CS506: Data Science Tools and Applications

Project: Sidewalks

Deliverable 4 Report

Team: 1

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Client Presentation

https://bostonu.zoom.us/rec/share/uWdMfvuEZ5LxgYFUVRBCsbneWxsmcK8bXKIEzTsTXrIgB7PK4c_B5A9TJ5MJAI5U.hinmScWTf3-AZ2vQ

Introduction

The main purpose of the Sidewalks project is to develop an accessibility score for the sidewalk network in the City of Boston thereby promoting equity, safety, and walkability for all members of the community. By developing an accessibility score for the sidewalk network and using it to identify inaccessible corridors, this project aims to create a more proactive approach to sidewalk maintenance and repair. The project involves determining the locations of inaccessible sidewalks in different districts and neighborhoods, identifying potential inequities in accessibility, assessing routes to access essential services, and developing a proactive sidewalk maintenance strategy based on accessibility scores and prioritization criteria. The analytics produced from this project will help promote greater social inclusion and reduce barriers to mobility for those with disabilities or limited mobility.

Datasets: In order to achieve this, we have been working with the data sets provided by our client as well as the public datasets available.

1. Boston Datasets
    - Ramps
    - Roadway Centerline
    - Sidewalk Hazards
    - Sidewalks
2. Boston Public Data sets
    - Public Works Active Work Zones Data
    - Climate Ready Social Vulnerability Data
    - 311 Requests
3. Census Demographic Data

Initial Analysis

We analyzed four datasets related to Boston's infrastructure - Ramps, Roadway Centerline, Sidewalk Hazards, and Sidewalks - to better understand what each dataset conveyed. By examining these datasets, we gathered insights into the city's accessibility infrastructure, including the locations of ramps, the centerlines of roadways, potential hazards on sidewalks, and the extent and conditions of sidewalks

throughout the city. This analysis helped inform our overall project goal of identifying and addressing inequities in sidewalk accessibility throughout Boston.

We have also examined information from Boston's public schools on the number of sidewalks within a 15-minute walking distance. Based on our analysis of this information, we have identified the top 5 schools with the most sidewalks within a 15-minute walk. Through these efforts, we aim to gain valuable insights to inform policy decisions.

1) Analysis on Ramp_0 Dataset

Contributor: Pranesh

Using the latitude and longitude from the dataset, postal code and address were extracted. In order to visualize this dataset, on the basis of the ramp condition using the folium library, the coordinates were plotted on the map with respect to the excellent, fair, and poor conditions.

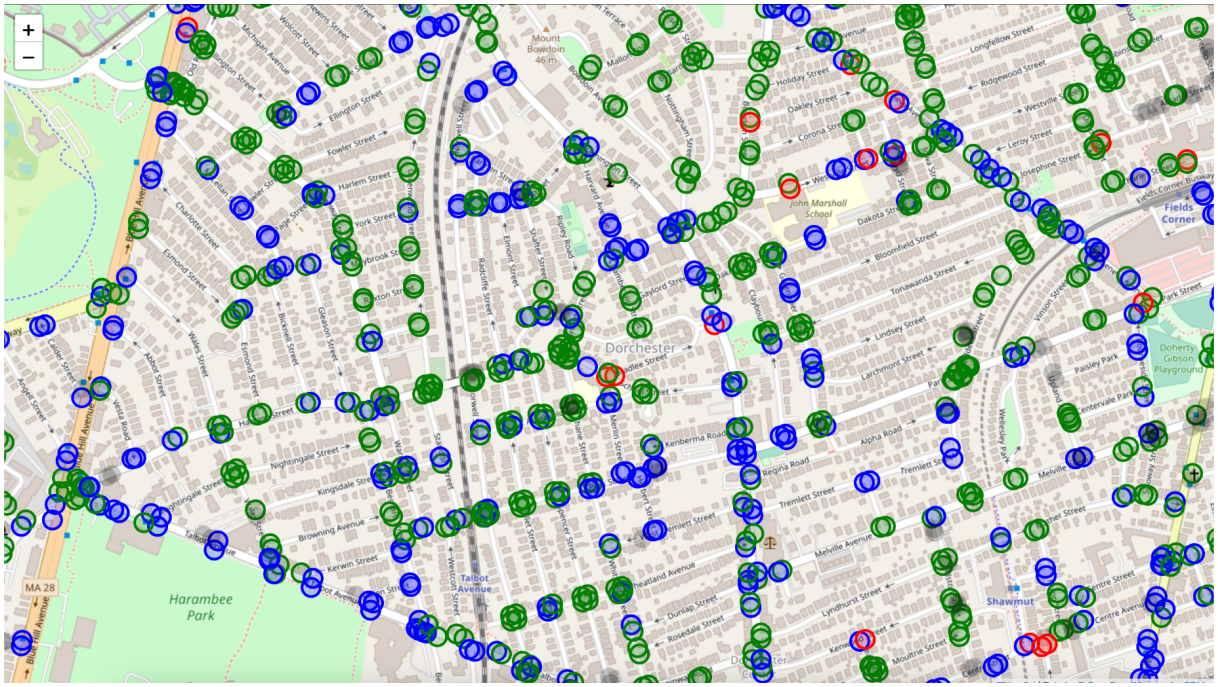


Fig 1.1: Various ramp conditions in Dorchester. Green indicates excellent, Blue indicates fair and Red indicates poor.

The below tables identify the top 5 locations based on the postal code and neighborhood to discern the locations where the ramps are in good condition, poor condition, and fair condition.

Table 1.1: Top 5 neighborhoods where the Ramps are in excellent condition

Postal Code	Neighborhood	Ramp Count

02132	West Roxbury	891
02127	South Boston	888
02119	Roxbury	816
02131	Roslindale	679
02124	Dorchester	659

Table 1.2: Top 5 neighborhoods where the Ramps are in fair condition

Postal Code	**Neighborhood**	**Ramp Count**
02126	Mattapan	414
02124	Dorchester	389
02128	East Boston	345
02127	South Boston	270
02129	Charlestown	269

Table 1.3: Top 5 neighborhoods where the Ramps are in poor condition

Postal Code	**Neighborhood**	**Ramp Count**
02131	Roslindale	50
02119	Roxbury	43
02122	Dorchester	42
02136	Hyder Park	42
02127	South Boston	37

2) Analysis of the Sidewalks_Hazards Dataset
(Contributor: Anargh)

The sidewalks hazards are classified into three types:

1) Fixed pinch point <36” sidewalk width
2) Trip hazards due to tree roots
3) Trip hazards not due to tree roots

Most of the hazards are of type trip hazards not due to tree roots.

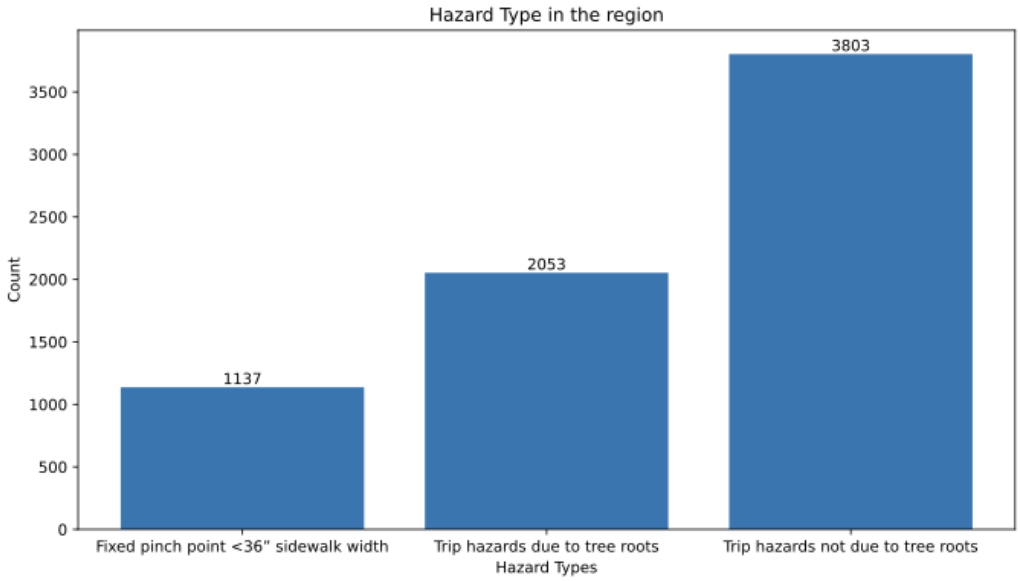
In addition to the existing dataset, the address of the hazards was extracted using the latitude and longitude coordinates. This can help identify neighborhoods with the most hazards that would require immediate attention for the safety of the pedestrians.

Table 2.1: Top 3 Neighborhoods with most of the hazards

Hazard Type/ Neighborhood	**Fixed pinch point < 36" sidewalk width**	**Trip hazards due to tree roots**	**Trip hazards not due to tree roots**	**Total hazards**
Highland	56	220	227	**503**
Dorchester Heights	59	52	149	**260**
Mount Hope	8	61	75	**144**

Fig2.1: Frequency of different types of Hazards

Using the coordinate system and the folium library, the different types of hazards were plotted on



the map.

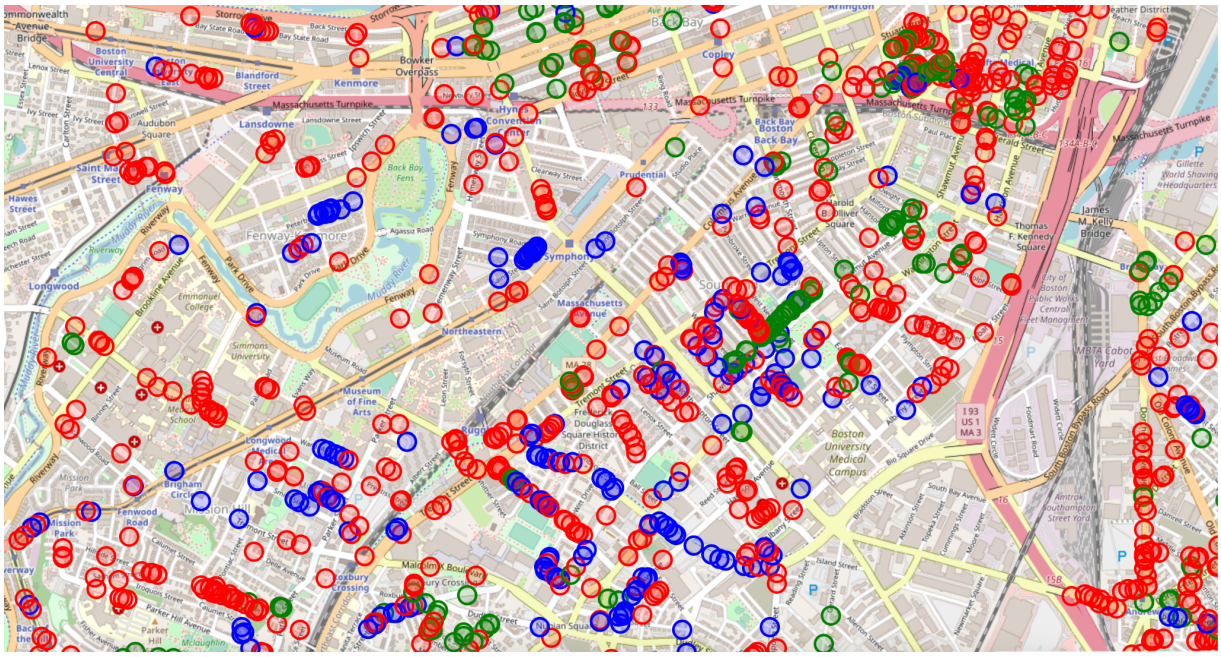


Fig2.2: Various hazards in Boston. Red identifies the trip hazards not due to tree roots, Blue identifies the trip hazards due to tree roots and Green identifies fixed pinch point <36'' sidewalk width

Table 2.2: Top 3 Neighborhoods for different types of hazards

Hazard Type	**Area**	**Count**
Fixed pinch point <36" sidewalk width	Dorchester Heights	59
	Highland	56
	Bay Village	27
Trip hazards due to tree roots	Highland	220
	Stonybrook Village	86
	Mount Hope	61
Trip hazards due to cracks	Highland	227
	Dorchester Heights	149
	Fields Corner	89

<u>3) Analysis of the Sidewalks Dataset</u>
Contributor: Akarvin

From this dataset, it was possible to identify the sidewalks in a region and their characteristics such as width and area. The dimensions of the sidewalks are assumed to be given in feet from the sidewalk's design documentation and older sidewalks' metadata.

Table 3.1: Top 5 Districts with the most number of sidewalks

District Name	Number Of Sidewalks
South Dorchester	3017
North Dorchester	2666
West Roxbury	2537
Downtown	2055
Allston/Brighton	2041

Table 3.2: Top 5 districts with the largest sidewalks' width

District Name	Sidewalk Width(ft)
East Boston	8.81
Downtown	8.64
Roxbury	8.33
Charlestown	8.14
North End	7.89

Table 3.3: Top 5 districts with the largest sidewalks' area

District Name	Sidewalk Area (sq ft)
Roxbury	4670.44
Roxbury 10A	3046.55
East Boston	2908.68
Downtown	2864.80
The North End	2682.57

The dataset from Boston's public schools provided information on the number of sidewalks that are accessible within a 15-minute walking distance (1.2 kilometers approx.)

Table 3.4: Top 5 Schools with most sidewalks within 15 min walk

School Name	Number of Sidewalks
Eliot (K-8)	1235
McKinley Elementary	910
Mckinley So. End Acad	910
Hurley Elementary	858
Kennedy Health Careers Academy	855

Using the shape files provided, we have plotted the sidewalks on the map as well.

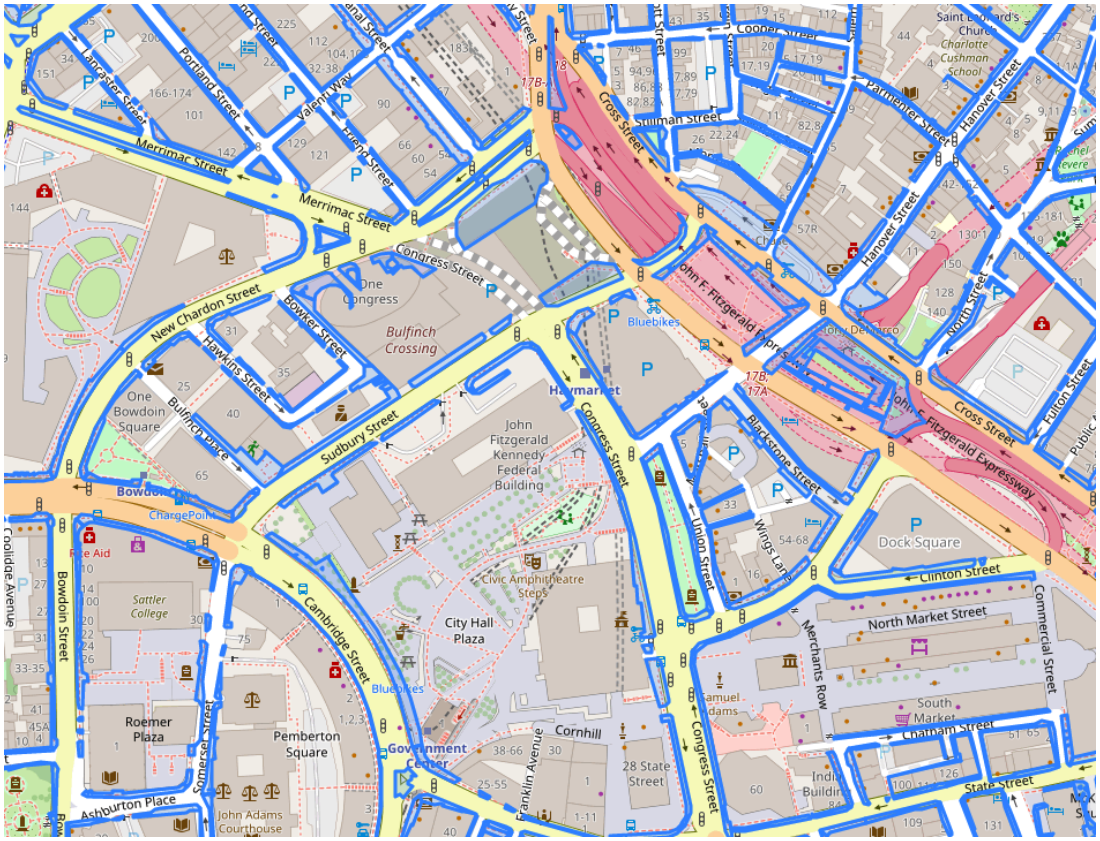


Fig 3.1: Sample sidewalks plotted using the shape files indicated by the blue polygon lines

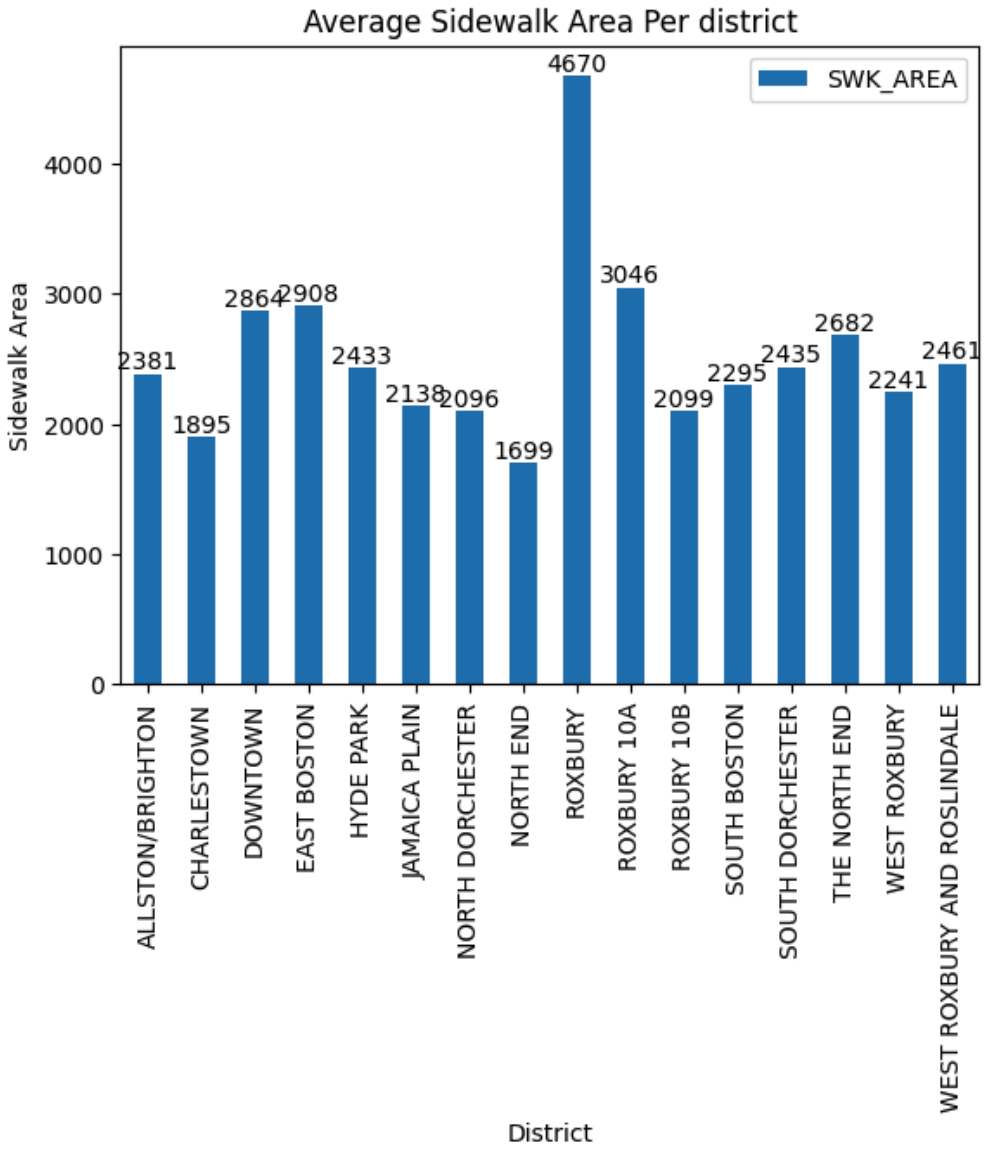


Fig 3.2: Bar plot showing the average sidewalk area per district

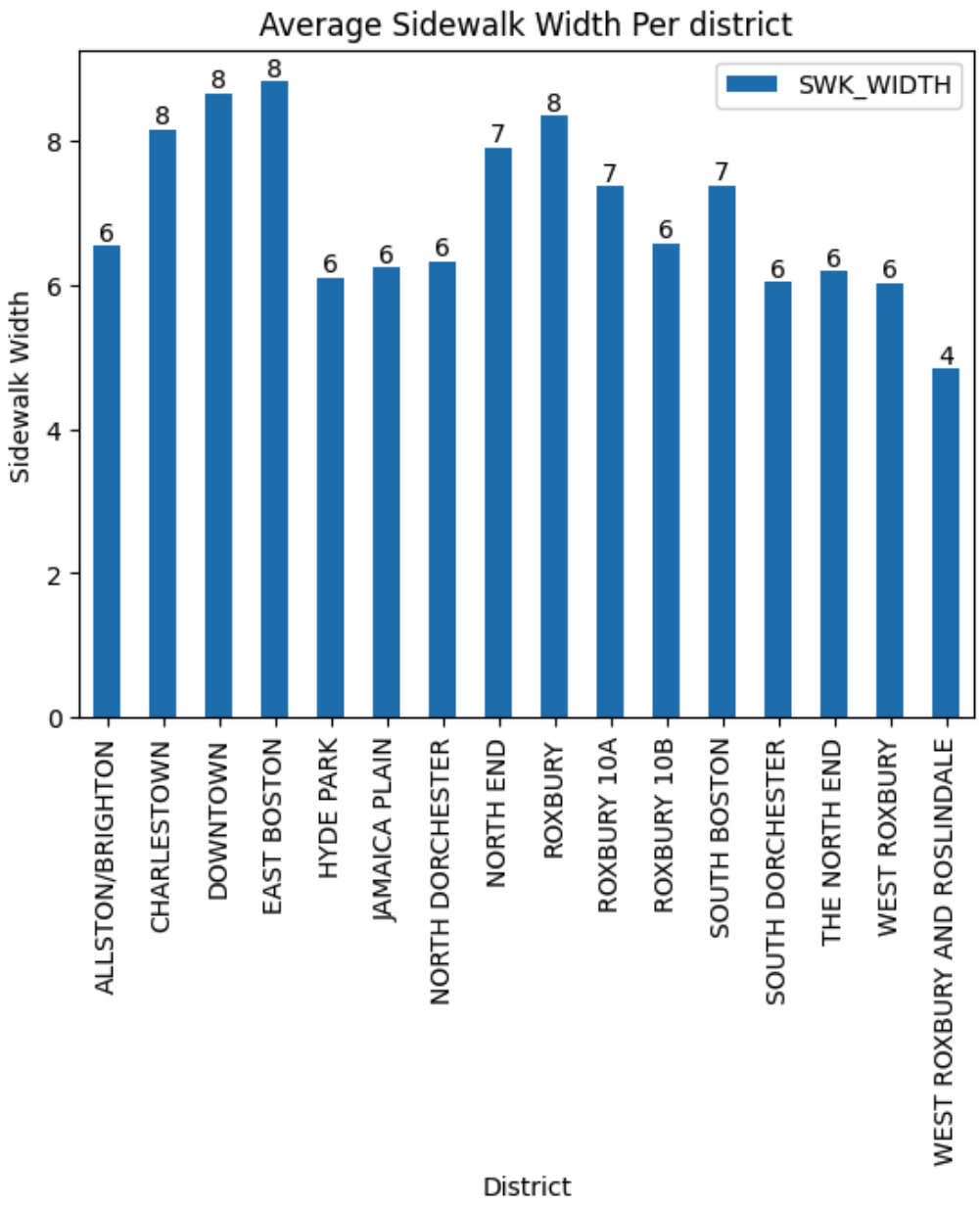


Fig 3.3: Bar plot showing the average sidewalk width per district

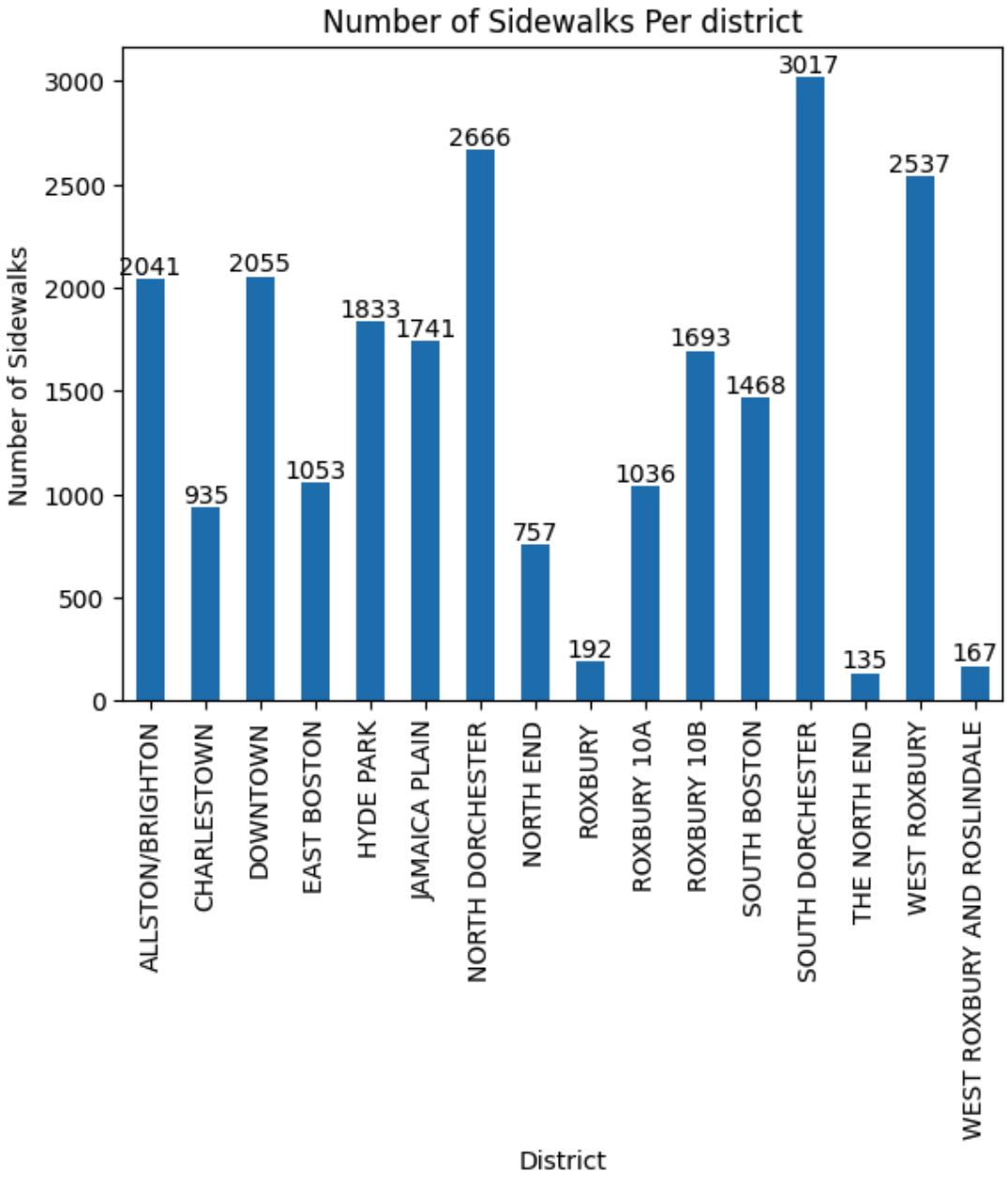


Fig 3.4: Bar plot showing the number of sidewalks per district

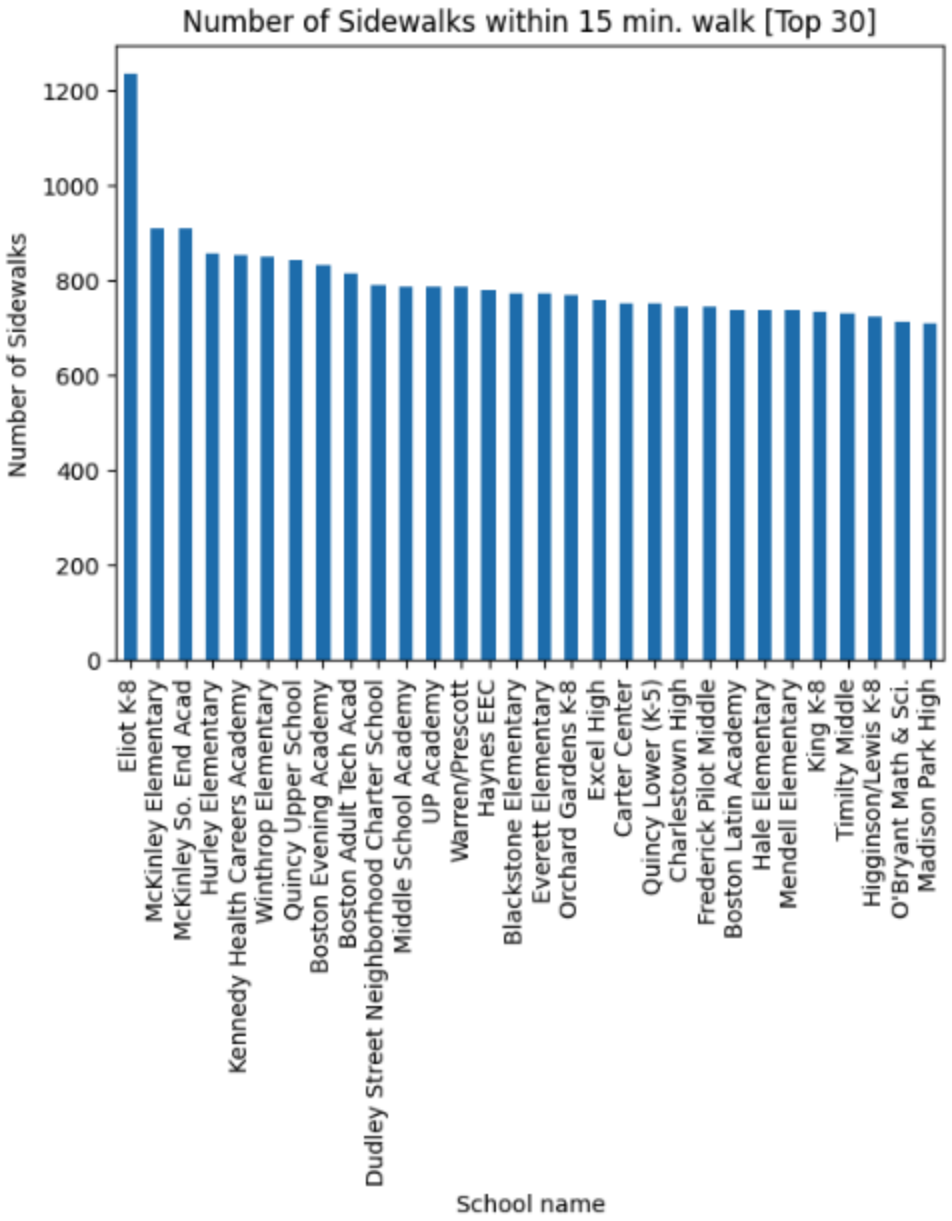


Fig 3.5: Bar plot showing the number of sidewalks available within 15 min walk from Schools

4) Analysis of the Roadway Centerline Dataset
Contributor: Quang

This dataset contains road centerline data in Boston. A roadway centerline is a vector line data that represents the geographic center of a roadway between road shoulders. It can be used to encode road characteristics, such as road name, type, speed limit, etc. It can also be used for linear referencing systems (LRS), which allow locating features along a route using distance measures. This dataset shows which roads are public or private, and what their functions are. It also shows which districts they cross. This could help with mapping. To get accessibility scores for each road, we need more data than this dataset, but some of its features might be helpful with other datasets.

Table 4.1: Top 5 Number of Roads per jurisdiction

Jurisdiction	Number of Roads
Public Way	3528
Private Way	1215
Public Way/Private Way	222
DCR	47
Town Line	13

Table 4.2: Top 5 Number of Roads per District

District	Number of Roads
(3-07)	599
(2-06)	569
(3-03)	506
(2-08)	452
(2-04)	447

Table 4.3: Top 5 Number of Roads per Council

Council	Number of Roads
6	803

5	710
1	676
7	585
2	543

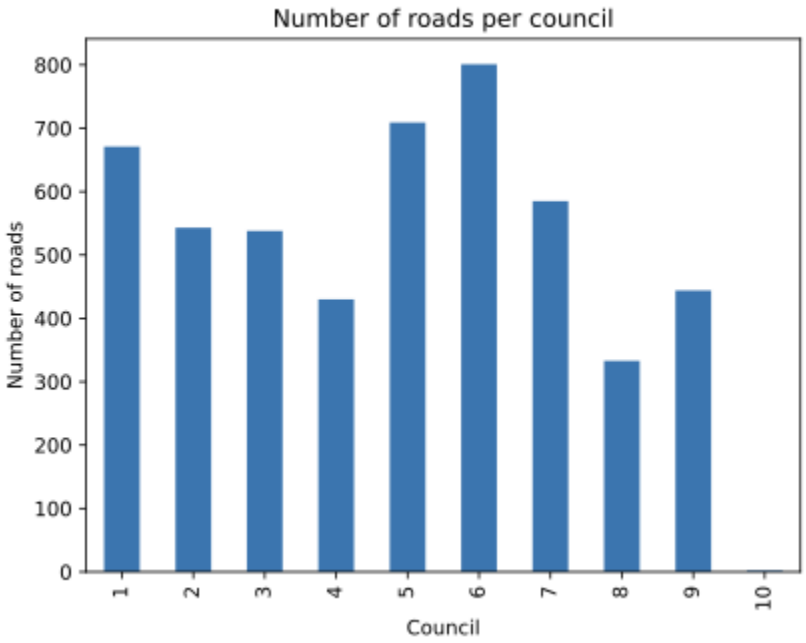


Fig 4.1: Bar plot to show the number of roads per council

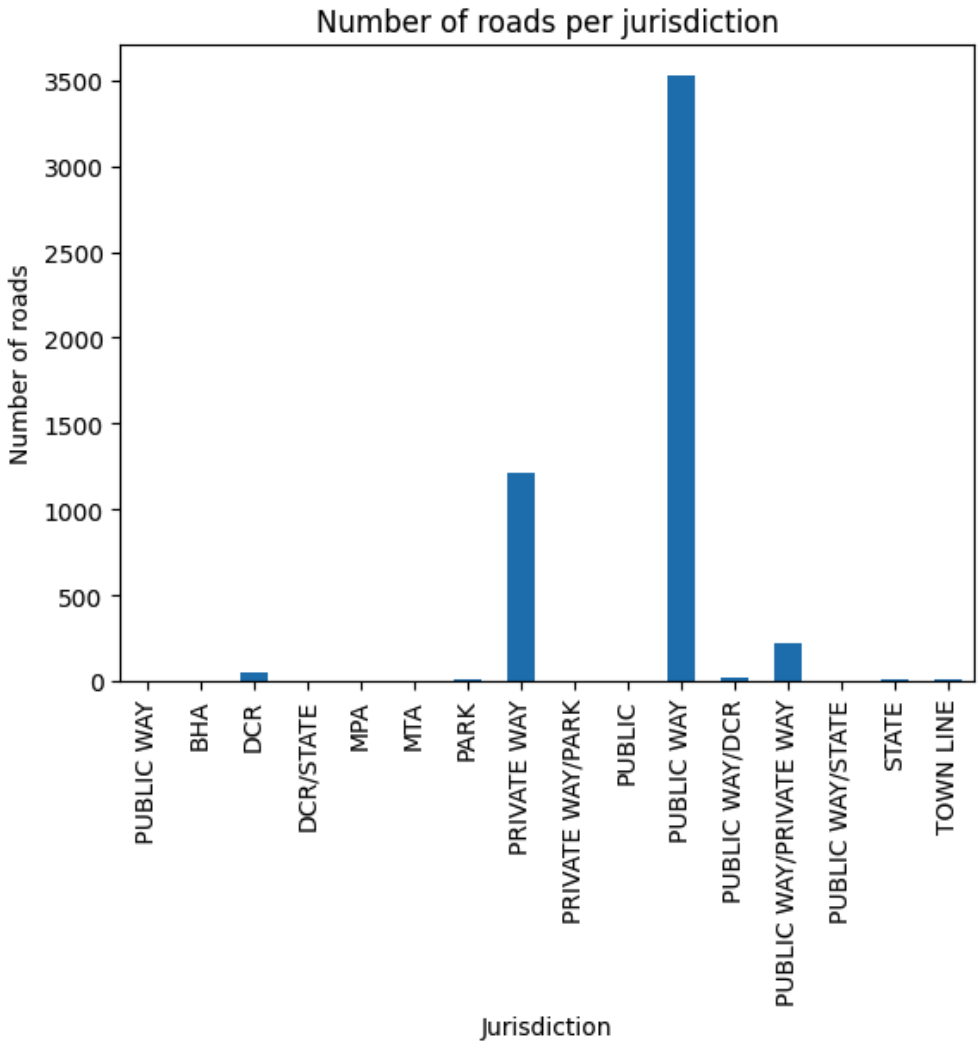


Fig 4.2: Bar plot to show the number of roads per jurisdiction

Results and Observations:

- The highest number of ramps in poor condition can be found in Dorchester.
- Roxbury and South Boston have the largest number of ramps in excellent condition around 64 % of their ramps.
- Within a 15-minute walk, the Eliot K-8 school has the greatest number of sidewalks.
- Highland neighborhood has the highest number of hazards.

Extended Analysis

We conducted an in-depth analysis of several datasets related to Boston's infrastructure and demographics. We initially focused on four datasets - Ramps, Roadway Centerline, Sidewalk Hazards, and Sidewalks - to better understand the city's accessibility and safety for pedestrians and individuals with disabilities. In addition to these datasets, we also examined four additional datasets - Public Works Active Work Zones Data, Climate Ready Social Vulnerability Data, 311 Requests, and Census Demographic Data.

Through this analysis, we were able to gather valuable insights and develop visualizations that highlight important trends and patterns in the data. This information can be used to inform policy decisions and improve the overall quality of life for Boston residents. Overall, our extended analysis provides a comprehensive view of Boston's infrastructure and demographic landscape, allowing us to identify areas of improvement and develop strategies for addressing key challenges facing the city.

Ramps

Contributors: Pranesh and Anargh

The table shows the top five locations for the respective ramp conditions filtered based on neighborhoods.

Table 5.1: Various Ramp Conditions filtered by neighborhood (Note: The percentages are wrt the number of ramps within the regions.)

Excellent Ramp		**Fair Ramp**		**Poor Ramp**	
Neighborhood	**Count**	**Neighborhood**	**Count**	**Neighborhood**	**Count**
Dorchester	1980 (55.38%)	Dorchester	932 (26.07%)	Dorchester	112 (3.13%)
Roxbury	1721 (63.53%)	Roxbury	608 (22.44%)	Roxbury	106 (3.91%)
South Boston	1458 (63.95%)	Mattapan	522 (37.74%)	Hyde Park	79 (4.86%)
West Roxbury	1072 (56.84%)	South Boston	435 (19.08%)	Roslindale	56 (3.91%)
Brighton	897	Hyde Park	407	South Boston	47

	(62.95%)		(25.03%)		(2.06%)

We have considered the neighborhood that has the maximum ramps count for generating the table above.

Below tables show the ramp ratios of poor and excellent ramps in the neighborhoods.

Table 5.2: Top 5 neighborhoods that have poor ramp ratio

Neighborhood	Poor Ramp Count	Total Ramps Count	Ratio Poor Ramp
Hyde Park	79	1626	0.0486
Roslindale	56	1431	0.0391
Roxbury	106	2709	0.0391
Jamaica Plain	40	1203	0.0333
Dorchester	112	3575	0.0313

Table 5.3: Top 5 neighborhoods that have excellent ramp ratio

Neighborhood	Excellent Ramp Count	Total Ramps Count	Ratio Excellent Ramp
Allston	513	798	0.6429
South Boston	1458	2280	0.6395
Roxbury	1721	2709	0.6353
Brighton	897	1425	0.6295
South End	659	1054	0.6252

Public Works Active Work Zones Data

Contributor: Pranesh

Using a public dataset that shows the active work zones in Boston, we identify those regions that will have temporary inaccessibility due to an on going construction in the site. As this dataset gets updated every day, the data is pulled directly from the site and used to generate the report.

Last fetched: 3/21/2023

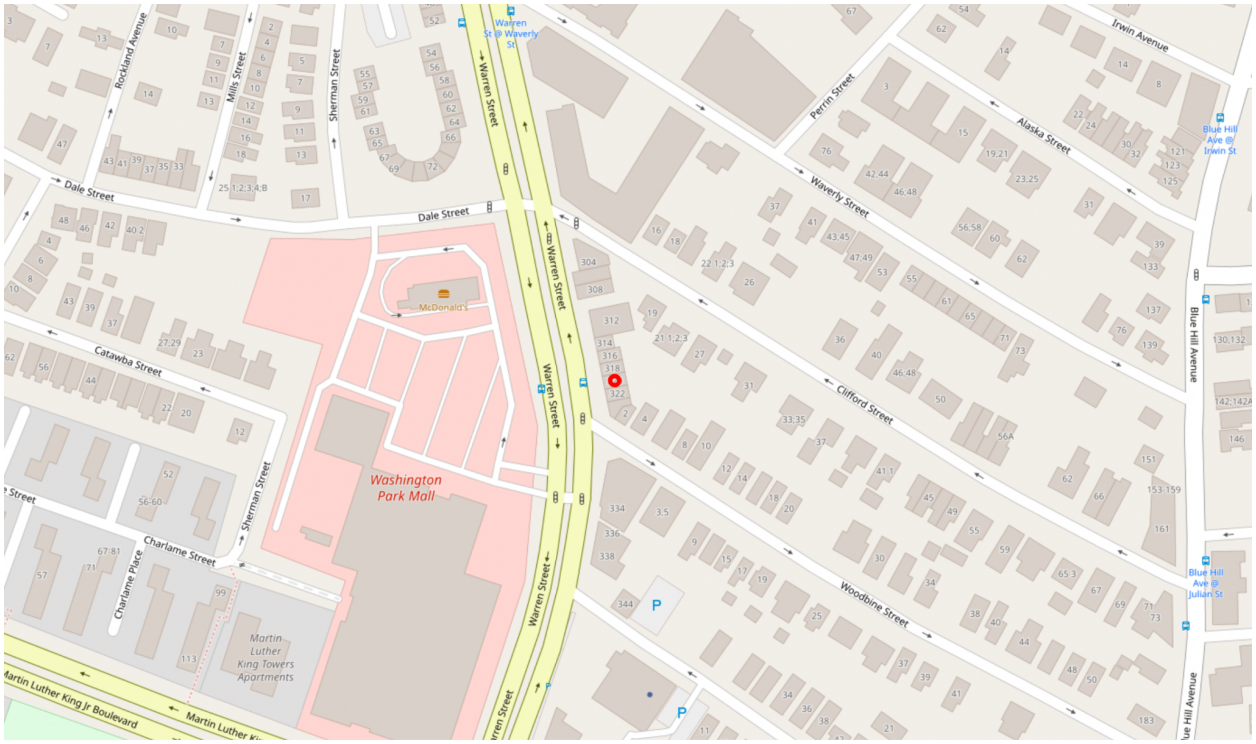


Fig 6.1: Shows 320, Warren St is a red zone as the Sidewalk_Plates_In_Use = 1

Ramps and Ramp Scores

Contributor: Anargh

The landing condition of a ramp in sidewalks refers to the level surface at the top and bottom of the ramp, where it connects to the sidewalk or other surfaces. The landing should be designed to ensure accessibility and safety for all users, including those with mobility impairments or using wheelchairs, scooters, or other assistive devices. The below table indicates the landing conditions of the ramps.

Table 7.1: Various Categories of landing conditions

Landing Condition of the Ramps	Count
Excellent (Like new)	14770
Fair (Minor/Hairline damage with no impact to accessibility)	4897
Poor (Panel is damaged and affecting functionality- to be replaced)	375

Un-identified	6170

Roxbury has the most poor ramp landing conditions with around 16% of the total poor landing conditions.

ADA Compliance of the ramps:

This checks the accessibility for people with disabilities.

Table 7.2: Various statuses of ramp compliance and overall count

Compliance Status	**Count**
Compliant	3289
Not Compliant	20809
Not Compliant - Missing	2061
Un-identified	53

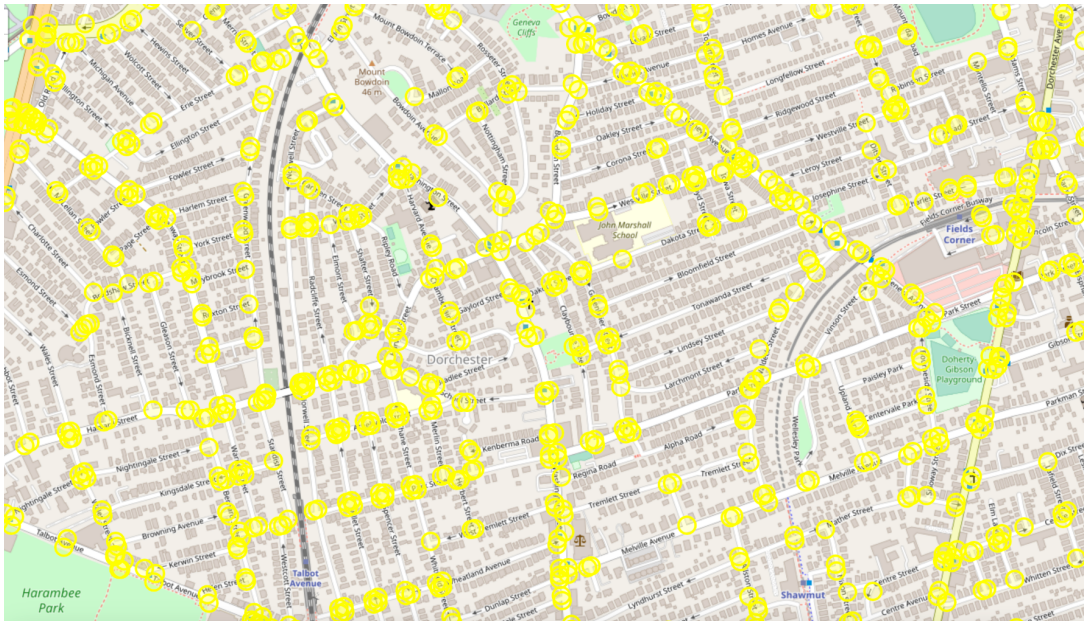


Fig 7.1: The yellow markers denote the non compliant ramps in Dorchester

The map above shows the non-compliant ramps in the Dorchester region which is ranked with the most number of non-compliant ramps.

Table 7.3: Top 5 regions with most non compliance rates

Neighborhood	Count	Percentage(wrt all non compliant regions)
Dorchester	2784	13.3%
Roxbury	2280	10.9%
South Boston	1874	9%
West Roxbury	1427	6.8%
Hyde Park	1223	5.8%

For Ramp Scores, a scoring system for the accessibility of the ramp where

0 = missing ramp, biggest barrier
1-20 = very poor condition ramp/inaccessible- still considered barrier
21-55 = existing but not very accessible
56-80 = fairly accessible
81-100 = accessible

Below are the low ramp score regions plotted on the map which shows the regions around Dorchester and Mattapan:

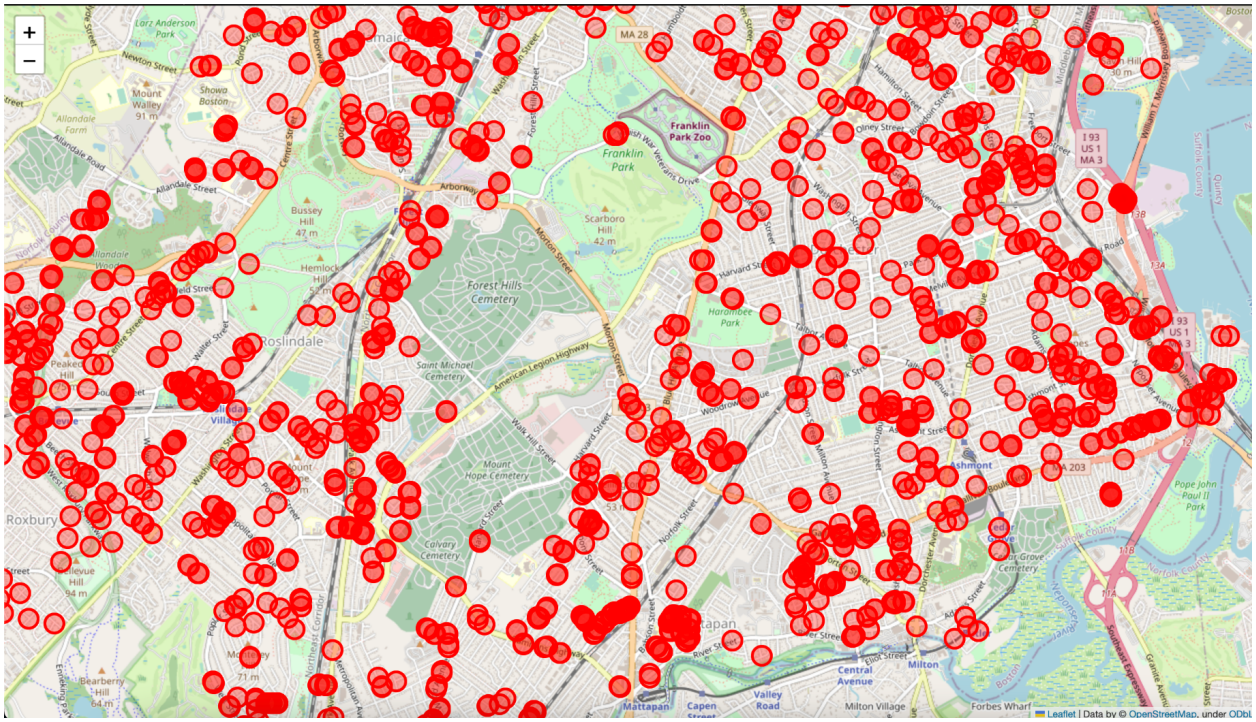


Fig 7.2: Low Ramp scores found in Dorchester and Mattapan

The bar graph below indicates the various ramp scores and their counts.

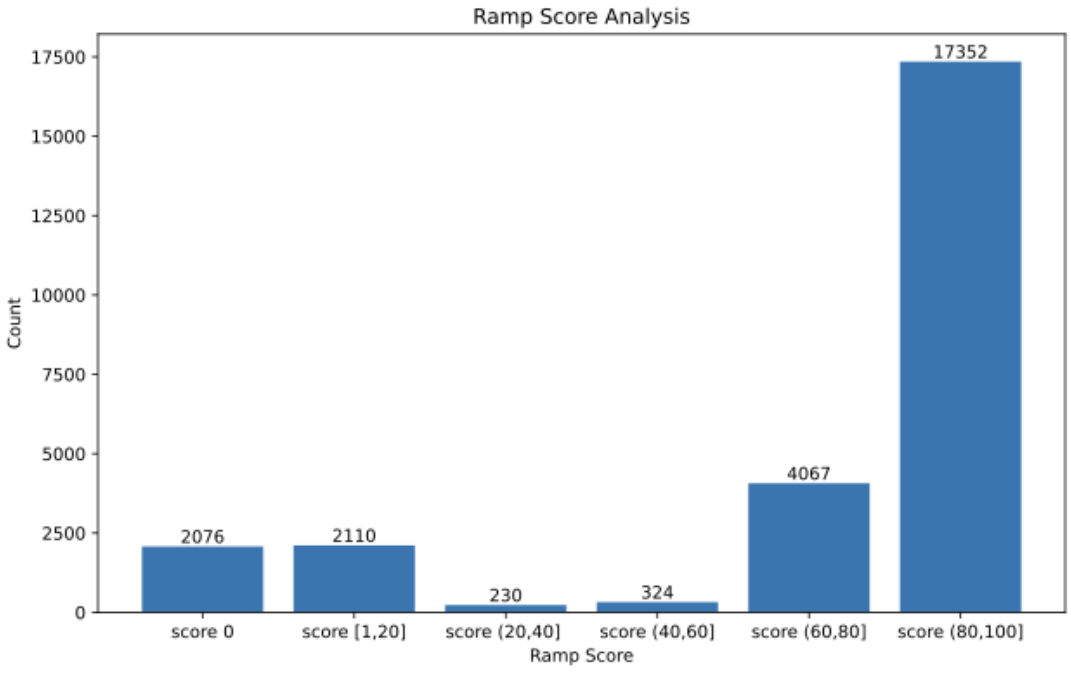


Fig 7.3: Ramp Accessibility Score Analysis

311 Requests

Contributor: Quang and Akarvin

311 is a non-emergency phone number that people can call in many cities to find information about services, make complaints, or report problems like graffiti or road damage. From the 311 datasets, we have filtered out 515 open requests related to sidewalk issues and repair requests and mapped them. Since the dataset is very recent, we might be able to utilize this data in addition to what we already have to calculate the latest accessibility scores for the sidewalks.

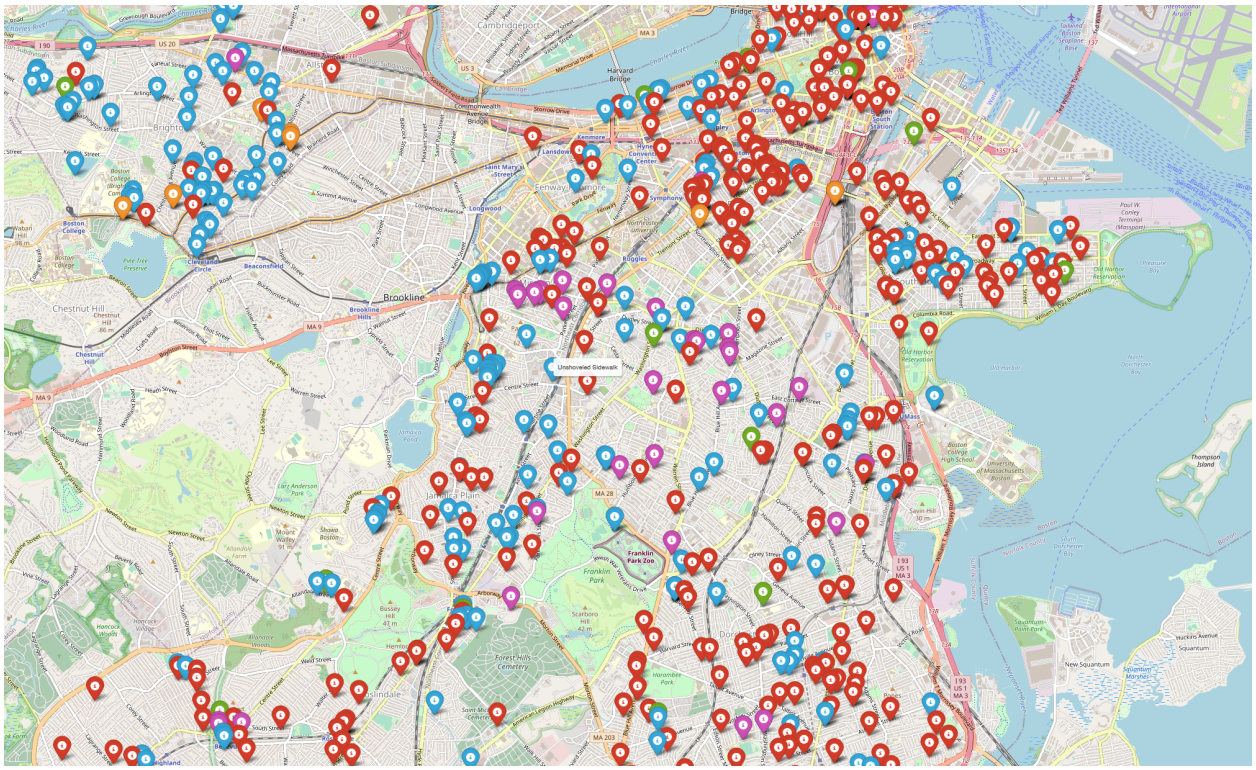


Fig 8.1: Types of sidewalk related repair requests found in the 311 requests (Refer legend below)

Legend	
Sidewalk Repair (Make Safe)	Red
Unshoveled Sidewalk	Blue
Sidewalk Cover / Manhole	Green
Missing Sign	Purple
Sidewalk Repair	Orange

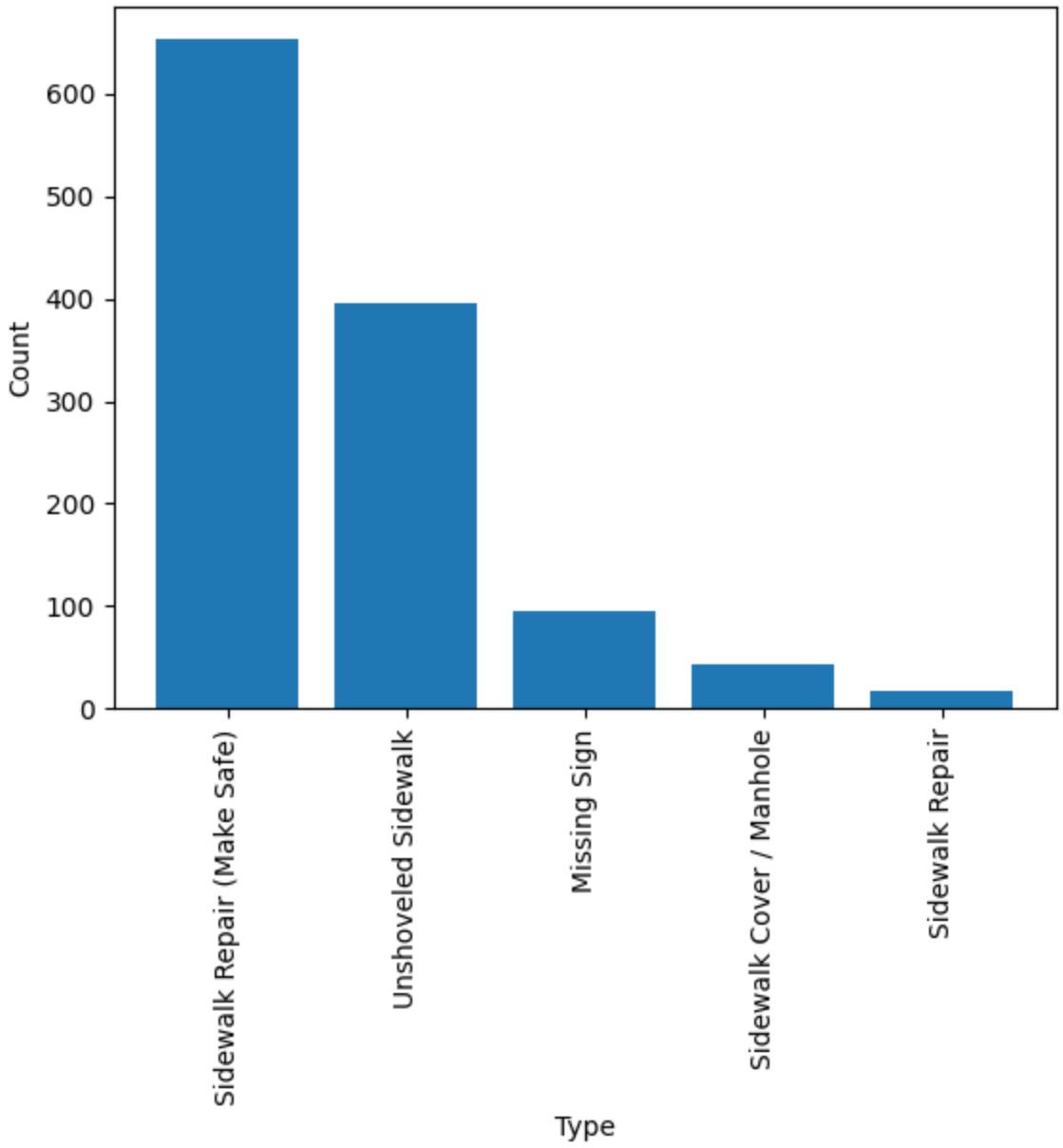


Fig 8.2: Number of sidewalk related repair request found in the 311 Requests

Combined Metrics [Hazards, Ramps with score less than 20, Non ADA Compliant Ramps, Ramps in poor condition]

Contributor: Akarvin and Anargh

Legend:

Circles : [Sidewalks Hazards]

- Red: Fixed Pinch Point Hazard

- Green: Trip Hazards due to tree roots
- Blue: Trip Hazards not due to tree roots

Blue Icon with Cross: Ramps that are not ADA Compliant
Red Icon with Exclamation: Ramps score less than 20
Purple Icon with ban circle: Poor ramp conditions

Fig 9.1: Combined hazards with non compliance, ramp scores less than 20 and poor ramp conditions (Refer legend above)

Analysis of Climate Ready Social Vulnerability Data

Contributor: Pranesh and Anargh

The Climate Ready Boston dataset focuses on social vulnerability, which is the increased susceptibility of certain social groups to hazards and their impacts. The dataset identifies several groups that are particularly vulnerable, including older adults, children, people of color, individuals with limited English proficiency, low-income individuals, people with disabilities, and those with medical illnesses.

Table 10.1: Top 5 most populated regions in Boston

Name	Total Population	Percentage(%)
Roxbury	77812	12.59
Dorchester	69695	11.28
Roslindale	60973	9.87
Brighton	60821	9.84
Jamaica Plain	42251	6.84

Table 10.2: Top 5 regions in Boston with most housing

Name	Total Housing	Percentage(%)
Roxbury	32887	12.06
Dorchester	27507	10.09
Brighton	27143	9.96
Roslindale	25153	9.23
Jamaica Plain	18844	6.91

Table 10.3: Top 5 regions in Boston with most children

Name	Total Children	Percentage(%)
Roxbury	19517	18.86
Dorchester	17424	16.64
Roslindale	13324	12.73
Mattapan	8859	8.46

East Boston	8665	8.27

Table 10.4: Top 5 regions in Boston with most disability

Name	Total Disability	Percentage(%)
Roxbury	12611	17.83
Dorchester	9819	13.88
Roslindale	7286	10.30
Mattapan	5605	7.92
Brighton	5502	7.78

Table 10.5: Top 5 regions in Boston with most number of older adults occupying

Name	Total Older Adults	Percentage(%)
Roslindale	8231	13.02
Roxbury	6675	10.56
Dorchester	6535	10.34
Brighton	5847	9.25
Jamaica Plain	4381	6.93

Table 10.6: Top 5 regions in Boston with low to no income

Name	Total Low to No Income	Percentage(%)
Roxbury	33272	18.89
Dorchester	22749	12.92
Brighton	17067	9.69
East Boston	13698	7.78
Jamaica Plain	12985	7.37

Table 10.7: Top 5 regions in Boston with most medical illness

Name	Total Medical Illness	Percentage(%)

Roxbury	28235.10	11.91
Dorchester	25010.76	10.55
Roslindale	24029.32	10.14
Brighton	23936.80	10.10
Jamaica Plain	16600.57	7.00

Observations:

1. 12% of the entire housing in Boston is situated in the neighborhood: **Roxbury**
2. 12.5% of the entire Boston population live in the neighborhood: **Roxbury**
3. 19% of the people who have low to no income live in the neighborhood: **Roxbury**
4. 18% of the people who has some disability live in the neighborhood: **Roxbury**
5. 19% of the children live in the neighborhood: **Roxbury**
6. 13% of the older adults live in the neighborhood: **Roxbury**
7. 12% of the people who has some medical illness live in the neighborhood: **Roxbury**

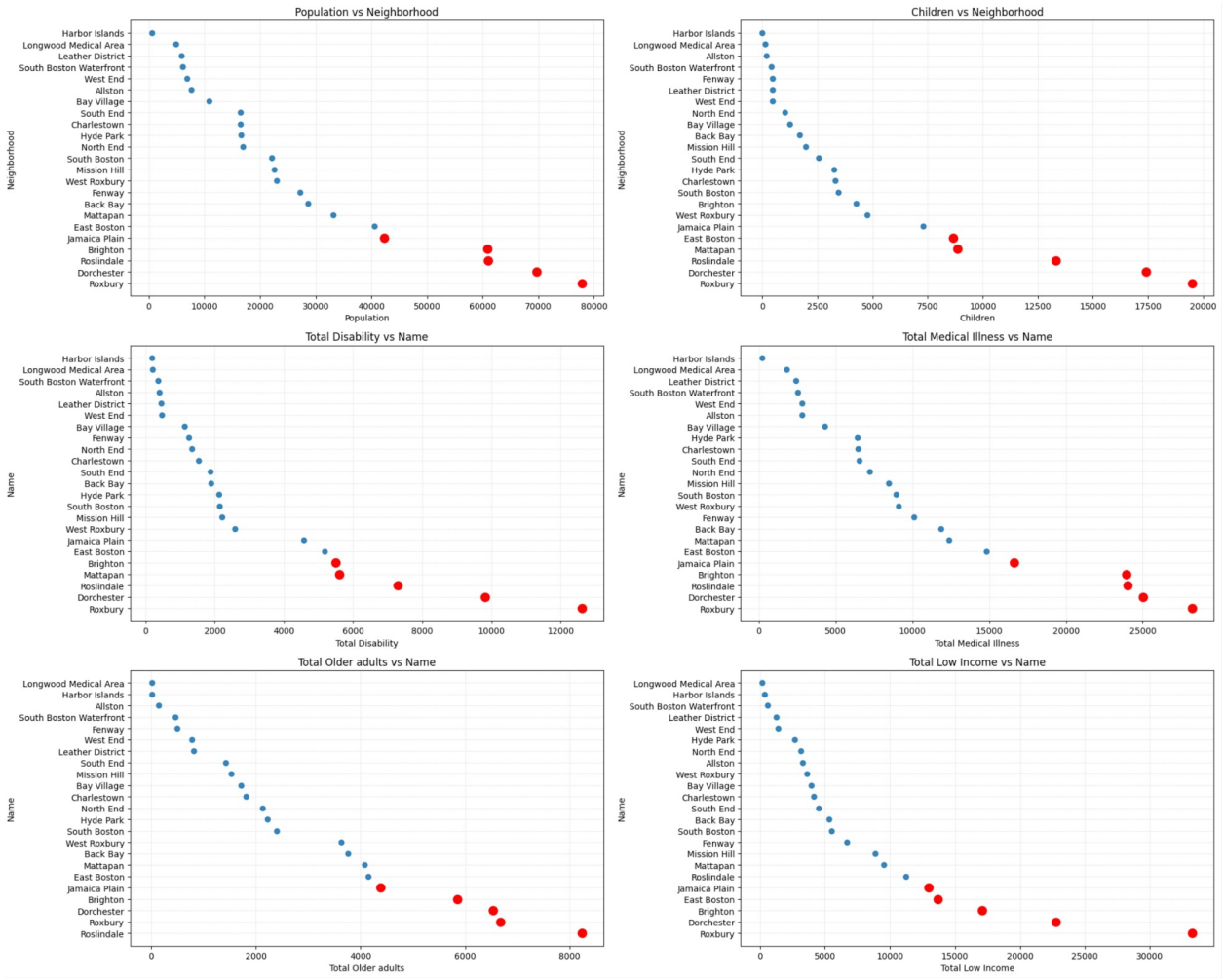


Fig 10.1: Scatter plots on Population vs Neighborhood; Children vs Neighborhood; Total disability vs Neighborhood; Total Medical illness vs Neighborhood; Total older Adults vs Neighborhood; Total Low Income vs Neighborhood

Using the above data, we can calculate the ramp density ie. the ramps per population. Ramp density (ramps per capita) is a useful measure to understand the ramp conditions in each neighborhood, as it accounts for the differences in population size. By using ramp density, you can compare the number of ramps in each neighborhood relative to its population, which gives you a better idea of how accessible the neighborhood is for people with mobility impairments.

For example, a neighborhood with a high ramp density might have a high number of ramps relative to its population, indicating that it is relatively accessible for people with mobility impairments. On the other hand, a neighborhood with a low ramp density might have a lower number of ramps relative to its population, indicating that it is less accessible for people with mobility impairments.

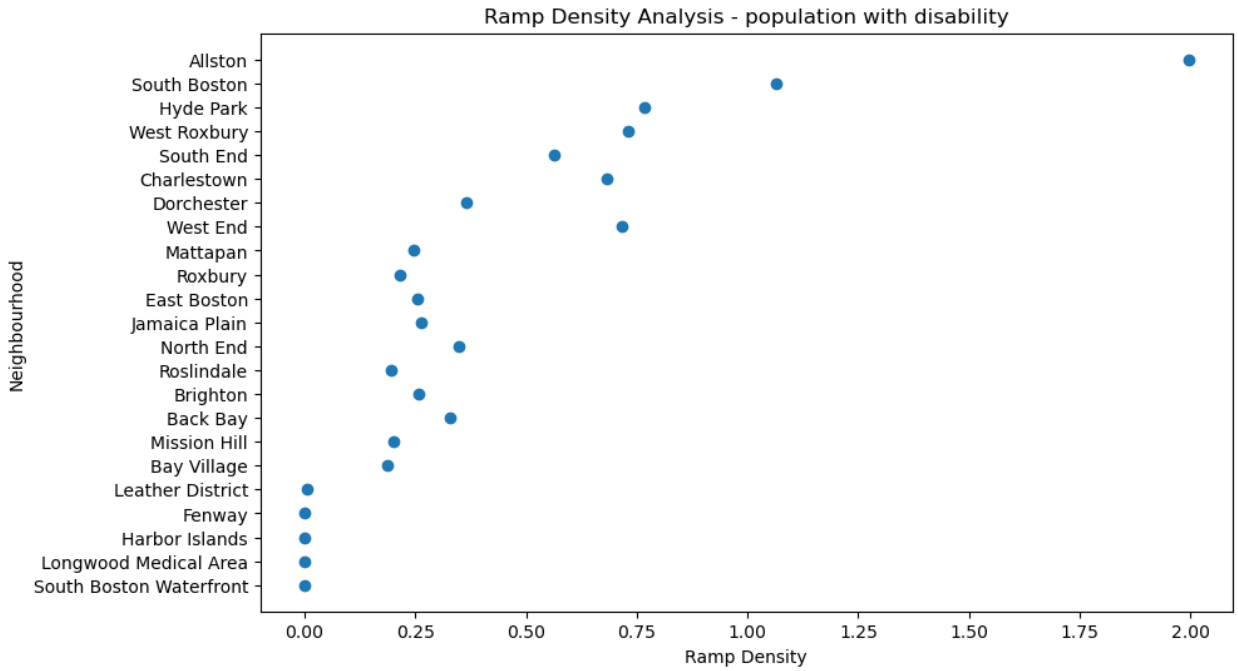


Fig 10.2: Total Ramp Density Analysis with population with disability

From the above graph, we can see that Allston has almost twice the number of ramps with respect to the population of disability.

Below are the tables that show the top 5 regions with poor ramp density per disability population and excellent ramp density per disability population.

Table 10.8: Top 5 regions with poor ramp density

Neighborhood	**Ramp Density (Poor ramps per disability population)**
Hyde Park	0.0373
South Boston	0.0219
Charlestown	0.0182
Allston	0.0175
West Roxbury	0.0132

Table 10.9: Top 5 regions with excellent ramp density

Neighborhood	**Ramp Density (Excellent ramps per disability population)**
Allston	1.283

South Boston	0.680
Hyde Park	0.423
West Roxbury	0.416
Charlestown	0.408

From the above table, we can see Allston has a high excellent ramp density, which means the number of excellent ramps per population of disability is high. However it ranks 4th in the poor ramp density as well.

Inaccessibility Score for Sidewalks

Contributor: Akarvin and Anargh

To generate the combined metrics, every sidewalk hazard is transformed to a circle with radius to 10 meters and intersection to every sidewalks' polygon was calculated, and assigned to the sidewalk with the largest intersection.

Legend Sidewalk Polygon:

Red - Hazards more than 20

Dark Pink - Hazards more than 11 less than 20

Violet - Hazards more than 5 less than 11

Navy Blue - Hazards more than 3 less than 5

Green - No hazards

Legend Hazards:

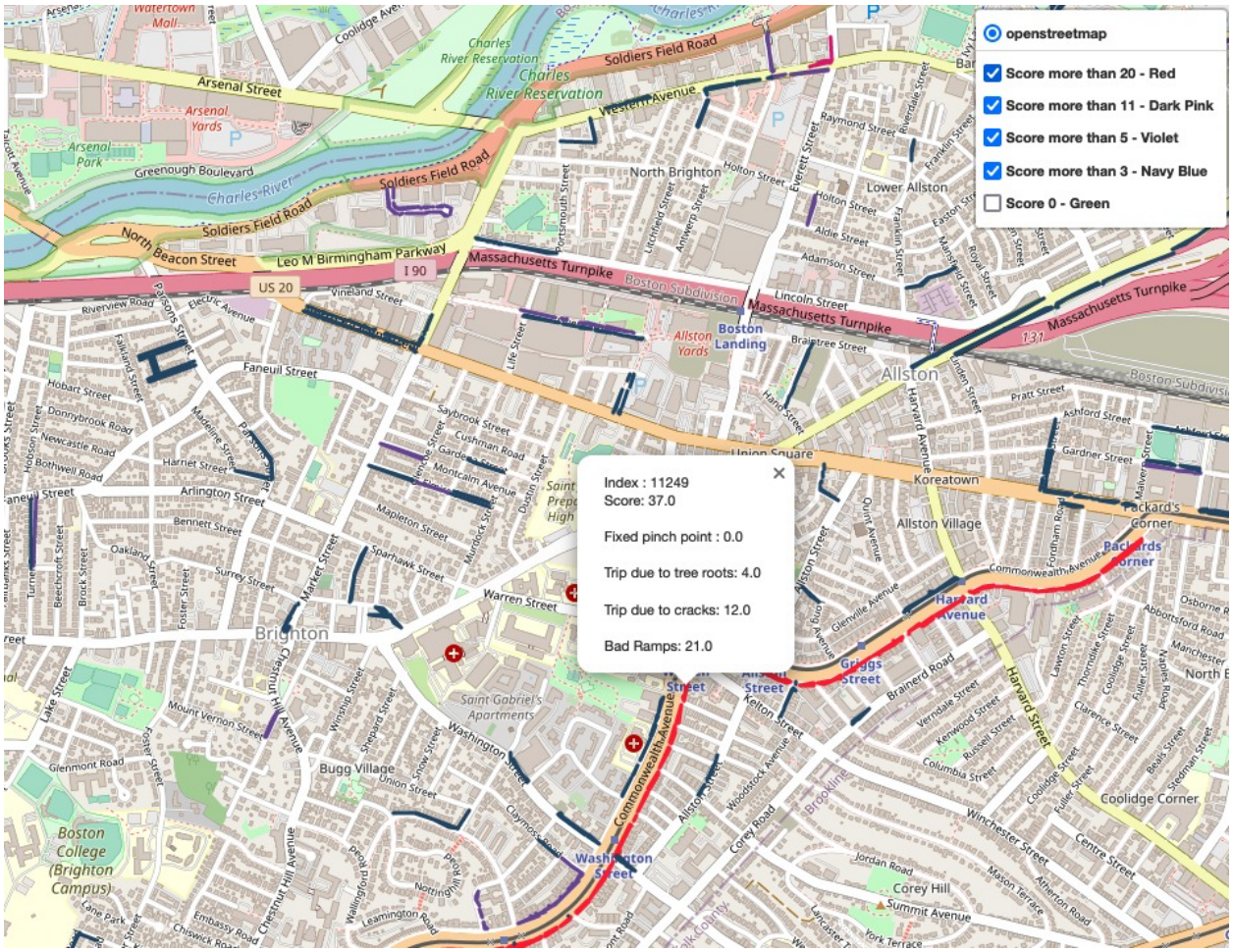


Fig 11.1: Sidewalks blocks with their inaccessible score - showing the highest score of 37

Formula to calculate the inaccessibility score

As suggested by our client, for a particular sidewalk block we calculate the number of inaccessible points and represent them in their raw count.

Inaccessibility score = w1* Number of hazards due to tree roots + w2* Number of hazards due to cracks + w3* Number of hazards due to fixed pinch point <36'' + w4* Number of ramp score values below 20 + w5* Number of 0 ramp score values + weightage for disability population

The above-weighted sum formula has weights associated with each parameter to give different priorities for hazard types. For example, ramps with a score of 0 are worse than ramps with a score of 19 and we would want to give that more weightage.

For now, we have initialized all weights to 1 and the weightage of the disability population is made to 0.

Table 11.1: Top 5 most inaccessible sidewalk blocks

ID	DISTRICT	Poor Ramp Score	Hazard Score	Score
16050	ALLSTON / BRIGHTON	21	16	**37**
22780	ALLSTON / BRIGHTON	28	1	**29**
9529	SOUTH BOSTON	13	9	**22**
2778	WEST ROXBURY	2	19	**21**
4617	CHARLESTOWN	1	19	**20**

Table 11.2: Top 5 sidewalk blocks with high hazard score

ID	DISTRICT	Hazard Score
2778	WEST ROXBURY	19
4617	CHARLESTOWN	19
9990	HYDE PARK	19
8969	NORTH END	18
16050	ALLSTON/BRIGHTON	16

Table 11.3: Top 5 sidewalk blocks with most poor ramp score

ID	DISTRICT	Poor Ramp Score
22780	ALLSTON/BRIGHTON	28
16050	ALLSTON/BRIGHTON	21

9529	SOUTH BOSTON	13
20946	ALLSTON/BRIGHTON	13
922	ROXBURY 10A	12

Table 11.4: Top 5 districts with 5% of the worst sidewalk blocks

District	**Count**
DOWNTOWN	145
WEST ROXBURY	141
SOUTH DORCHESTER	92
EAST BOSTON	89
SOUTH BOSTON	86

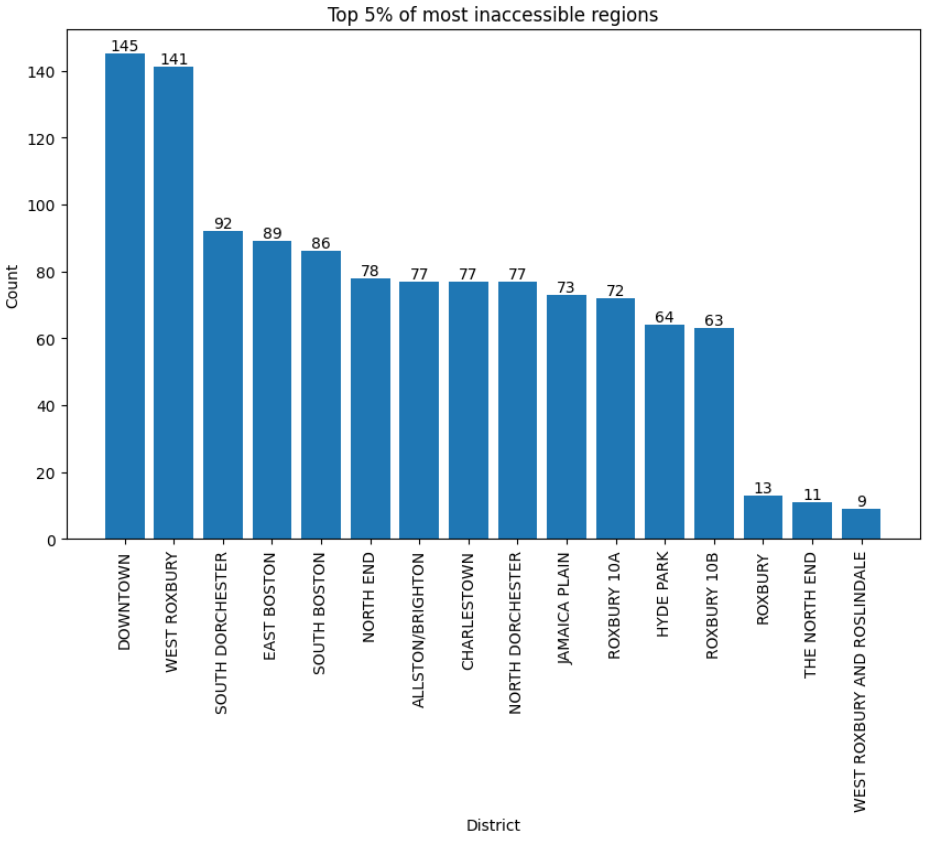


Fig 11.2: Distribution of the top 5% of the worst sidewalk blocks

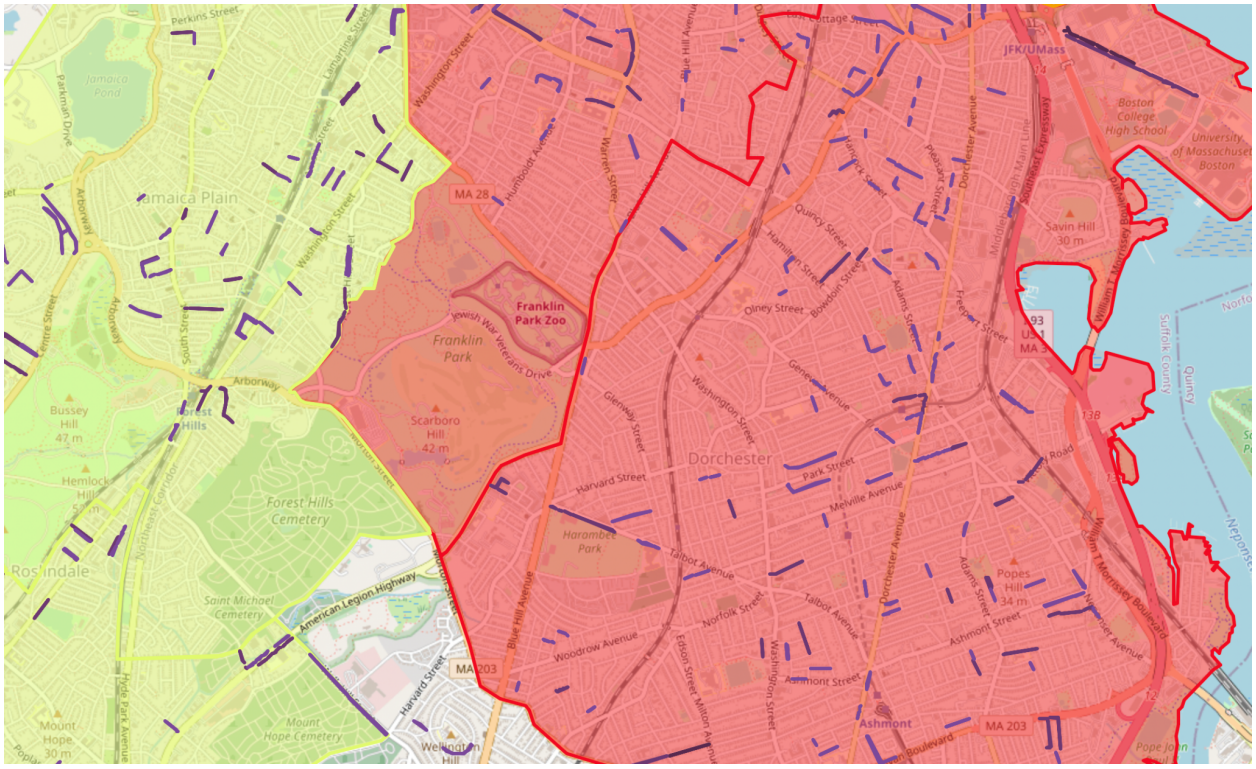


Fig11.3: The geospatial representation of the sidewalk blocks that contribute to the top 5% of the worst sidewalks

Observations:

- Highland neighborhood has the highest number of hazards.
- Most of the hazards are trip hazards due to cracks etc.
- Dorchester Heights has the most number of “Fixed pinch point <36” sidewalk width” hazard.
- Highland has the most number of hazards due to tree roots and other factors like cracks etc.
- Dorchester has the most number of poor ramp scores.
- The highest inaccessibility score is 37 which is in Allston/Brighton.
- Sidewalks in West Roxbury, Charlestown and Hyde Park have the highest hazard count.
- Allston/Brighton has sidewalks with the most number of poor ramp scores.
- Downtown neighborhoods have the most number of inaccessible sidewalks.
- Roxbury is the most populated region in Boston followed by Dorchester.
- 17% of the disability population is in Roxbury.
- Roxbury also has the highest child population, people with medical illness as well.
- Around 18% of the population in Roxbury has low income and 12% in Dorchester.
- 13% of the Roslindale population is occupied by older adults.
- Roslindale is the second highest neighborhood with a poor ramp ratio.

Conclusions:

As we can clearly see, the neighborhood of Roxbury will be the most impacted locality if there are any hazards or disasters, and if the ramps are not in proper condition. It would be a hassle for older people to commute from one place to another. If any natural disaster occurs, people who have low to no income would not be able to recover from this without the government's help. It's better we proactively monitor the ramp conditions, sidewalk conditions, and other measures which will ease their livelihood.

Challenges:

- The lack of a description document had held us back for some time.
- Assumptions of possible hazard metrics were made.
- Inconsistent latitude and longitude format across the datasets.
- Normalizing the ramp data with population.

Code:

Follow the ReadMe document in the git to reproduce the results. The data files used in the project come under the data folder and the code files are in the files folder. All the libraries used are mentioned in the requirements document.

Question-Answering

1) Can we use the results of this score to identify regions of the City that are the most accessible vs. least accessible?

   As seen from the report above, we have identified Dorchester to be the least accessible region. With respect to the ramp ratios, we can see that Hyde Park has the highest ratio of poor ramp and Allston has the highest ratio for excellent ramp. Additionally, using ramp density we are able to identify that Allston has the highest excellent ramp density with respect to the population of disabilities and Hyde Park has the highest poor ramp density with respect to the population of disabilities. We are also able to identify specific sideblocks that have the least accessibility. The highest inaccessibility score is for a sidewalk block in Allston/Brighton region with a score of 37.

2) Can we also compare these results with different elements of social vulnerability to see how equitable/inequitable accessibility is?

   Using the data from our analysis of the climate-ready social vulnerability, we can understand how equitable or inequitable different regions are in terms of accessibility. As an example, we found that Dorchester and Roxbury have the highest number of disabled individuals and also the largest count of ADA non-compliant ramps, indicating potential inequities in accessibility infrastructure in these areas. Also, Dorchester and Roxbury have the highest number of people who have Low to No income, and if any natural disaster happens to occur, these people are more susceptible to negative impacts and it's quite hard for them to recover. We can conclude that people in these regions have less access to resources or services due to their social status as well. Specifically we have seen how Roslindale is the second highest neighborhood with a poor ramp ratio and also has the highest percentage(13%) of older adults.

3) Can we create routes from residential parcels to the nearest important pedestrian destinations (transit stops/ commercial zones/ parks/ schools/ etc.) to see how many residents can get to these destinations without coming across any inaccessible features? How do these routes differ for citizens that live in different parts of the City?

   By using the climate-ready social vulnerability data, we can obtain information about the demographic makeup of various regions in Boston. This information can be combined with parcel datasets and latitude/longitude coordinates to create routes from residential parcels to important pedestrian destinations. We can use metrics such as the number of sidewalk hazards and normalized ramp scores based on population density to identify

potential obstacles along the route and estimate the number of residents who can access these destinations without encountering any hazards or issues based on region-based census data. Creating routes that exclude specific polygons or areas can be a difficult task. While APIs exist for excluding areas while driving, there is no similar option available for walking routes. As a result, to achieve this exclusion, one would need to calculate routes between every sidewalk, which would require more than 100,000 API calls. However, this is not feasible with the unpaid version of the APIs, which limits the number of API calls that can be made.

4) Based on all the findings above, how should the City re-strategize its sidewalk repair strategy to be most impactful? Can we optimize repairs that would help the most people get to important destinations?

   After analyzing the demographics related to climate readiness and social vulnerability, it has been determined that Roxbury and Dorchester have a low-income population, substandard living conditions, and a significant number of hazardous and non-compliant ramps. As a result, the City should prioritize its efforts to repair sidewalks and ramps in these areas, particularly in locations with high populations of elderly, disabled individuals, and people who have some sort of medical illness. We have also localized the specific sidewalks with most inaccessible scores and also the top 5% of the worst sidewalk blocks.