

BU Sustainability: Water Bottle Filling Stations Final Report

Team C

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Github link for final:

https://github.com/BU-Spark/ds-bu-sustainability-water/tree/team-c_extension/sp24-team-c

Original Wifi (Foot Traffic) Data Filter and Processing

- We simplify our analysis by calculating and focusing on average and max density counts for each floor. This helps us quickly identify when and where traffic peaks.
- We exclude Housing, and Commercial buildings because they're private . For residential buildings we only consider large dorm-style residences for similar reason. We also exclude parking building or floors since people usually do not stay long here.

Results in [updated wifi data.csv](#)

building_floor	building_desc	latitude	longitude	building_type	capacity	mean_density_cnt	max_density_cnt	average_dc_ratio	max_dc_ratio
1	771 COMMONWEALTH AVENUE	42.351	-71.108	Student Support	73	25.44899797	309	0.348616411	4.232876712
2	771 COMMONWEALTH AVENUE	42.351	-71.108	Student Support	92	30.47722567	283	0.331274192	3.076086957
1	775 COMMONWEALTH AVENUE	42.3509	-71.109	Student Support	534	78.56353344	534	0.147122722	1
1	1 UNIVERSITY ROAD	42.3512	-71.11	Academic	307	51.58559521	351	0.168031255	1.143322476
1	745 - 755 COMMONWEALTH AVENUE	42.3505	-71.1073	Academic	129	40.2194126	319	0.311778392	2.472868217
2	745 - 755 COMMONWEALTH AVENUE	42.3505	-71.1073	Academic	60	10.39021281	81	0.173170213	1.35
1	264 270 BAY STATE ROAD	42.3507	-71.1054	Academic	58	25.8062755	227	0.144027500	5.810244828

Original Kitchen and Station Filter and Processing

Floor	Building Description	Space@Bu room	Quantity	Date Installed
1	1 UNIVERSITY ROAD	190A	1	
1	1 UNIVERSITY ROAD		1	
3	1 UNIVERSITY ROAD	390	1	
2	1 UNIVERSITY ROAD	284	1	
1	100 ASHFORD STREET	191	1	
3	100 BAY STATE ROAD	329	1	2012
6	100 BAY STATE ROAD	691A	1	2012
5	100 BAY STATE ROAD	591D	1	2012
-1	100 BAY STATE ROAD	B91	1	2012
1	100 BAY STATE ROAD	191B	1	2012
4	100 BAY STATE ROAD	491A	1	2012
1	1019 COMMONWEALTH AVENUE	198	1	
5	1019 COMMONWEALTH AVENUE	591	1	2023-07-23 00:00:00
6	1019 COMMONWEALTH AVENUE	691	1	2023-07-23 00:00:00
2	1019 COMMONWEALTH AVENUE	291	1	2023-07-23 00:00:00
3	1019 COMMONWEALTH AVENUE	394	1	2023-07-23 00:00:00
4	1019 COMMONWEALTH AVENUE	491	1	2023-07-23 00:00:00

For existed water stations, we combine address A and B into a full building description and retain only the floor, building description, room, quantity, installation date, and station type.

For the kitchens, we retain only the floor, building code, building description, and room details.

results in [Stations.csv](#) and [Kitchens.csv](#)

Floor	Building Code	Building Description	Room #
1	623	1 UNIVERSITY ROAD	104
1	623	1 UNIVERSITY ROAD	150G
1	623	1 UNIVERSITY ROAD	150K
10	500	10 BUICK STREET	1001
5	500	10 BUICK STREET	505
5	500	10 BUICK STREET	506
5	500	10 BUICK STREET	507
5	500	10 BUICK STREET	508
5	500	10 BUICK STREET	509
5	500	10 BUICK STREET	510
5	500	10 BUICK STREET	511
5	500	10 BUICK STREET	512
5	500	10 BUICK STREET	513
5	500	10 BUICK STREET	514
5	500	10 BUICK STREET	515
5	500	10 BUICK STREET	516

Other selection before answer our key question

1. Exclude covered floor (water station & kitchen floor)

Floors with existing water bottle stations or kitchens are excluded from new station consideration because they already have drinking water access, and kitchen floors often restrict public access.

2. Add high volume and air condition (Mechanical Ventilation)
3. Delete dining hall floors. Many types of beverage are offered in dining halls.

Now we get covered floors.csv and uncovered floors.csv

Now answer key questions....

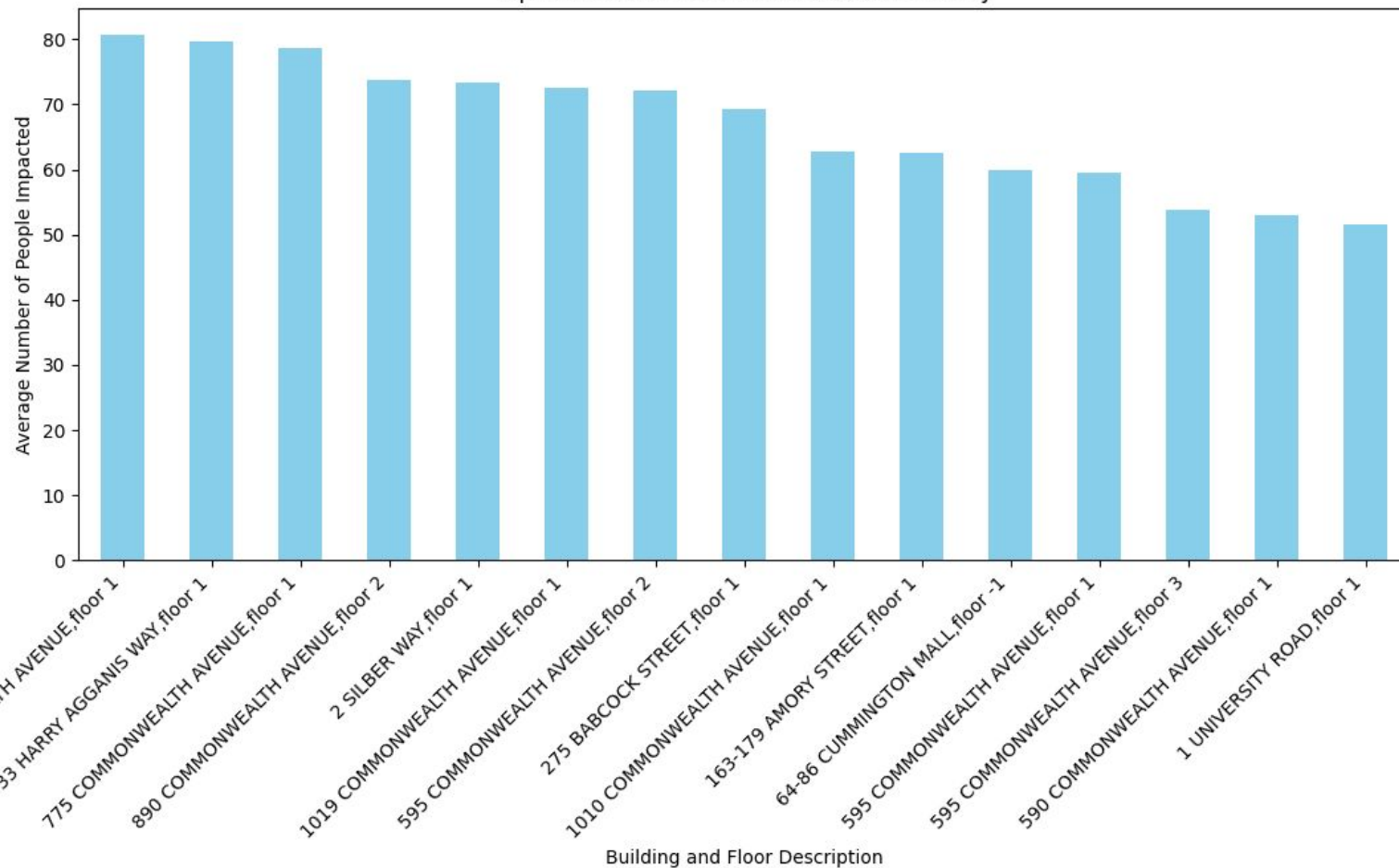
Key Question 1: Establish how many students and employees are impacted by each current water filling station and kitchen

Answer: From our filtered water station and kitchen list [covered floors.csv](#) , we found the average and maximum foot traffic (through the day) of these floors. This gives a rough idea of how many people each water filling station affects.

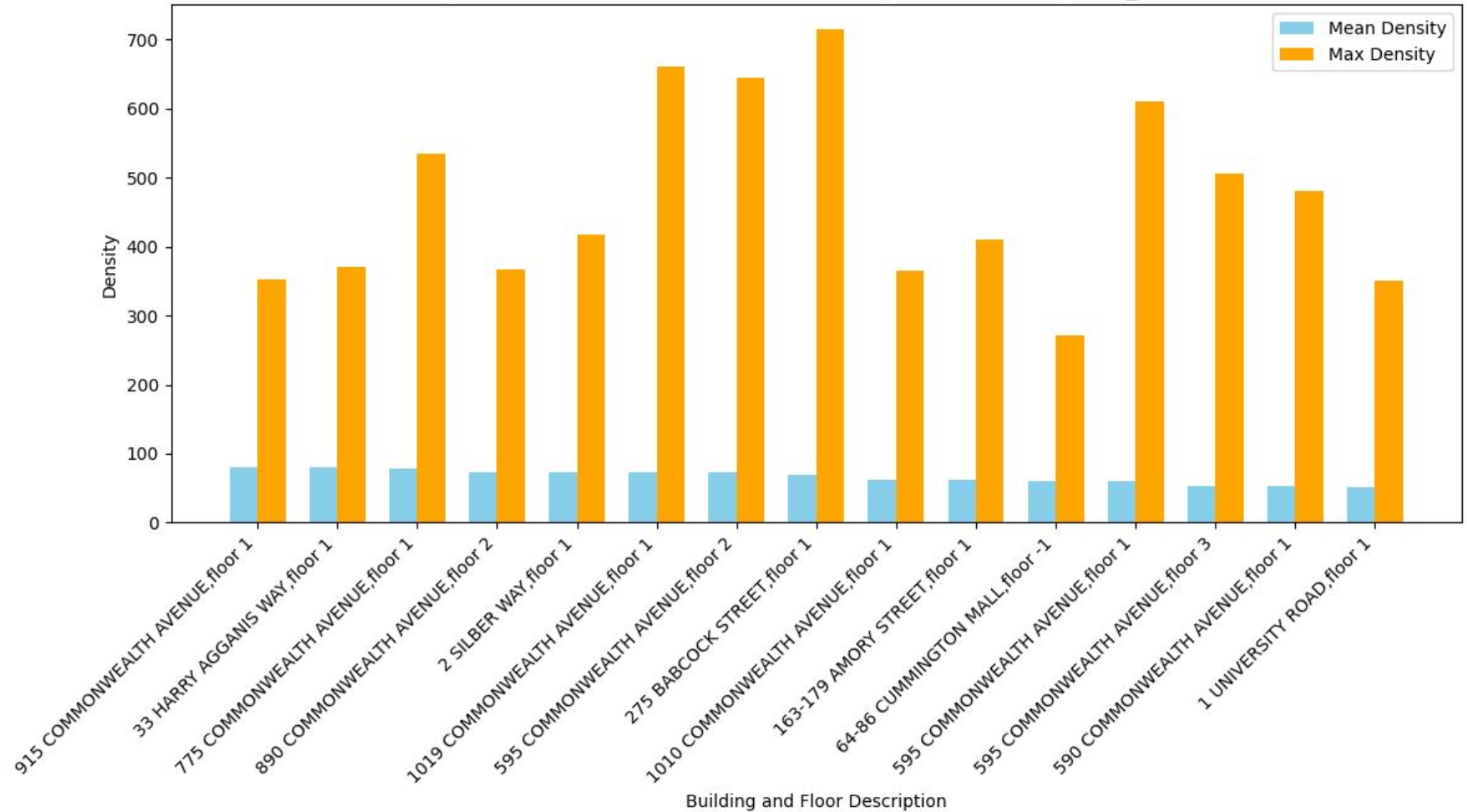
We sort **mean density** as high to low to see how many student and employees are impacted by each current water filling station and kitchen

building_flr	building_desc	latitude	longitude	building_ty	capacity	mean_density_cnt
1	915 COMMONWEALTH AVENUE	42.3518	-71.1165	Student Su	204	80.63353488
1	33 HARRY AGGANIS WAY	42.3532	-71.1178	Residentia	84	79.65136535
1	775 COMMONWEALTH AVENUE	42.3509	-71.109	Student Su	534	78.56353344
2	890 COMMONWEALTH AVENUE	42.3505	-71.1156	Academic	238	73.77037838
1	2 SILBER WAY	42.3497	-71.1009	Academic	87	73.43170503
1	1019 COMMONWEALTH AVENUE	42.3523	-71.1214	Residentia	50	72.45283836
2	595 COMMONWEALTH AVENUE	42.3496	-71.0997	Academic	213	72.19832014
1	275 BABCOCK STREET	42.3528	-71.1204	Residentia	250	69.18003565
1	1010 COMMONWEALTH AVENUE	42.3513	-71.121	Academic	92	62.83898377
1	163-179 AMORY STREET	42.3502	-71.1136	Administra	103	62.57086306
-1	64-86 CUMMINGTON MALL	42.3487	-71.104	Academic	0	59.99750652
1	595 COMMONWEALTH AVENUE	42.3496	-71.0997	Academic	245	59.59259443
3	595 COMMONWEALTH AVENUE	42.3496	-71.0997	Academic	269	53.81736928
1	590 COMMONWEALTH AVENUE	42.3484	-71.1002	Research	326	53.01517739
1	1 UNIVERSITY ROAD	42.3512	-71.11	Academic	307	51.58559521
1	595 COMMONWEALTH AVENUE	42.3496	-71.0997	Academic	314	49.82912045

Top 15 covered floors based on Mean density



Top 15 covered floors based on Mean density with Max density also_shown



Key Question 2: Establish a full list of the factors and criteria for installation of new filling stations.

1. Filter section : as I mentioned in filter and process step before
 - A. Exclude covered floor (water station & kitchen floor)
 - B. Exclude Parking ,Housing, and Commercial buildings . For residential buildings we only consider large dorm-style residences
 - C. Exclude dining hall floors

Now we get

[uncovered floors.csv](#)

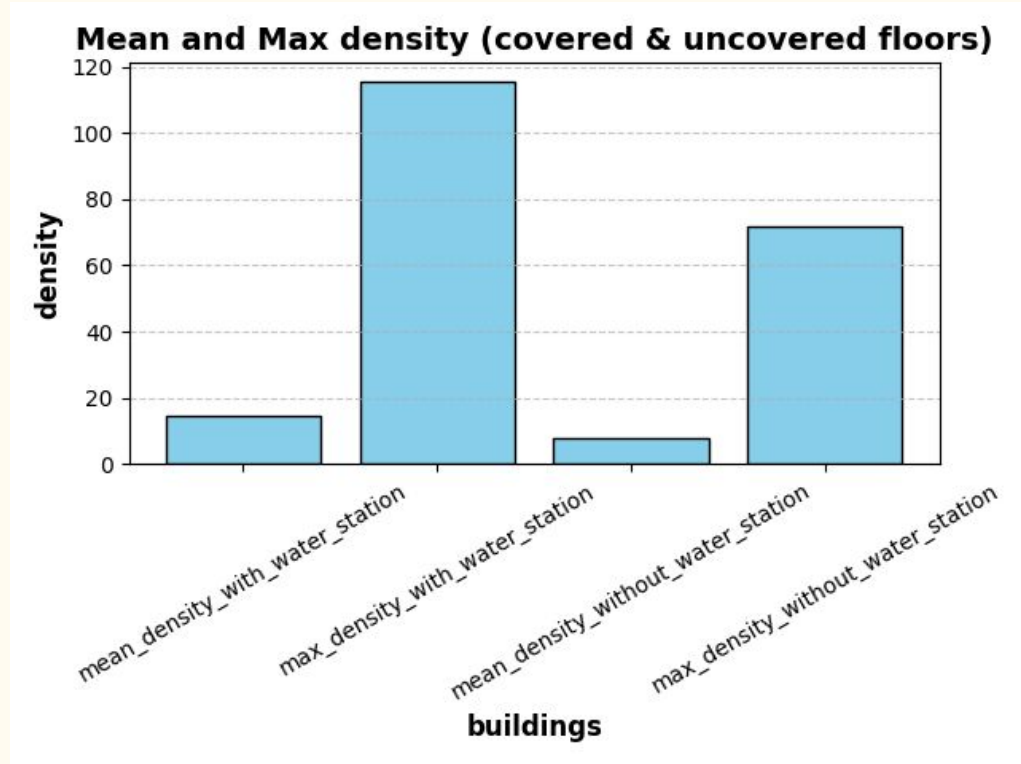
2. Factor section

- A. Mean Density (Foot Traffic)
- B. Max Density (Foot Traffic)
- C. Air Condition (Mechanical Ventilation)
- D. High Volume

Factor: Mean and Max Density (of Foot Traffic)

High mean density tell us when and where most people usually gather together. High max density density tell us where most people gather at busiest time. More people implies more requirement for water bottle station.

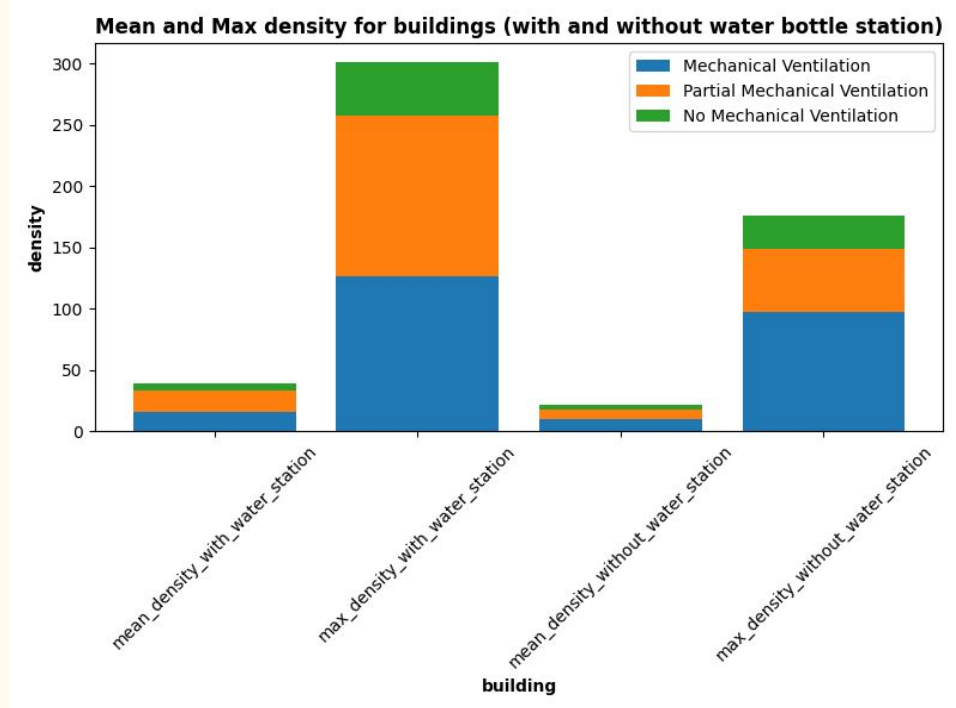
We can see from figure that both mean and max density are larger for floors with water station.



Factor: Air Condition

Air conditioning is key because poor air quality can make people more dehydrated. So, it's super important to have water stations where the air isn't great.

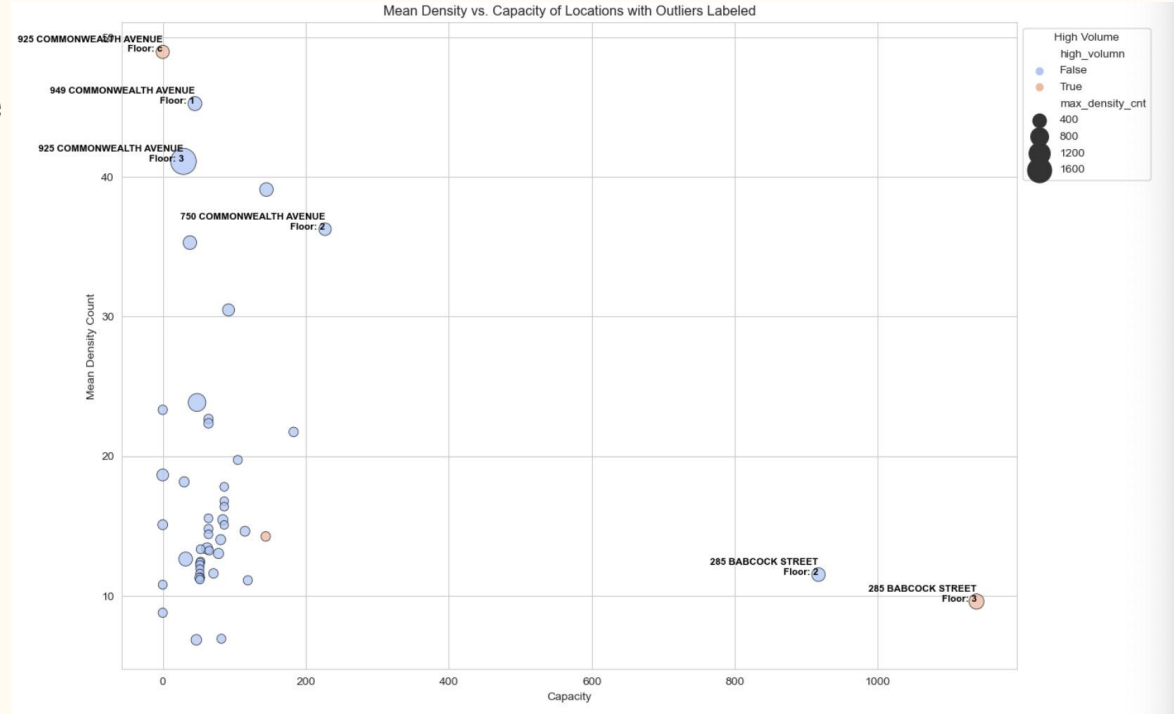
This figure shows average mean and max density while mechanical ventilation are yes, no, or partial . We can see that these are several places without air conditioning, where should be high considered for new bottle station.



Factor: High Volume

High-volume spots like gyms, stadiums, or concert stages are always crowded, which implies a huge need for a quick drink.

The plot show the relationship between the capacity of locations and their mean density count, with the size of each point indicating the max density count observed.



Key Question 3 (Extension question) :Determine criteria and factors for new, high-priority water filling station locations.

Answer: As we explained in last question, we make some filters and get [uncovered floors.csv](#) and then take **mean density, max density, air condition and high volume** as factors.

Then we build a **weight score standard** based on these factors , and select top 50 weight score floors from [uncovered floors.csv](#) and define them as new candidates.

All codes about building this new standard and choose new stations can be found in [final_selection_and_visualization.ipynb](#), and the new candidate list is [selected_candidates.csv](#)

Key Question 3 (Extension question) :Determine criteria and factors for new, high-priority water filling station locations.

Here is the details about this weight score standard:

Weight = { [mean density] X 1 + [max density] X 0.3 }

{

{

X 1 if not high volume

X 1 if Mechanical Ventilation is 'Yes'

X 10 if high volume

X 2 if Mechanical Ventilation is 'Partial'

}

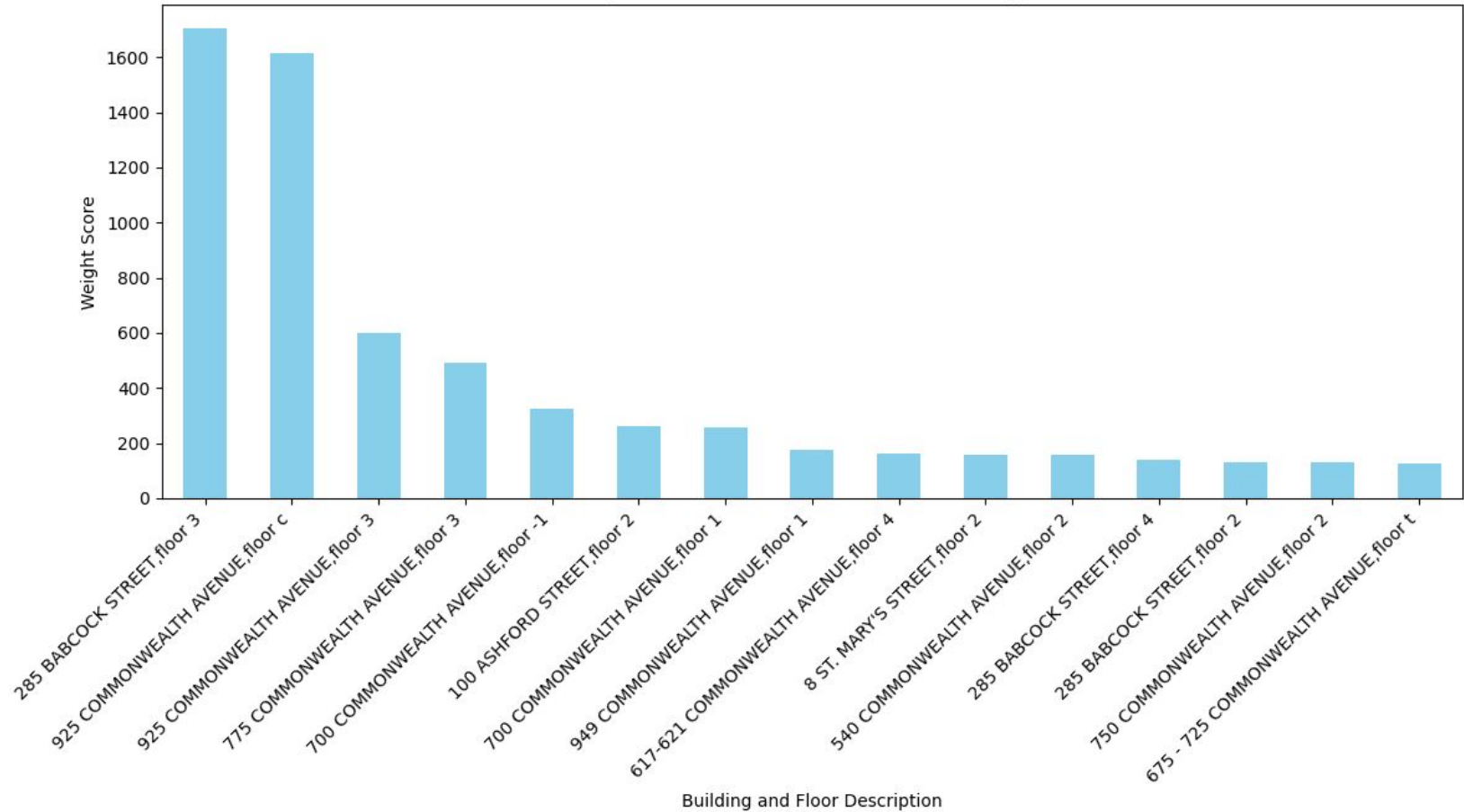
X 3 if Mechanical Ventilation is 'No'

}

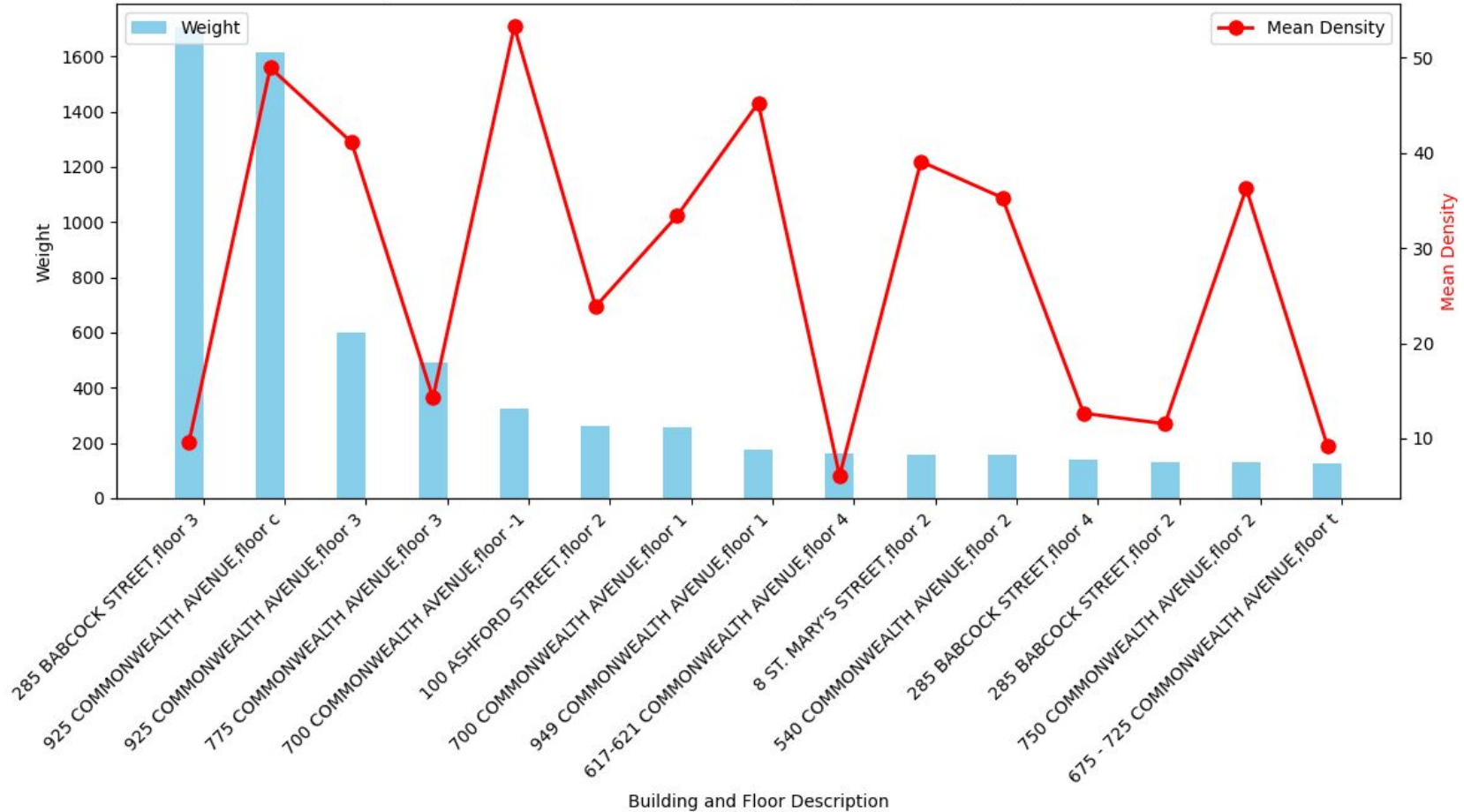
Now we get [selected_candidates.csv](#)
as our new station list

weight	uilding_floc	building_desc	latitude	longitude	uilding_type	capacity	mean_density_cnt	max_density_cnt
1703.998059	3	285 BABCOCK STREET	42.354	-71.1203	Athletic	1138	9.599805933	536
1614.545178	c	925 COMMONWEALTH AVENUE	42.3522	-71.1177	Athletic	0	48.95451777	375
598.2118556	3	925 COMMONWEALTH AVENUE	42.3522	-71.1177	Athletic	29	41.11185557	1857
493.6014381	3	775 COMMONWEALTH AVENUE	42.3509	-71.109	ident Supp	144	14.26014381	117
324.3480467	-1	700 COMMONWEALTH AVENUE	42.3493	-71.104	Residential	0	53.27402333	363
262.952264	2	100 ASHFORD STREET	42.3546	-71.1236	Athletic	48	23.85226405	797
255.134273	1	700 COMMONWEALTH AVENUE	42.3493	-71.104	Residential	171	33.36713651	314
174.8488739	1	949 COMMONWEALTH AVENUE	42.3519	-71.1187	Academic	45	45.24887387	432
161.3063834	4	617-621 COMMONWEALTH AVENUE	42.3497	-71.1013	Academic	30	6.068794459	159
159.6977046	2	8 ST. MARY'S STREET	42.3492	-71.1061	Research	145	39.09770461	402
156.4947511	2	540 COMMONWEALTH AVENUE			Academic	38	35.29475113	404
140.1428073	4	285 BABCOCK STREET	42.354	-71.1203	Athletic	32	12.64280733	425
132.1275374	2	285 BABCOCK STREET	42.354	-71.1203	Athletic	917	11.52753737	402
131.6557755	2	750 COMMONWEALTH AVENUE	42.3498	-71.108	Academic	227	36.25577546	318
124.5108067	t	675 - 725 COMMONWEALTH AVENUE	42.3502	-71.1046	Research	0	9.155403364	177

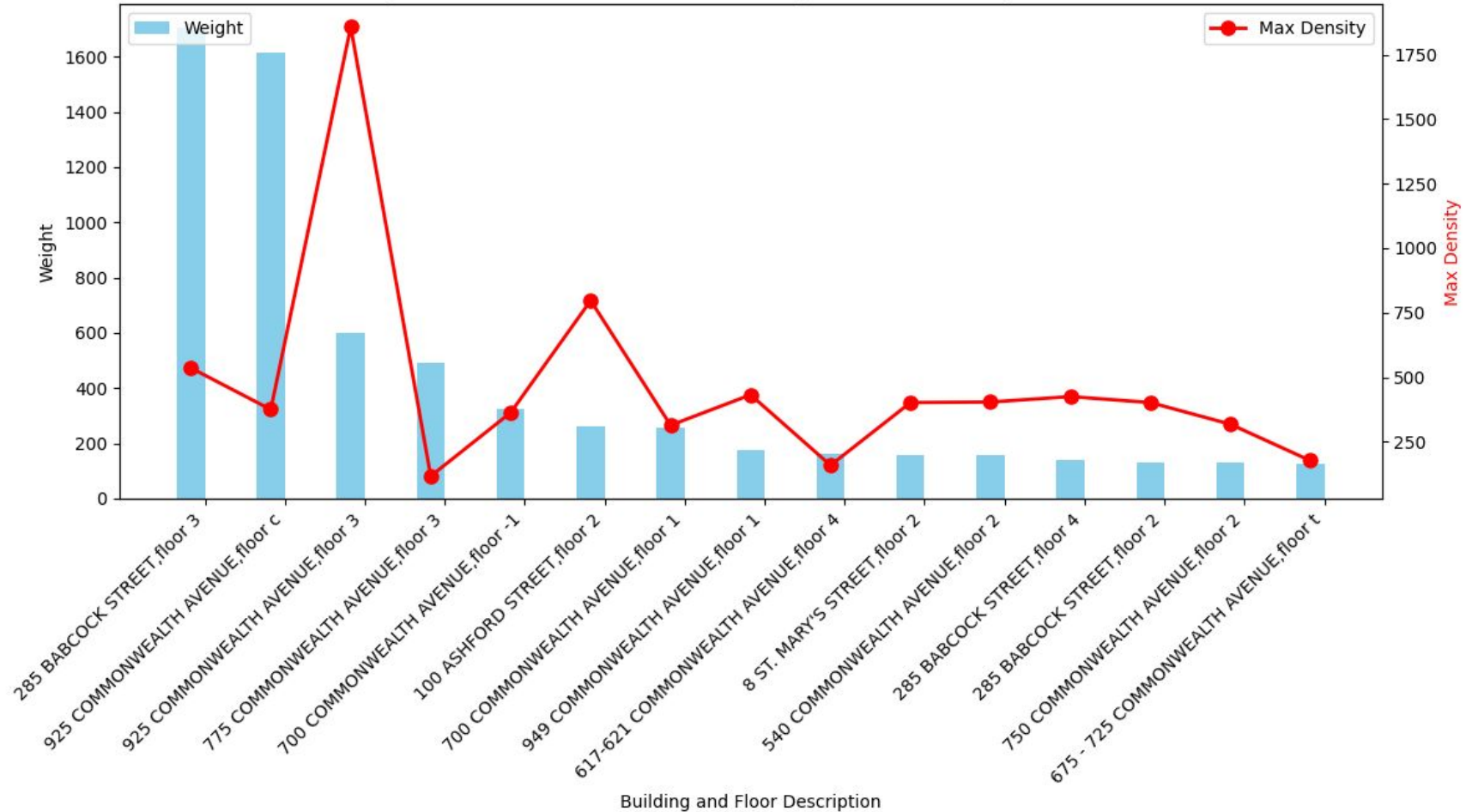
Top 15 selected candidates based on Weight



Top 15 Selected Candidates Based on Weight with Mean Density Also Shown



Top 15 Selected Candidates Based on Weight with Max Density Also Shown



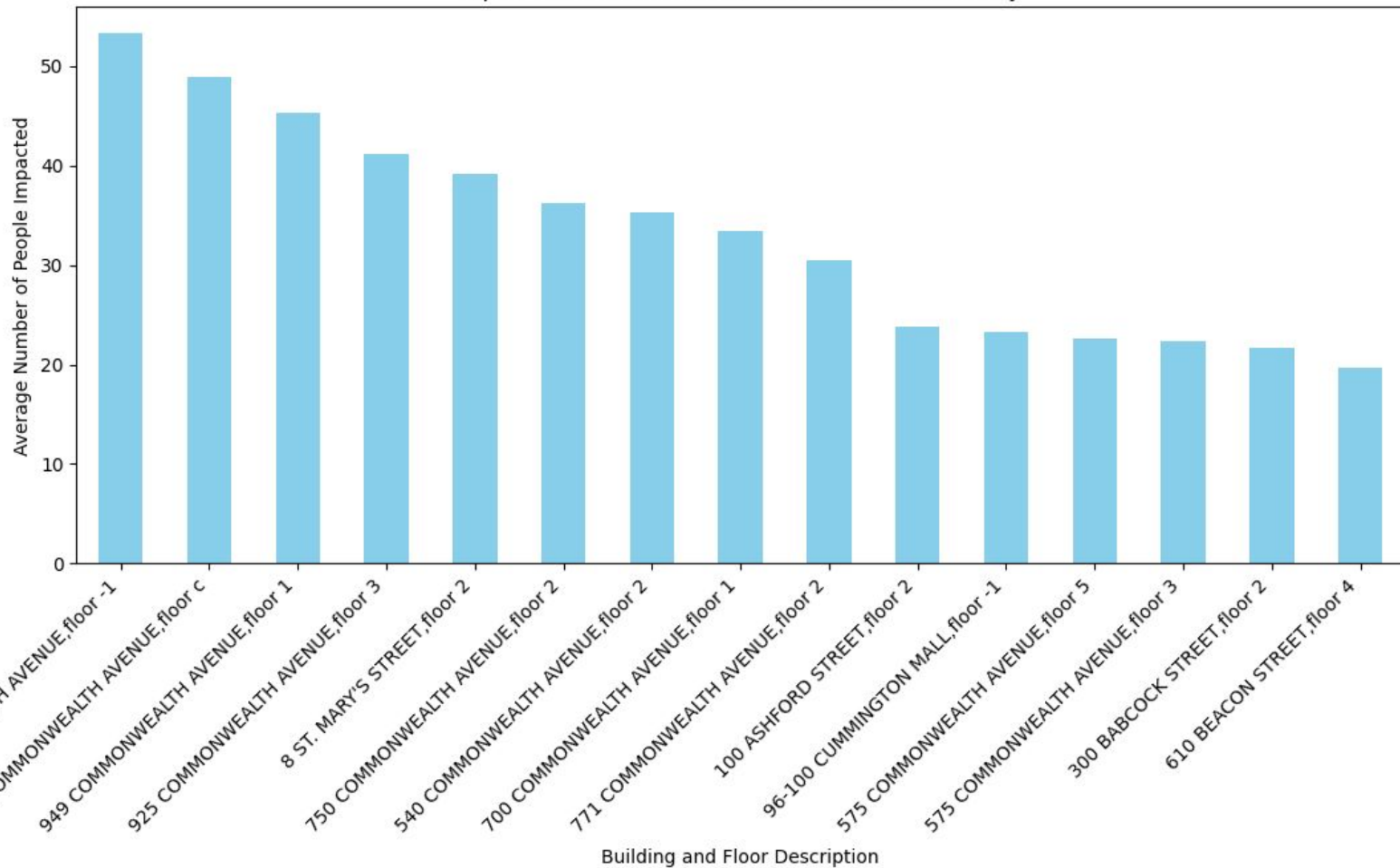
Key Question 4: Establish how many students and employees would have access to each of the proposed new filling stations.

As we mentioned in last question, we build a new weight standard for finding new stations and we get [selected_candidates.csv](#). Mean and max density in this sheet is the estimation of how many students and employees would be impacted by proposed new filling stations.

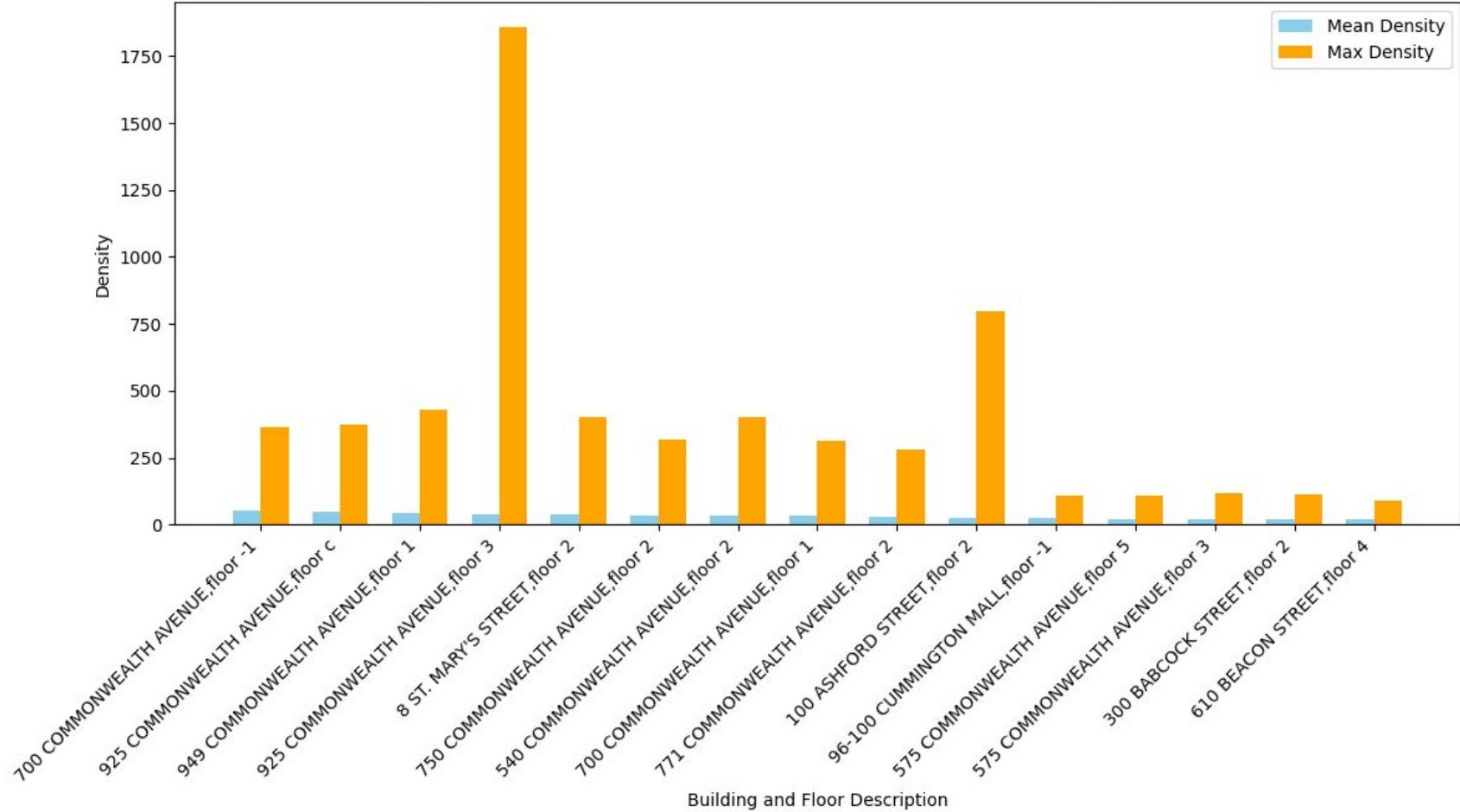
We sort **mean density** as high to low to see how many student and employees would have access to proposed new filling stations.

weight	uilding_floc	building_desc	latitude	longitude	uilding_typ	capacity	mean_density_cnt	max_density_cnt
324.3480467	-1	700 COMMONWEALTH AVENUE	42.3493	-71.104	Residential	0	53.27402333	363
1614.545178	c	925 COMMONWEALTH AVENUE	42.3522	-71.1177	Athletic	0	48.95451777	375
174.8488739	1	949 COMMONWEALTH AVENUE	42.3519	-71.1187	Academic	45	45.24887387	432
598.2118556	3	925 COMMONWEALTH AVENUE	42.3522	-71.1177	Athletic	29	41.11185557	1857
159.6977046	2	8 ST. MARY'S STREET	42.3492	-71.1061	Research	145	39.09770461	402
131.6557755	2	750 COMMONWEALTH AVENUE	42.3498	-71.108	Academic	227	36.25577546	318
156.4947511	2	540 COMMONWEALTH AVENUE			Academic	38	35.29475113	404
255.134273	1	700 COMMONWEALTH AVENUE	42.3493	-71.104	Residential	171	33.36713651	314
115.3772257	2	771 COMMONWEALTH AVENUE	42.351	-71.108	ident Supp	92	30.47722567	283
262.952264	2	100 ASHFORD STREET	42.3546	-71.1236	Athletic	48	23.85226405	797
56.02488263	-1	96-100 CUMMINGTON MALL	42.3489	-71.1048	Academic	0	23.32488263	109
54.77361909	5	575 COMMONWEALTH AVENUE	42.3495	-71.0987	Residential	64	22.67361909	107
58.36092985	3	575 COMMONWEALTH AVENUE	42.3495	-71.0987	Residential	64	22.36092985	120
55.94228251	2	300 BABCOCK STREET	42.3542	-71.1212	Athletic	183	21.74228251	114
47.03643787	4	610 BEACON STREET	42.3497	-71.0945	Residential	105	19.73643787	91

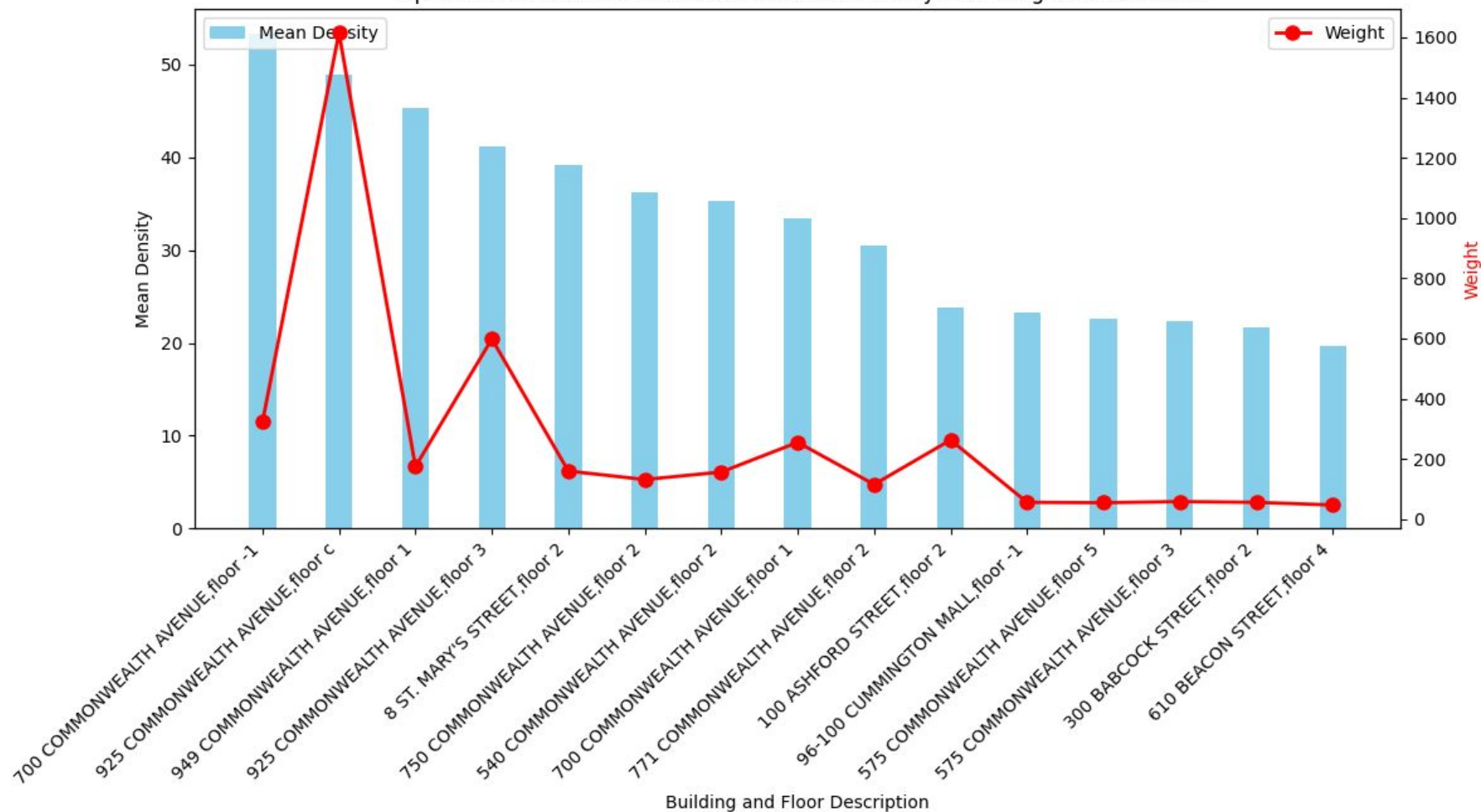
Top 15 selected candidates based on Mean density



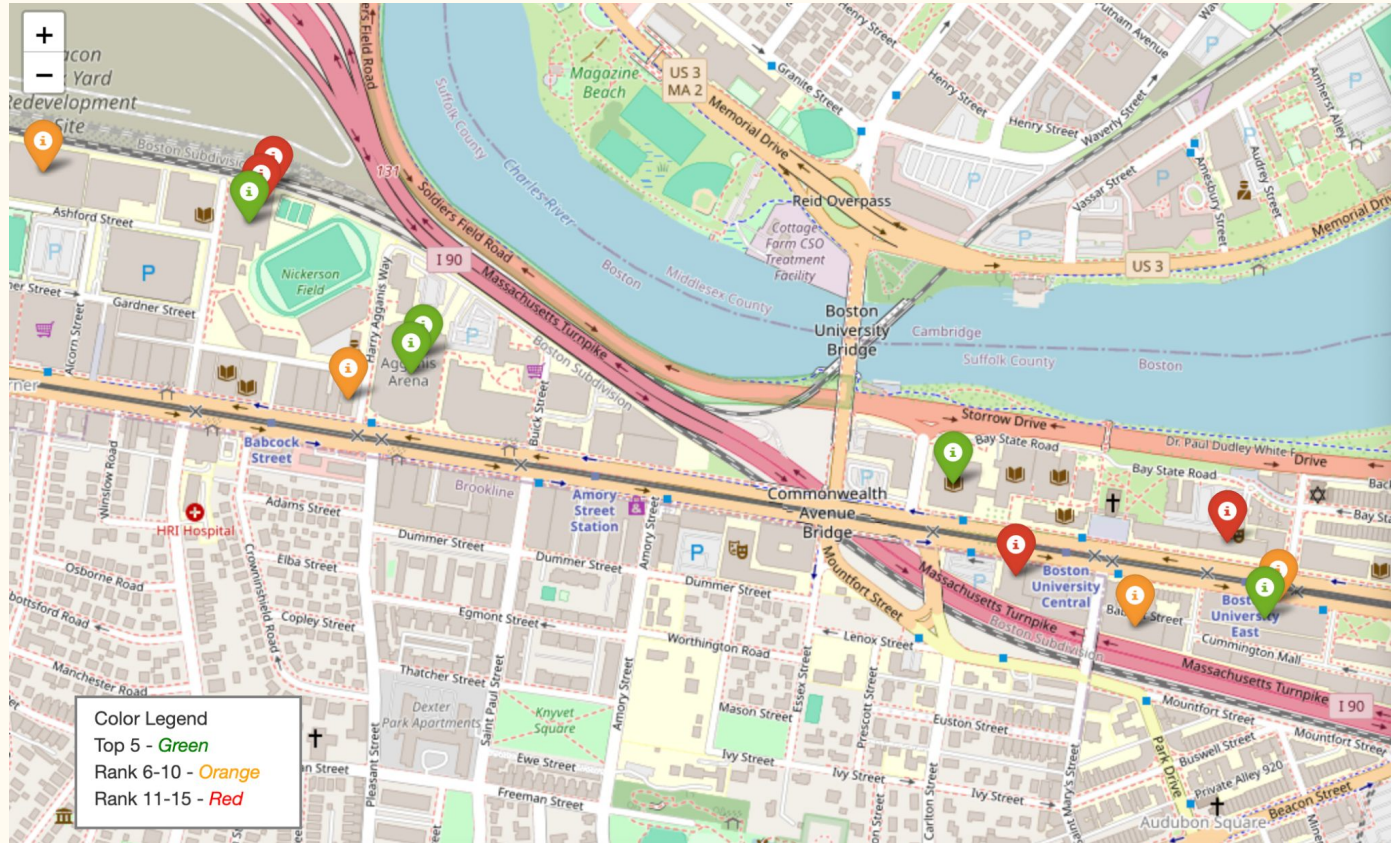
Top 15 selected candidates based on Mean density with Max density also shown

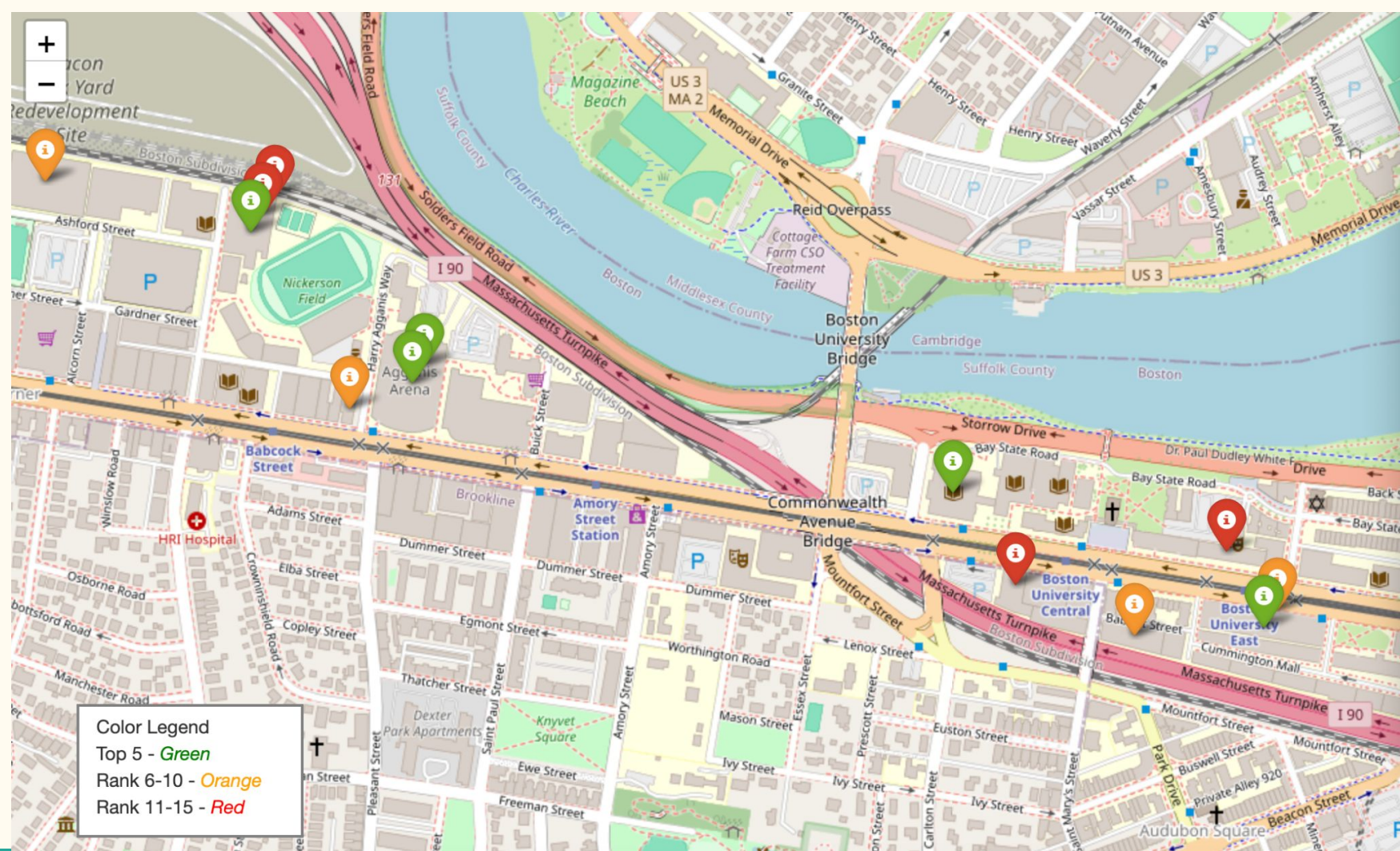


Top 15 Selected Candidates Based on Mean Density with Weights also Shown

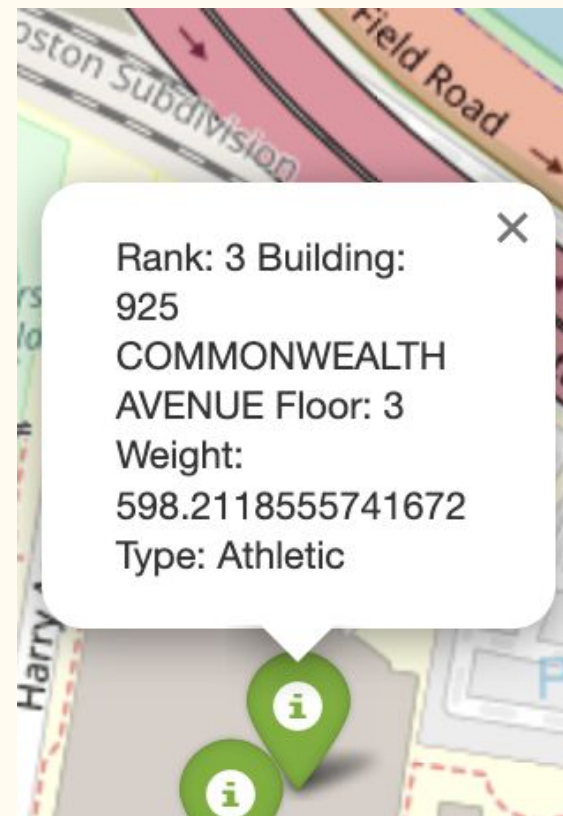
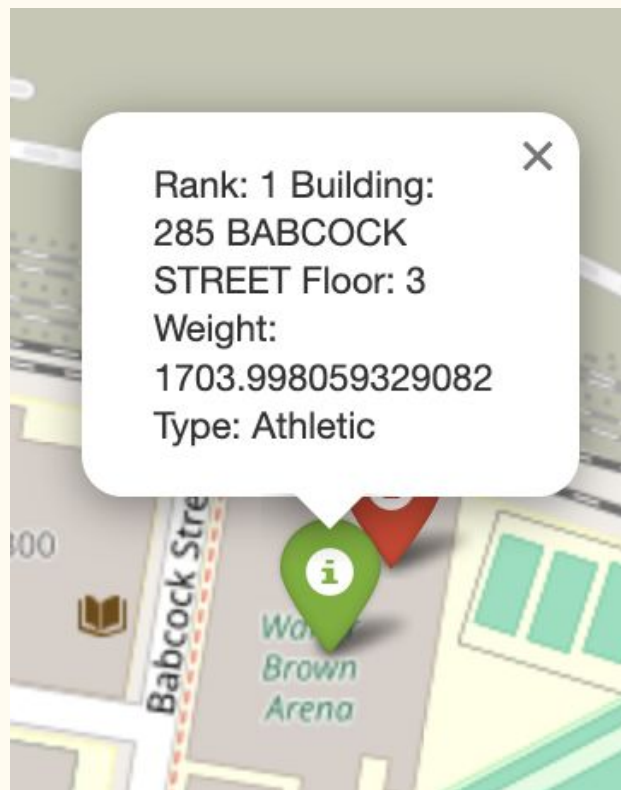
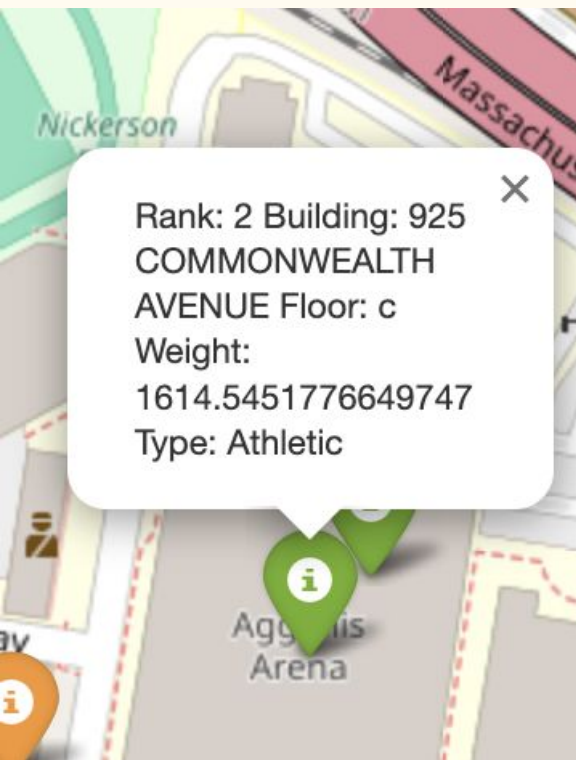


Key question 5: A geospatial map of new water filling stations highlighted by priority (weights): [top 15 candidates map by weight.html](#)





Click to see Details of Top 3 new stations based on our weight score



A word cloud featuring the phrase "Thank You" in numerous languages. The words are arranged in a circular pattern, with "thank you" in the center in large red letters. Other prominent words include "danke" (blue), "gracias" (green), "mercies" (orange), and "shukriya" (purple). Smaller words like "arigato", "terima kasih", "dank je", and "mochchakkeram" are also visible. The background is white with a subtle grid pattern.