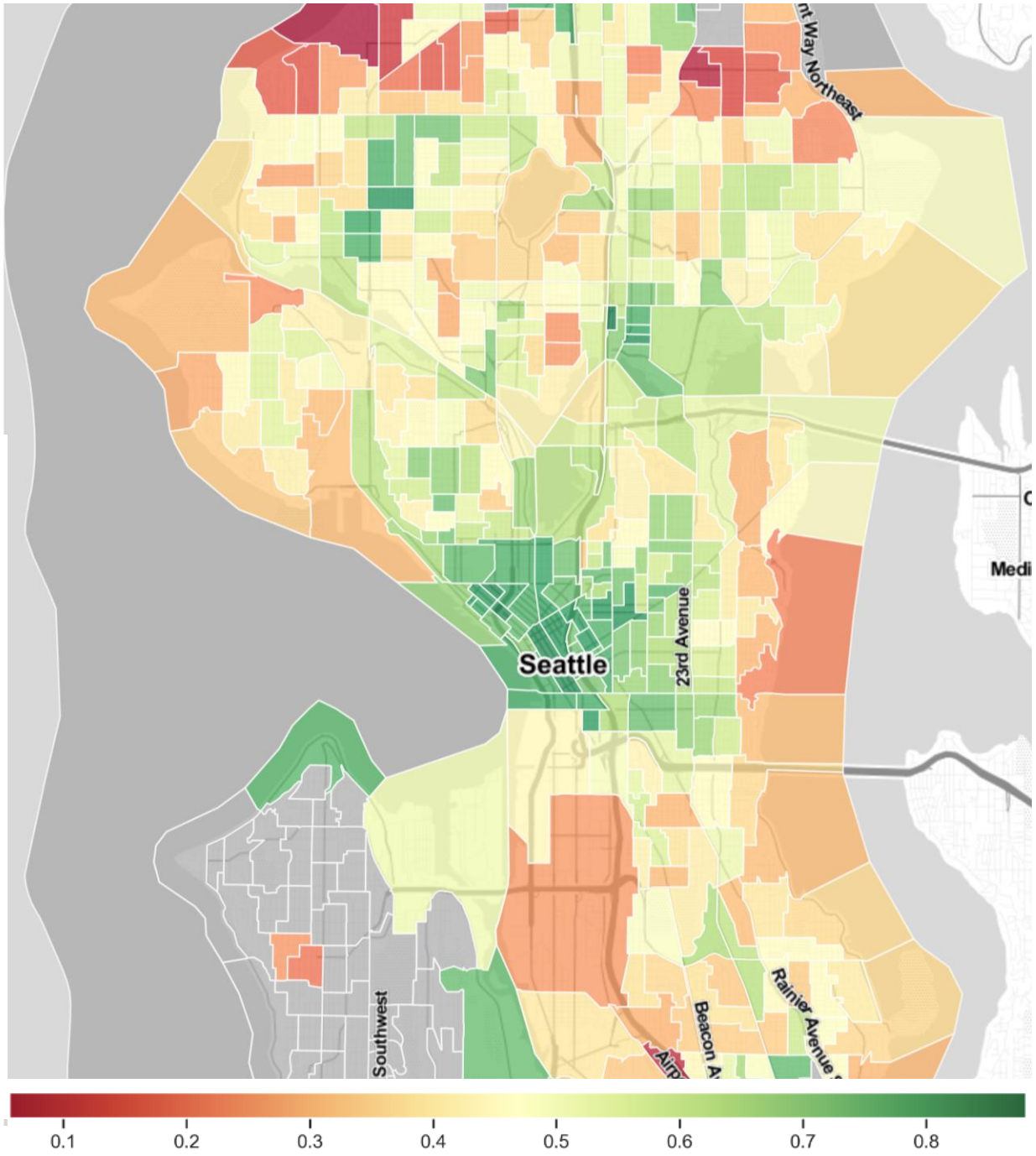


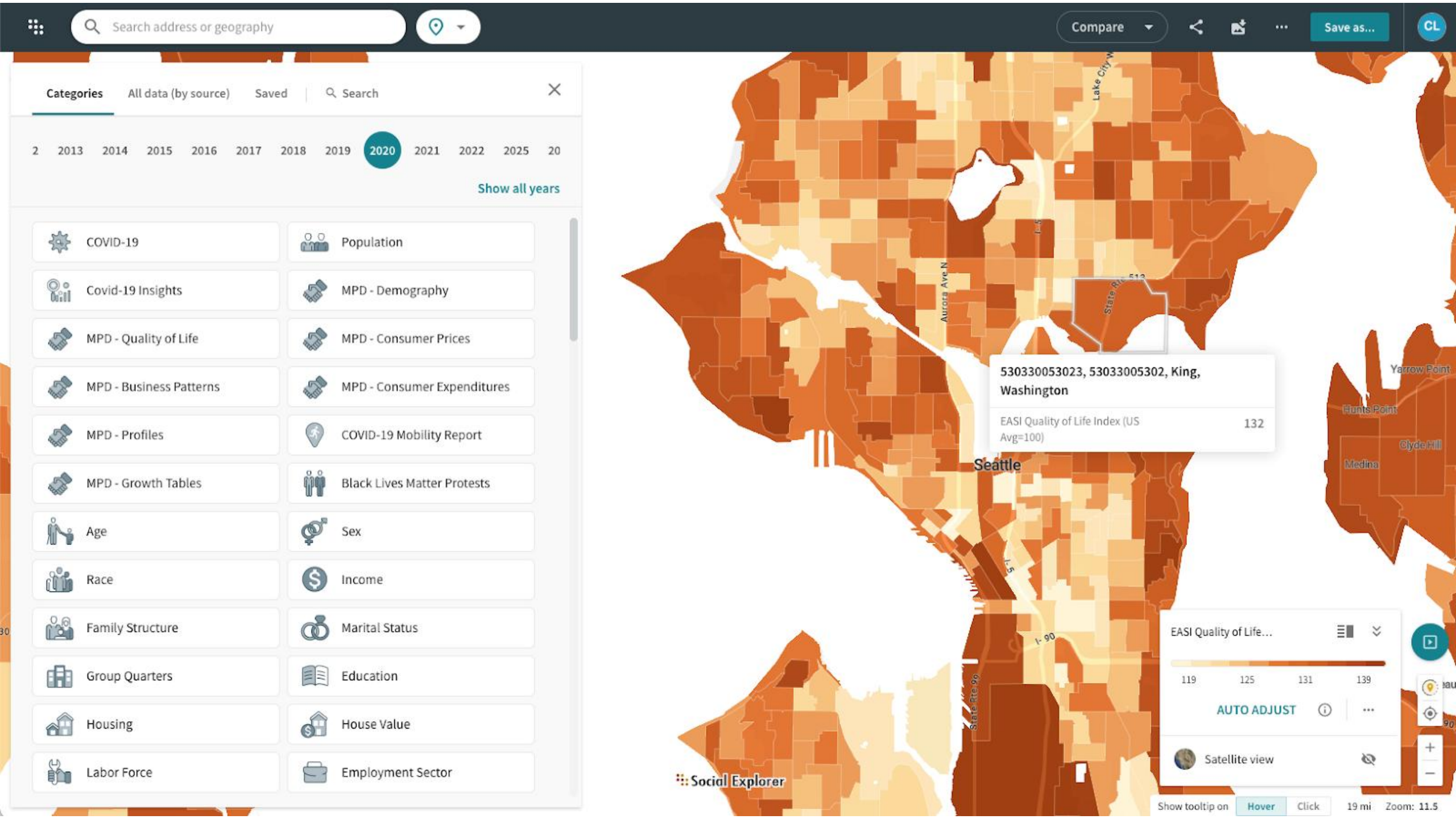



FINDINGS

# Spatial Distribution Per Neighborhood




Search address or geography
Compare
Save as...
CL
Categories
All data (by source)
Saved
Search
2 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2025 20
Show all years
COVID-19
Population
Covid-19 Insights
MPD - Demography
MPD - Quality of Life
MPD - Consumer Prices
MPD - Business Patterns
MPD - Consumer Expenditures
MPD - Profiles
COVID-19 Mobility Report
MPD - Growth Tables
Black Lives Matter Protests
Age
Sex
Race
Income
Family Structure
Marital Status
Group Quarters
Education
Housing
House Value
Labor Force
Employment Sector
530330053023, 53033005302, King, Washington
EASI Quality of Life Index (US Avg=100)
132
Seattle
Yarrow Point
Hunts Point
Clyde Hill
Medina
Aurora Ave N
I-5
I-90
EASI Quality of Life...
119
125
131
139
AUTO ADJUST
Satellite view
Social Explorer
Show tooltip on
Hover
Click
19 mi
Zoom: 11.5

FINDINGS

# Socio-economic Correlations

- Population
- Race & Citizenship
- Education
- Income
- Housing
- Modes of travel

| Property | rho | Property | rho | Property | rho |
|---|---|---|---|---|---|
| Population Density (Per Sq. Mile) | 0.52 | Car, Truck, or Van% | -0.50 | Average Gross Rent | -0.13 |
| White Alone% | -0.23 | Drove Alone% | -0.49 | Owner Occupied% | -0.57 |
| Black or African American Alone% | 0.12 | Carpooled% | -0.24 | Renter Occupied% | 0.57 |
| American Indian & Alaska Native Alone% | 0.16 | Public Transportation% | 0.23 | 1, Detached% | -0.60 |
| Asian Alone% | 0.23 | Motorcycle% | -0.07 | 1, Attached% | -0.04 |
| Pacific Islander Alone% | 0.07 | Bicycle% | -0.07 | 2% | -0.07 |
| Some Other Race Alone% | 0.14 | Walked% | 0.50 | 3 or 4% | 0.03 |
| Two or More Race% | -0.01 | Other Means% | 0.04 | 5 to 9% | 0.07 |
| Racial Diversity | -0.23 | Less than 10 Minutes% | 0.13 | 10 to 19% | 0.20 |
| Citizenship - Native% | -0.08 | 10 to 19 Minutes% | 0.21 | 20 to 49% | 0.43 |
| Foreign Born - Naturalized% | -0.17 | 20 to 29 Minutes% | 0.07 | 50 or More% | 0.51 |
| Foreign Born - Not a Citizen% | 0.23 | 30 to 39 Minutes% | -0.14 | Housing Units Built 2014 or Later% | 0.35 |
| Family Households% | -0.49 | 40 to 59 Minutes% | -0.20 | Housing Units Built 2010 to 2013% | 0.27 |
| Average Household Size | -0.42 | 60 to 89 Minutes% | -0.13 | Housing Units Built 2000 to 2009% | 0.28 |
| Less than High School% | 0.12 | Median Household Income | -0.31 | Housing Units Built 1990 to 1999% | 0.22 |
| High School Graduate% | 0.00 | Average Household Income | -0.32 | Housing Units Built 1980 to 1989% | 0.07 |
| Some College% | 0.04 | Median Family Income | -0.15 | Housing Units Built 1970 to 1979% | -0.02 |
| Bachelors Degree% | -0.02 | Average Family Income | -0.13 | Housing Units Built 1960 to 1969% | -0.10 |
| Masters Degree% | -0.01 | Per Capita Income | -0.06 | Housing Units Built 1950 to 1959% | -0.33 |
| Professional School Degree% | -0.09 | Median Housing Value | -0.21 | Housing Units Built 1940 to 1949% | -0.42 |
| Doctorate Degree% | -0.13 | Median Gross Rent | -0.13 | Housing Units Built 1939 or Earlier% | -0.12 |
| Unemployed% | 0.07 | Median Gross Rent as a % of Income | 0.16 | | |

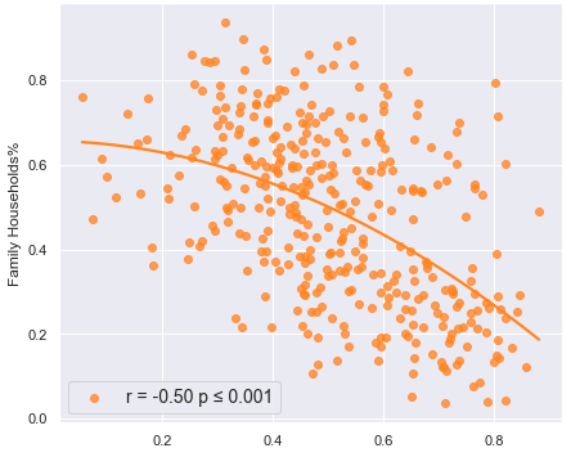
FINDINGS

# Socio-economic Correlations

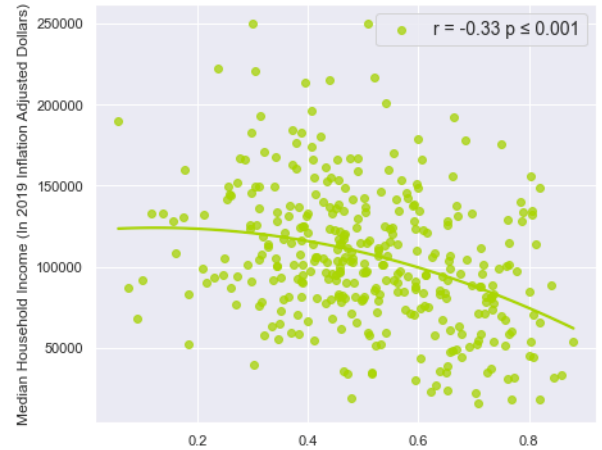
## Lower sidewalk quality neighborhoods:

- More affluent
- Predominantly white
- Higher percentage of families
- Lower housing and population density
- Driving is the primary mode of transportation

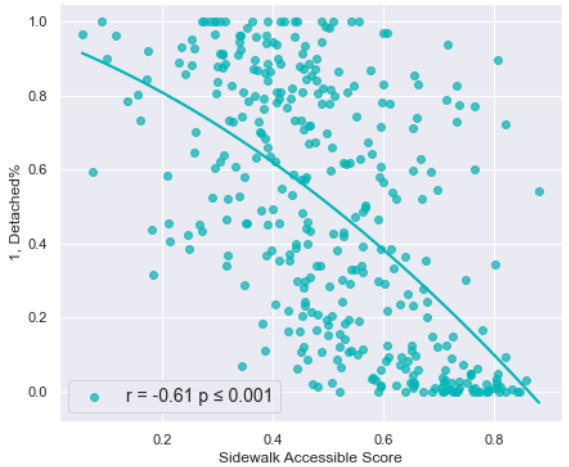
### Family Households



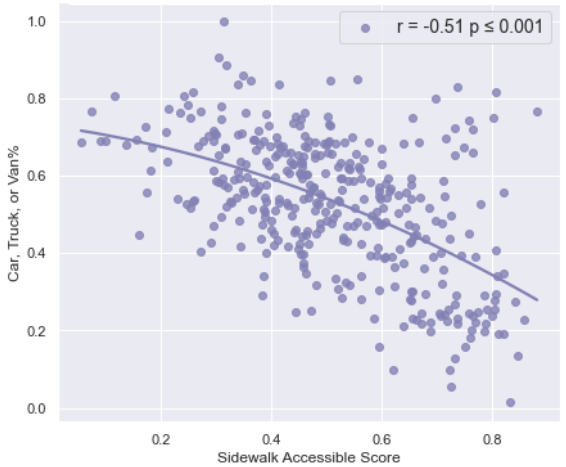

### Income Per Capita




### Single Family Housing




### Drive To Work



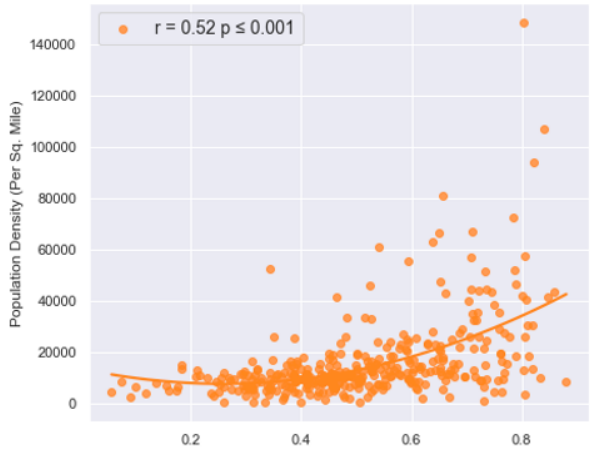
FINDINGS

# Socio-economic Correlations

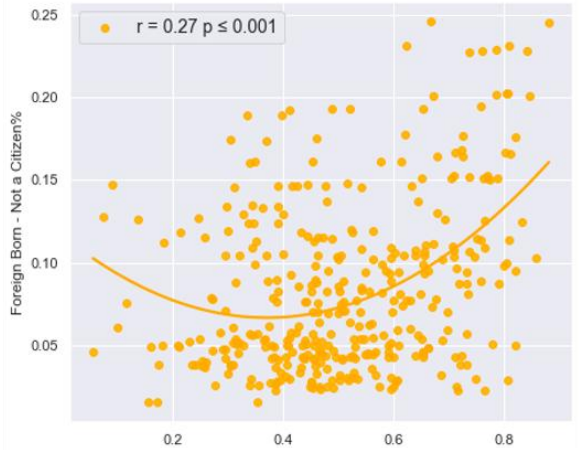
## Higher sidewalk quality neighborhoods:

- Higher population and housing density
- Higher racially diversity
- Higher proportion of immigrants
- Commute primarily by walking or public transportation

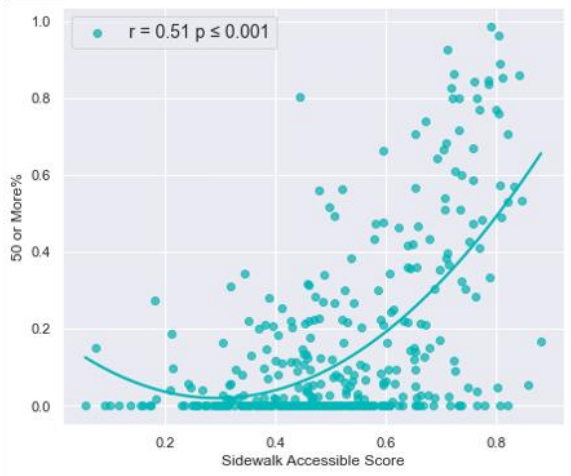
Population Density



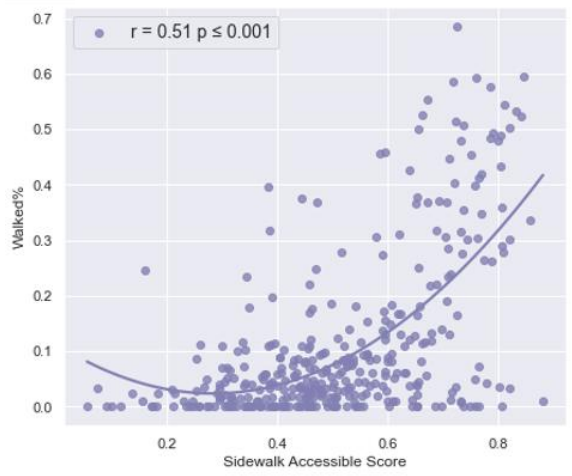

Non-citizens




Multi-family Housing



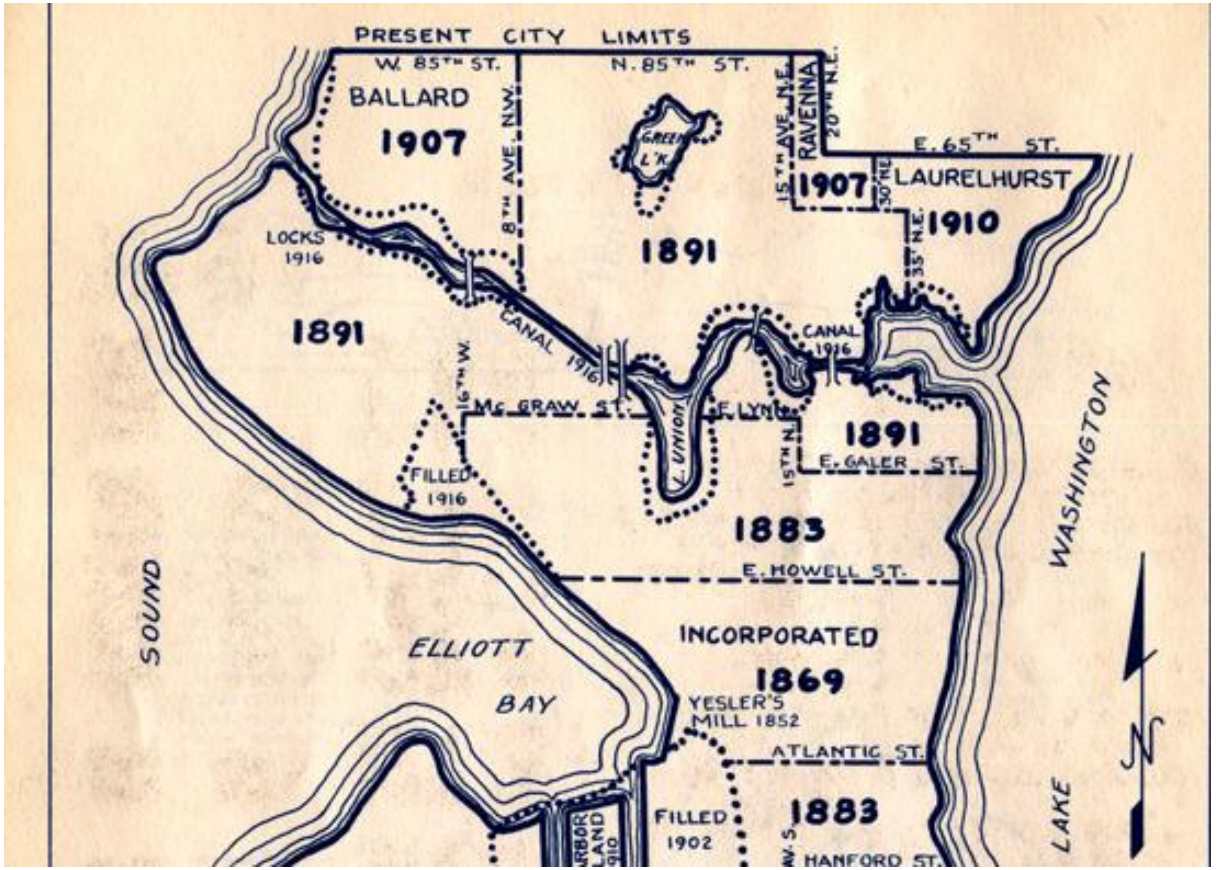

Walk/Public Transit



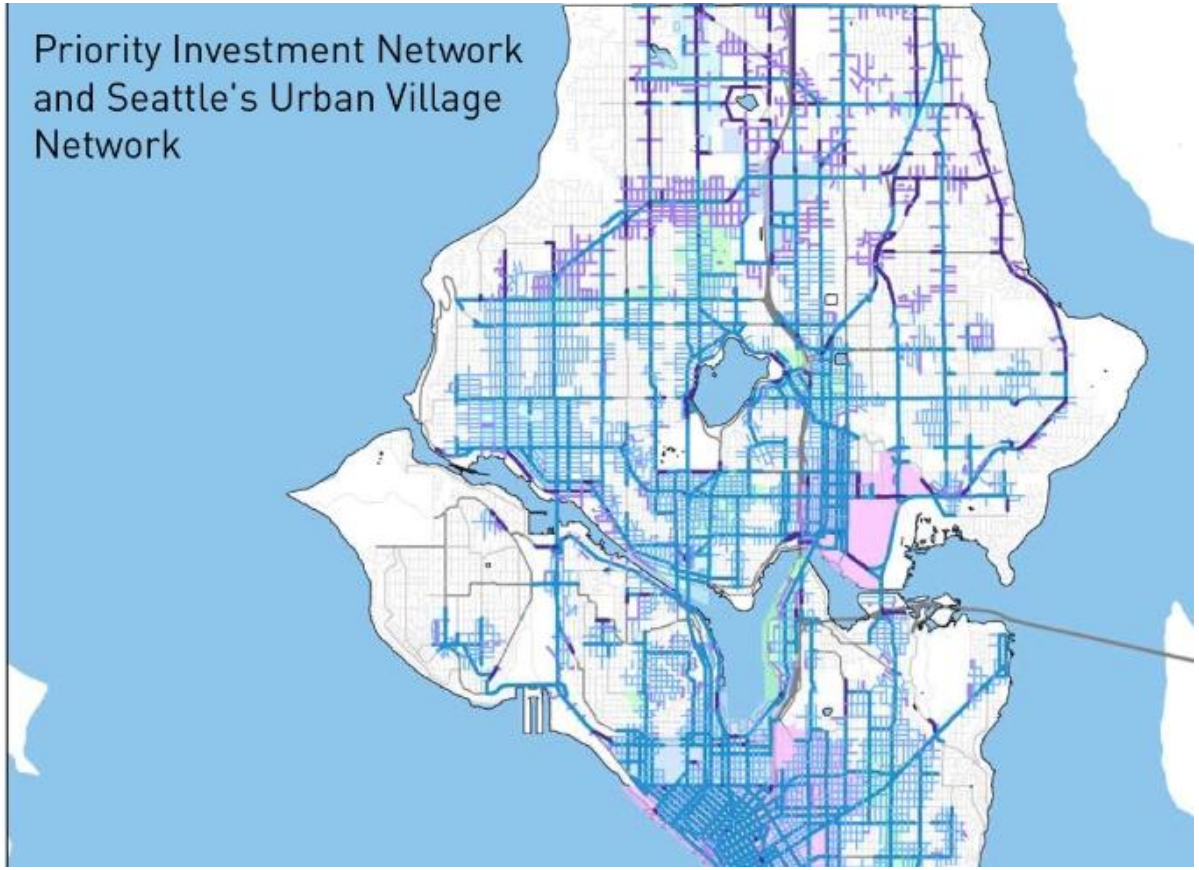
DISCUSSIONS

# The ‘Then & Now’ of Seattle

## Urban Sprawl in 1950s




## Recent Planning Efforts



# Future Work

Large-scale, cross-regional studies on sidewalk equity

Improve the accessibility of existing infrastructure

Influence urban design guidelines and policies