Report

Finding a location for a flagshipstore for fitness food in Frankfurt, Germany

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Table of Content

Introduction

A big US company for fitness food wants to open a flagship store in Germany.

They have already chosen Frankfurt (am Main) as the target city, because Frankfurt is one of the biggest cities in central Germany and the one hot spot for fitness influencer and bodybuilding. In this project we will try to find an optimal location for the flagship store. Specifically, this report will be targeted to stakeholders of the US company.

From their experience in other countries the company identified the following location-based criteria to guarantee the success of the flagship store.

- There should be many fitness centers or sports clubs in the city, which indicates that there are a lot of customers living in the city.
- There should not be many competitors in the city which also offer health menus.

There are a lot of fitness centers and sport clubs in the city so we will try to identify locations that have a very high number of restaurants. In addition, we are particularly interested in areas with no Asian restaurants in vicinity. We would also prefer locations as close to city center as possible, assuming that first two conditions are met.

To be able to make a reasonable recommendation more detailed information about the city environments are needed. To fulfill customer criteria location data derived from foursquare will be used to give an educated suggestion in which location the company should open their flagship store. Advantages of each area will then be clearly expressed so that best possible final location can be chosen by stakeholders.

Data

Based on definition of our problem, factors that will influence our decision are:

- number of existing Asian restaurants in the neighborhood
- number of and distance to fitness and sports clubs in the neighborhood if any
- distance of neighborhood from city center

We decided to use regularly spaced grid of locations, centered around city center, to define our neighborhoods.

Following data sources will be needed to extract/generate the required information:

- centers of candidate areas will be generated algorithmically and approximate addresses of centers of those areas will be obtained using **Nominatim API reverse geocoding**
- number of restaurants and their type and location in every neighborhood will be obtained using **Foursquare API**
- coordinate of Frankfurt center will be obtained using **Nominatim API geocoding** of well-known Frankfurt location (Freßgass)

Neighborhood Candidates

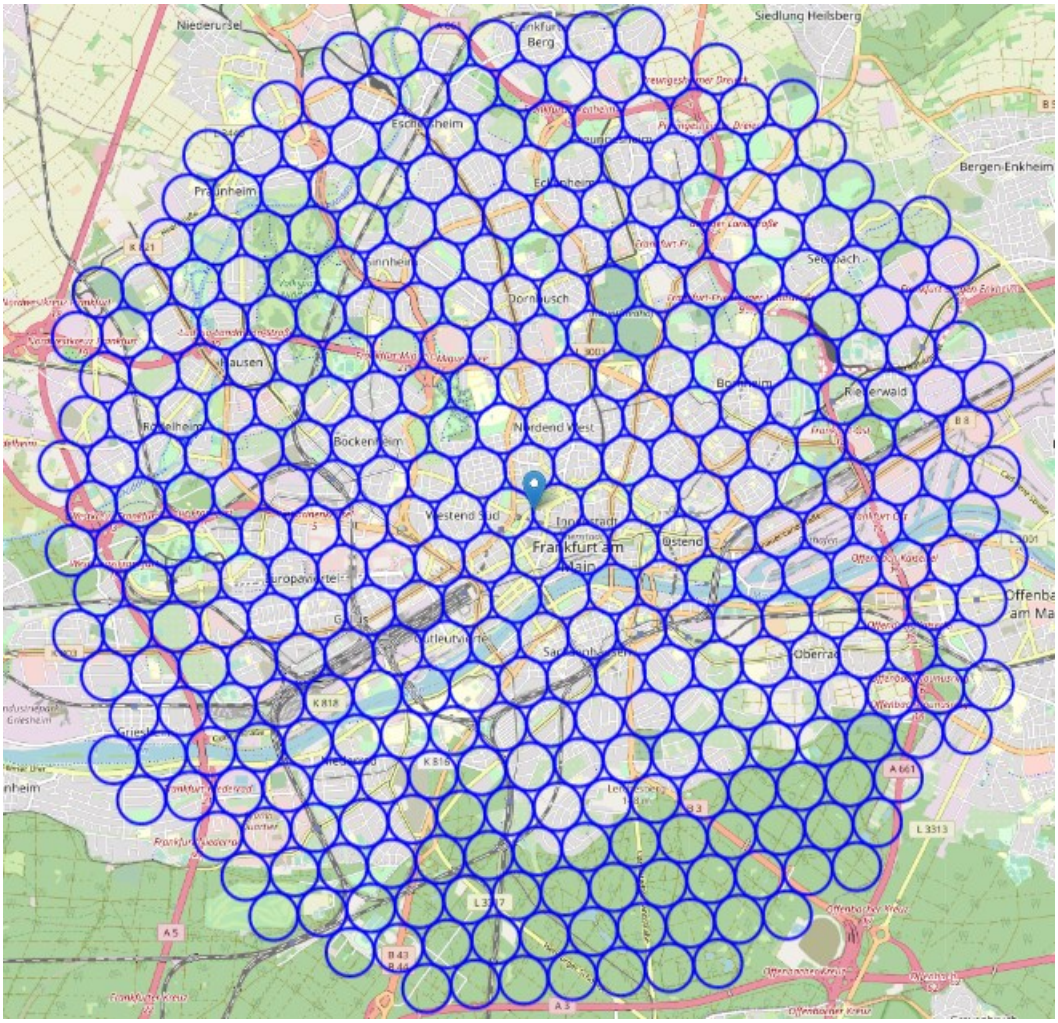
Let's create latitude & longitude coordinates for centroids of our candidate neighborhoods. We will create a grid of cells covering our area of interest which is approx. 12x12 kilometers centered around Frankfurt city center.

Let's first find the latitude & longitude of the Frankfurt city center, using specific, well known address and Nominatim API geocoding. The specific address we are looking for is a street called "Freßgass" (Hochstraße 43, 60313 Frankfurt).

Coordinates of Hochstraße 43, Frankfurt, Germany: 50.1156658,8.67436999298753

Now let's create a grid of area candidates, equally spaced, centered around city center and within ~6km from "Freßgass". Our neighborhoods will be defined as circular areas with a radius of 300 meters, so our neighborhood centers will be 600 meters apart.

To accurately calculate distances, we need to create our grid of locations in Cartesian 2D coordinate system which allows us to calculate distances in meters (not in latitude/longitude degrees). Then we'll project those coordinates back to latitude/longitude degrees to be shown on Folium map. So, let's create functions to convert between WGS84 spherical coordinate system (latitude/longitude degrees) and UTM Cartesian coordinate system (X/Y coordinates in meters).



Now have the coordinates of centers of neighborhoods/areas to be evaluated, equally spaced (distance from every point to its neighbors is the same) and within ~6km from "Freßgass".

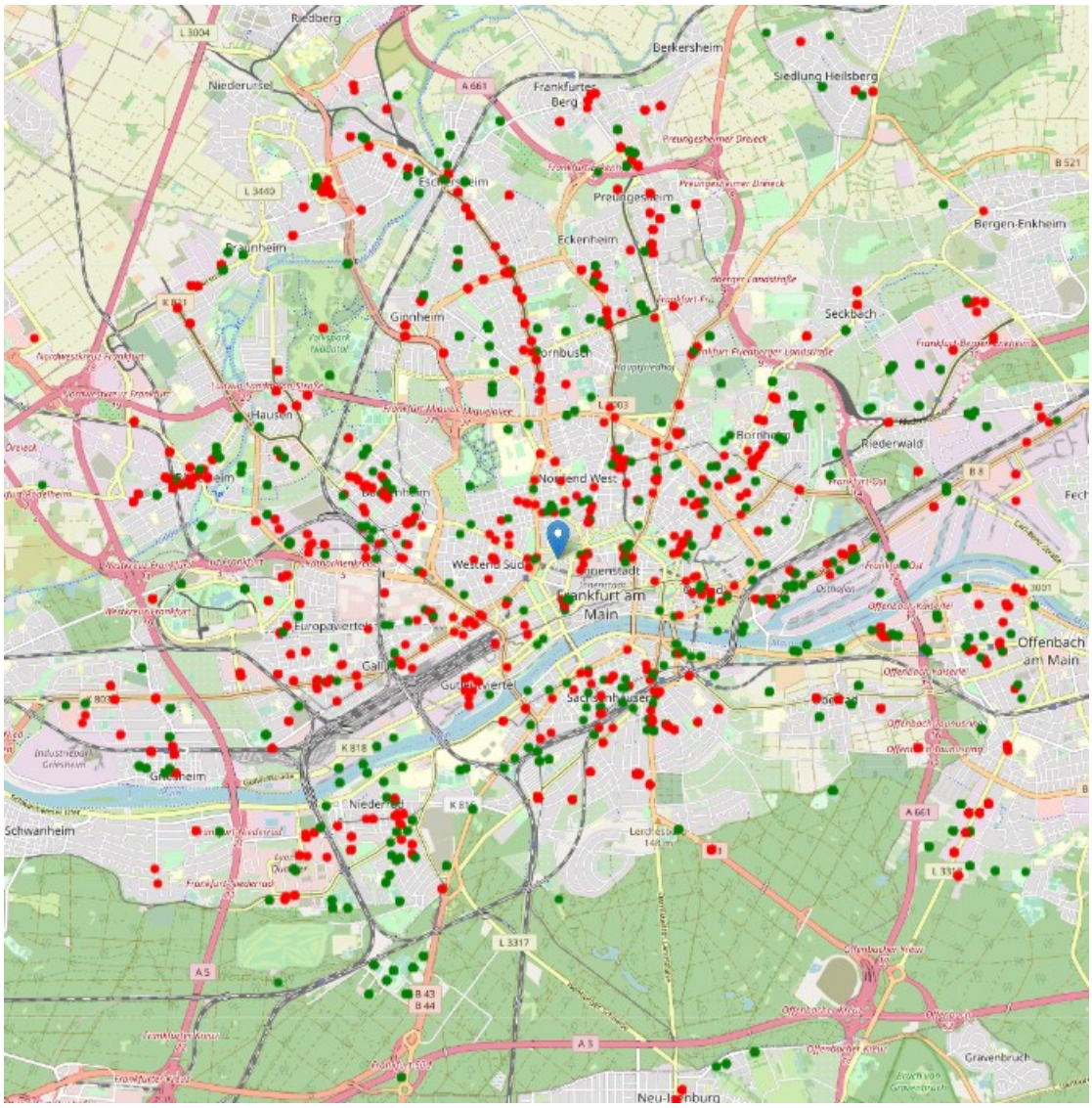
Now use Nominatim API to get approximate addresses of those locations. We will only use locations where information about road, postcode and city are present.

	Address	Latitude	Longitude	X	Y	Distance from center	Number_Asian_Restaurants	Number_Sports_Clubs	Distance to restaurant	Distance to sports club
0	Habichtschneise, 60528 Frankfurt	50.063203	8.656123	46113.103211	5.564961e+06	5992.495307	0	9	1481.763972	689.944259
1	Bussardschneise, 60528 Frankfurt	50.063660	8.664455	46713.103211	5.564961e+06	5840.376700	0	6	1247.635724	1210.873222
2	Milanschneise, 60528 Frankfurt	50.064116	8.672787	47313.103211	5.564961e+06	5747.173218	3	5	1279.673917	1506.595880
3	F 10, 60598 Frankfurt	50.064572	8.681119	47913.103211	5.564961e+06	5715.767665	3	2	1259.981955	1518.850515
4	Welscher Weg, 60598 Frankfurt	50.065027	8.689452	48513.103211	5.564961e+06	5747.173218	2	1	1117.507161	1167.917859
...	...	...	...	...	...	...	...	...	...	...
354	Im Mellsig, 60433 Frankfurt	50.166301	8.659251	47313.103211	5.576392e+06	5747.173218	2	7	849.076123	397.173878
355	Ebereschenweg, 60433 Frankfurt	50.166759	8.667601	47913.103211	5.576392e+06	5715.767665	5	4	560.268870	295.745543
356	Luzernenweg, 60433 Frankfurt	50.167216	8.675951	48513.103211	5.576392e+06	5747.173218	8	5	273.022027	743.092028
357	Oberer Ornberg, 60433 Frankfurt	50.167672	8.684301	49113.103211	5.576392e+06	5840.376700	10	5	240.953732	411.674150
358	Im Steinbügel, 60435 Frankfurt	50.168127	8.692652	49713.103211	5.576392e+06	5992.495307	9	4	158.434831	711.874602

Now that we have our location candidates, let's use Foursquare API to get info on restaurants in each neighborhood.

We're interested in venues in 'food' category, but only those that are Asian restaurants - coffee shops, pizza places, bakeries etc. are not direct competitors so we don't care about those. So we will include in our list only venues that have 'restaurant' in category name, and we'll make sure to detect and include all the subcategories of specific 'Asian restaurant' category, as we need info on Asian restaurants in the neighborhood.

	Name	Latitude	Longitude	Asian_Restaurant	Sports_Club
0	Wintersporthalle	50.070166	8.642346	0	1
1	Eintracht Frankfurt	50.068369	8.644447	0	1
2	Nike Store Frankfurt	50.066792	8.648029	0	1
3	Eintracht Frankfurt Fanshop	50.069466	8.645740	0	1
4	Nike Gym "Painbox"	50.066802	8.648301	0	1
...	...	...	...	...	...
2914	REWE	50.166707	8.692581	1	0
2915	DAV Kletterzentrum	50.160000	8.686608	0	1
2916	REWE	50.159913	8.688712	1	0
2917	Boulderwelt Frankfurt	50.164010	8.685051	0	1
2918	Dông Xuân Quán	50.166267	8.689807	1	0



Now that we have the Asian restaurants and sports clubs in the areas, we can start to analyses this data and use it for our location recommendation.

Methodology

In this project we will direct our efforts on detecting areas in Frankfurt that have a low amount of Asian restaurant and a high number of sports clubs. We will limit our analysis to an area ~6km around the city center.

In the first step we have collected the required data: the location every Asian restaurant and every sports club within 6km from Frankfurt center ("Freßgass"). The locations have been identified according to the Foursquare categorization.

The Second step in our analysis will be the calculation and exploration of the 'restaurant density' and the 'sports club density' across different areas of Frankfurt - we will use heatmaps to identify a few promising areas close to the center with a low number of restaurants and a high number of sports clubs.

In third and final step we will focus on most the promising areas and within those create clusters of locations that meet the basic requirements, which were established in discussions with the stakeholders. We will take into consideration locations with:

- no Asian restaurant in radius of 250 meters and
- at least 5 sports clubs in radius of 400 meters.

We will present a map of those locations but also create clusters (using k-means clustering) to identify general zones / neighborhoods / addresses which should be a starting point for final selection process. In the final selection process the stakeholders will visit the recommended locations and perform some further analysis based on customer flows, which will not be part of this analysis report.

Results

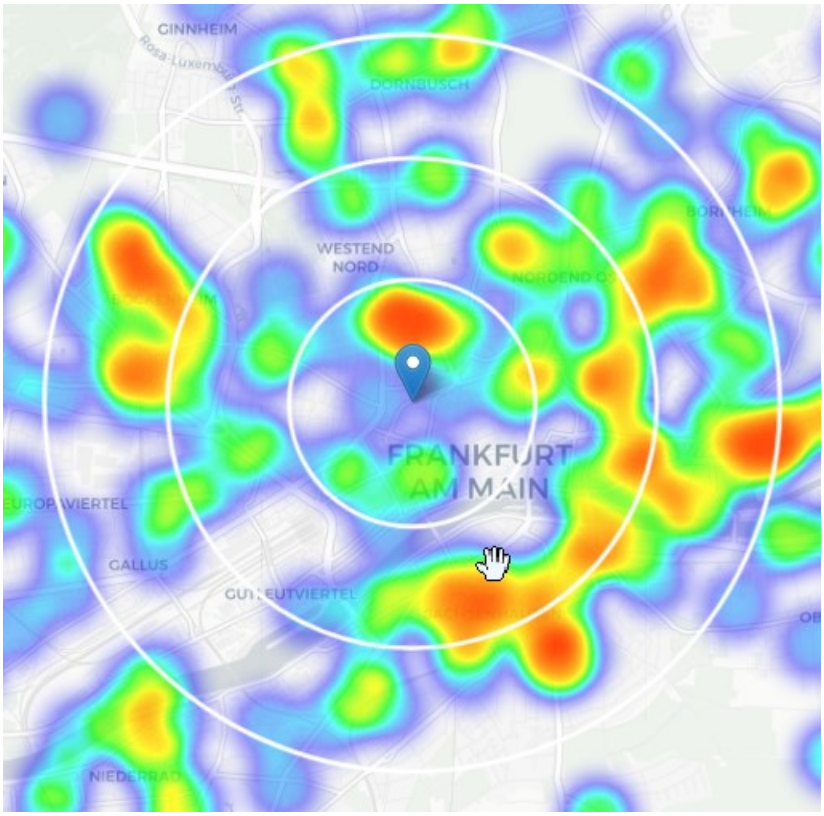
First, we calculate the distance to the nearest restaurant and the nearest sport club from every area candidate center (not only those within 300m - we want distance to closest one, regardless of how distant it is).

Average distance to restaurant from each area center: 452.8798331754038

Average distance to sports club from each area center: 431.31103520814094

In the next step we create a map showing heatmap/density of restaurants. Also, we will on our map and circles indicating the distance of 1km, 2km and 3km from the "Freßgass".

In the next step we create another map showing heatmap/density of sport clubs. Also, we will on our map and circles indicating the distance of 1km, 2km and 3km from the "Freßgass".


GINNHEIM
DORNBUSCH
WESTEND
NORD
FRANKFURT
AM MAIN
GALLUS
NIEDERRAD

Discussion

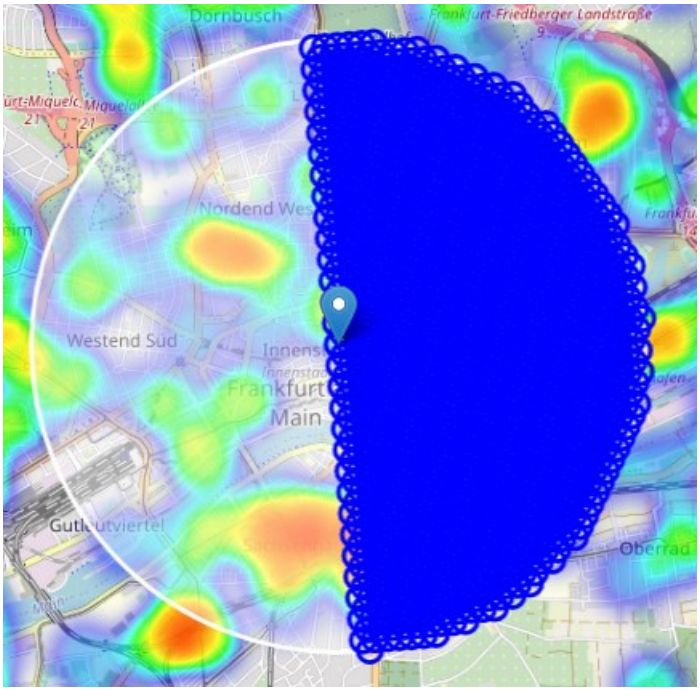
Based on the maps we will now focus our analysis on the area north-east the center - we will move the center of our area of interest and reduce its size to have a radius of 2.5km. The center will be moved to "Zeil 64, 60313 Frankfurt am Main".

Coordinates of Zeil 64, Frankfurt, Germany: 50.1148522,8.6868859

1145 candidate neighborhood centers generated.

Total number of venues: 2919

Number of venues within 2,5km: 463



Now we calculate two most important things for each location candidate: number of restaurants in vicinity (we'll use radius of 250 meters) and number of sports clubs in vicinity (we'll use radius of 400 meters).

	Address	Latitude	Longitude	X	Y	Number_Asian_Restaurants	Number_Sports_Clubs
0	Darmstädter Landstraße, 60598 Frankfurt	50.092542	8.690529	48849.278355	5.568010e+06	0	0
1	Grethenweg, 60598 Frankfurt	50.093278	8.689732	48799.278355	5.568097e+06	0	6
2	Darmstädter Landstraße, 60598 Frankfurt	50.093354	8.691122	48899.278355	5.568097e+06	0	6
3	Unterster Zwerchweg, 60599 Frankfurt	50.093430	8.692512	48999.278355	5.568097e+06	0	6
4	Unterster Zwerchweg, 60599 Frankfurt	50.093506	8.693901	49099.278355	5.568097e+06	0	4
...	...	...	...	...	...	...	...
1131	Eckenheimer Landstraße, 60320 Frankfurt	50.136707	8.685400	48899.278355	5.572946e+06	0	0
1132	Lindenweg, 60320 Frankfurt	50.136783	8.686790	48999.278355	5.572946e+06	0	0
1133	Verlängerter Gruftenweg, 60320 Frankfurt	50.136859	8.688181	49099.278355	5.572946e+06	0	0
1134	Ehrenmalweg, 60320 Frankfurt	50.136935	8.689572	49199.278355	5.572946e+06	0	0
1135	Baumhaselweg, 60320 Frankfurt	50.137011	8.690963	49299.278355	5.572946e+06	0	0

Now we filter those locations. We're interested only in locations with:

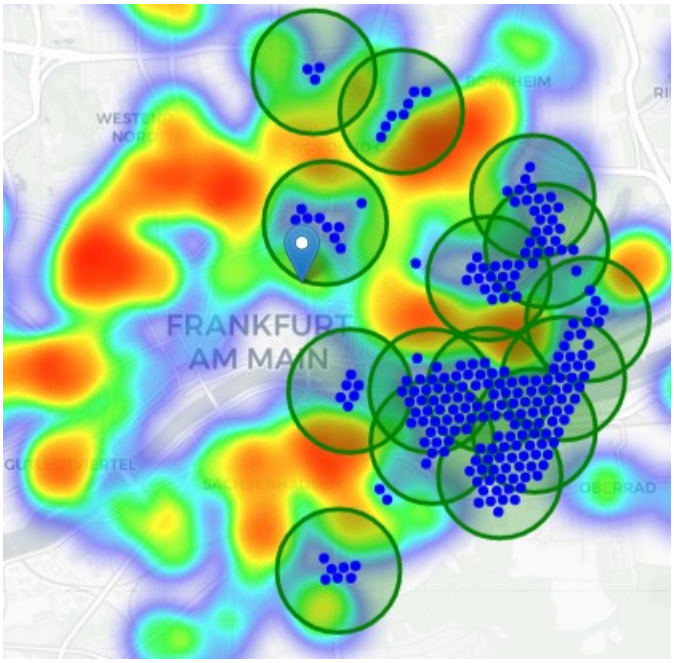
- no Asian restaurant in radius of 250 meters and
- at least 5 sports clubs in radius of 400 meters.

Locations with no more than one restaurant nearby: 425

Locations with more than two sports clubs nearby: 653

Locations with both conditions met: 226

We now have a list of locations which meet our requirements. Any of those locations is a potential candidate for the new flagship store. In the next step we cluster those locations to create centers of zones containing good locations. Those zones, their centers and addresses will be the result of our analysis.



Conclusion

Finally, let's reverse geocode those candidate area centers to get the addresses which can be presented to stakeholders.

Addresses of centers of areas recommended for further analysis:

Friedberger Landstraße, 60316 Frankfurt	=> 1.2km from Freßgass
Lange Straße, 60311 Frankfurt	=> 1.6km from Freßgass
Nibelungenallee, 60318 Frankfurt	=> 1.9km from Freßgass
Günthersburgallee, 60389 Frankfurt	=> 2.2km from Freßgass
Weseler Werft, 60314 Frankfurt	=> 2.2km from Freßgass
Länderweg, 60599 Frankfurt	=> 2.4km from Freßgass
Röderbergweg, 60314 Frankfurt	=> 2.4km from Freßgass
Mayfarthstraße, 60314 Frankfurt	=> 2.6km from Freßgass
Darmstädter Landstraße, 60598 Frankfurt	=> 2.7km from Freßgass
Gagernstraße, 60385 Frankfurt	=> 2.9km from Freßgass
Röderbergweg, 60385 Frankfurt	=> 2.9km from Freßgass
Strahlenberger Weg, 60599 Frankfurt	=> 3.0km from Freßgass
Im Bärengarten, 60599 Frankfurt	=> 3.1km from Freßgass
Franziusstraße, 60314 Frankfurt	=> 3.2km from Freßgass
Querstraße Nr. 25, 60314 Frankfurt	=> 3.3km from Freßgass

This concludes our analysis. We have created 15 addresses representing centers of zones containing locations with low number of Asian restaurants and a high number of sports clubs nearby, all zones being close to city center. Although zones are shown on map with a radius of ~500 meters (green circles), their shape is very irregular, and their centers/addresses should be considered only as a starting point for exploring area neighborhoods in search for potential locations.