GIS FALL 2024 FINAL PROJECT REPORT
OPTIMAL PET STORE LOCATION IN CALGARY USING GIS 2024

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SUMMARY

Overview

This report describes the work flow and answer to our fall semester final project geographic question "where is the optimal location to open a new pet store in Calgary using GIS". It includes information on how we approached to the problem, how we solved the problem, explains methods we solved the problem, and where the best location is.

Problem Summary

The pet industry in Canada is growing rapidly, with a market value more than $5 billion and Alberta has one of the highest rates of pet ownership with 63% of households owning pets in Canada. It would be great opportunity to open new pet store in Calgary. The problem is that there are already about 60 pet stores in Calgary, but since it is growing market and more people are moving into the city. There is big chance that we can enter this market. So, we need to figure out where is the best location to open new store.

Solution Summary

There are studies about correlation between various variables that can tell us where the pet store demand is the highest and where that would be. In order to make that conclusion, we need to collect data, which includes pet density, population density, community map and competitor's location. With this information, we can use it to do spatial analysis and find out the best location.

Analysis

Our Analysis showed us that there is high positive correlation between pet density and single-family house, pet density and house ownership. Meanwhile there was also weak correlation between pet density and duplex, multiplex, and apartments. Our network analysis also showed us where service area of each competitor is, and we found multiple candidate locations that can potentially succeed.

Conclusion summary

We identified 11 optimal location for a new store. While it is possible to narrow down further, we will have to do dive deeper with more previse analysis, more detailed data that is not available to us at the moment. This project was a very valuable lesson for us to learn about how GIS can benefit and implement to world of business. We believe that this experience on this project will be one of the memorable step stones for us to get into the industry.

INTRODUCTION

There has been a growing interest in use of GIS techniques in the analysis and planning of retail store network. Also, there has been a significant growing pet ownership in Canada, especially in large cities. The pet industry in Canada is growing with a market value more than $5 billion and expected to have annual growth rate of 4.3% over the next few years (Fraser, 2024). Alberta specially has one of the highest rates of pet ownership with 63% of households owning pets (Blair, 2024). With Calgary being major city in Alberta, has seen continuous growth in both population and pet ownerships. So, it is expected to create strong demand for pet supplies and services in the city (Pet Licenses and Responsible Pet Ownership, n.d.). With Alberta welcoming slightly over 200,000 newcomers in 2023 and the number expected to stay or grow for next few years, and 53% of them being a permanent resident excluding new born babies, many of them are likely to become pet owners (Fletcher, 2024). The opportunity to open new pet store in one of the major cities in Alberta look promising with demand for pet products and services is also increasing as pet population continues to grow currently standing at about 8.6 million licensed pets in Calgary in 2024. (Open Calgary, 2024) By selecting an optimal location for new store, we are sure that we can strategically position ourselves to meet the needs of expanding pet owner community, entering this growing market and ensuring long-term success.

Analytical procedures in GIS and statistical techniques have been applied to carry out the analysis in this study. In particular, we have applied techniques we learned from several courses we are studying in fall semester 2024, for examples, hot spot analysis from GEOS419, correlation and regression analysis from GEOS418, and FME transformation from GEOS410. The result of the study brought out a better understanding of how location factors influence the performance of the stores.

This report will explain techniques we used and how they figured out the optimal location for new pet store in Calgary in 2024.

PROJECT PLAN

1. GEOS 406

We wanted to make sure that project does not go off on a tangent. It can commonly happen when project is prolonged and the team has a number of members. To ensure that a project stays on track toward its goal and progresses steadily, it is crucial to create a clear plan and manage it effectively. There are various tools available to assist with this, and we learned about them in the GEOS406 course, which we immediately applied to our project.

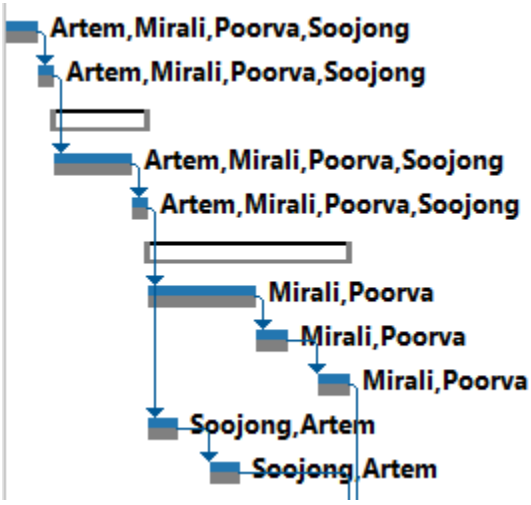


Figure 1 Gantt Chart

With this Gantt chart on MS project, we could maintain and see our progress toward the main goal of the project and see what steps we have and have finished. Which made it really efficient to finish this project successfully. We also created risk management plan to see what kind of risks we could encounter in the future during this project, and planned our actions to mitigate those risks. With risk management plan, we could figure out what possible risks are there and learned how we can avoid them.

DATA COLLECTION

1. What data do we need?

After literature review, we could find some clues how we could approach to the conclusion. First thing we needed was data like population of each community, community boundary, information about pet owners/number of licensed pets in each community, competitor's location data such as pet stores and big grocery stores with pet supplies. Although we wanted to figure out exact number of pets in Calgary assuming there are more than just licensed pets in Calgary, we could only find licensed pet data because it was only legal information we could gather from Open Calgary.

2. How did we get them?

All data that we needed were available on Open Calgary except competitor's location. Competitor's location was not available as in a form that we can directly implement to ArcGIS. Also, there was

basically no open source data for it. So, we have used one of Google's API called Location API through google cloud. We wrote simple python script to search through the area of city of Calgary with keyword 'Pet store', and grocery stores we figured out that they have pet supplies for sale. We had to find article and literature for cross-reference the number of stores in Calgary to ensure that the data we collected is accurate. Then we figured out that there are about 60 to 70 pet stores in Calgary, which was very close to our number (*Best-rated Pet Stores & Supplies in Calgary in 2024 | Yably*, n.d.)
.

3. GEOS 409 – Geocoding, Road Network

When we extracted data from google API, we have store's name and its address in csv format. We did not have latitude and longitude so we could not just convert this using XY to point tool or FME. Then we learned about geocoding during GEOS409 course, and we could utilize that to solve this issue, with locator we created we could geocode our store addresses and see exact location of them on the map. Also, while we were working on analysis phase of our project, we figured out that we need road network for Calgary. Fortunately, we were given that data from GEOS409 instructor Adrian.

VISUALIZATION

1. GEOS419 – Projection, Symbology, Join and Spatial Join, Map Overlay (Buffer, Dissolve)

There were a lot of things we could take from GEOS419 course for visualization step. First, we created custom projection for our map with transverse Mercator projection, because Calgary is longer in north to south than it is in west to east. We used 3TM with scale factor 0.9999.
After we put feature classes to the map we figured out pet licensed data was formed as point in the center of each community when we expected and needed it to be in polygon representing each community boundary. We used spatial join in this case to solve the issue, we did a spatial join with community boundary so then each community boundary has its pet licensed data.
We also did regular join between community boundaries and population by community data so we can have every information in one table to ease the analysis later.

We also tried to use buffer to visualize service area of each store, but then after more literature review and by learning more advanced techniques like road network analysis, we decided to ignore buffer. Then we used dissolve tool to create the city boundary using community boundary layer. So, we can have better visual representation of our study area.

2. GEOS 410 – Projection conversion and export features

After we created that projection, we exported all layers that had WGS 84 as its projection to geodatabase to convert them into geodatabase feature class with coordinate system we created.

DATA ANALYSIS AND OUTPUT

1. GEOS 418 Correlation, Regression, ERD

We analyze the relationship between several distinct neighborhoods and the distribution of pets in the Calgary. We look specifically in the correlation between pet density and a series of demographic and residential factors, including the house ownership percentage, single-family homes percentage, residential percentage, dwellings percentage, percentage of preschool children, duplex percentage, multiplex percentage and apartment percentage. Finding the pattern which helped us to identify trends that may inform the location and concentration of pets in the city

	Res%	Dwell%	Preschool%	Ownership%	SingleFamily%
Res%	1.000				
Dwell%	0.914	1.000			
Preschool%	0.902	0.735	1.000		
Ownership%	0.945	0.817	0.867	1.000	
SingleFamily%	0.882	0.673	0.840	0.951	1.000
Duplex%	0.424	0.401	0.458	0.381	0.338
Multiplex%	0.066	0.130	0.075	0.024	-0.015
Apartment%	0.317	0.644	0.087	0.144	-0.088
TownHouse%	0.603	0.549	0.638	0.596	0.509
Male_0_19%	0.931	0.721	0.958	0.915	0.919
Male_20_64%	0.981	0.961	0.851	0.885	0.796
Male_65%	0.742	0.691	0.512	0.779	0.744
female_0_19%	0.930	0.725	0.960	0.921	0.918
female_20_64%	0.993	0.943	0.881	0.921	0.838
female_65%	0.729	0.690	0.514	0.762	0.708
PET_DENSITY	0.839	0.798	0.748	0.909	0.856

Figure 2 Strong Correlation Variables

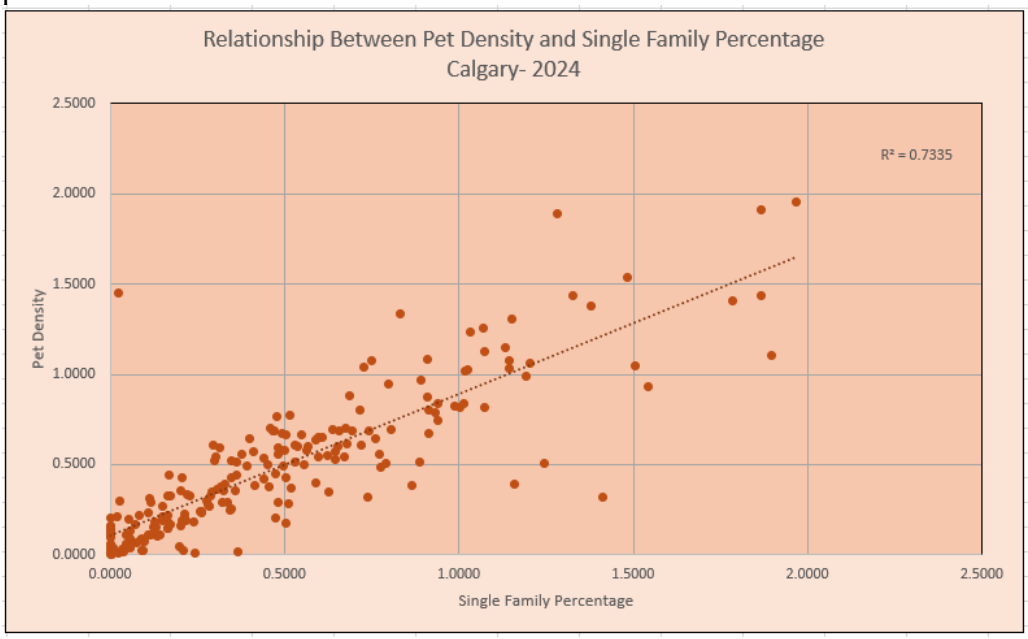
	Duplex%	Multiplex%	Apartment%	TownHouse%
Res%				
Dwell%				
Preschool%				
Ownership%				
SingleFamily%				
Duplex%	1.000			
Multiplex%	0.289	1.000		
Apartment%	-0.027	0.099	1.000	
TownHouse%	0.490	0.133	0.045	1.000
Male_0_19%	0.403	0.021	0.019	0.585
Male_20_64%	0.409	0.087	0.467	0.566
Male_65%	0.337	-0.003	0.166	0.484
female_0_19%	0.405	0.027	0.024	0.593
female_20_64%	0.414	0.092	0.403	0.586
female_65%	0.355	0.016	0.191	0.511

PET_DENSITY	0.437	0.057	0.192	0.610

Figure 3 Weak Correlation Variables

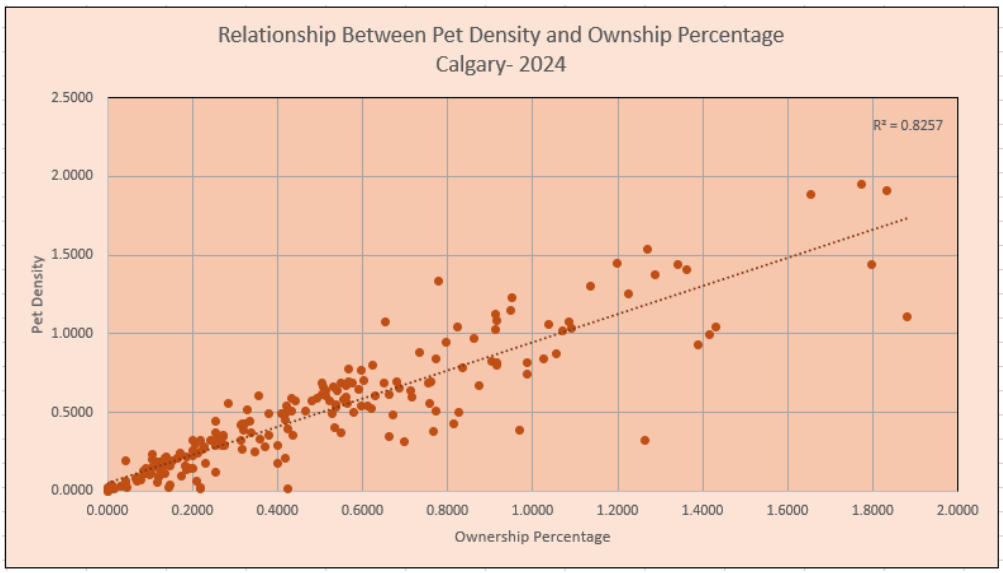
1.1 Single Family

Assumption: A positive strong correlation is **0.855705** between single-family housing areas and pet density imply that single-family houses are important factor to determine the pet ownership. Single family houses provide more space and better facilities to accommodate pets compared to multi-family units or apartments.
Impact: Areas dominated by single-family housing should also be prioritized when deciding the pet store location.



1.2 House Ownership

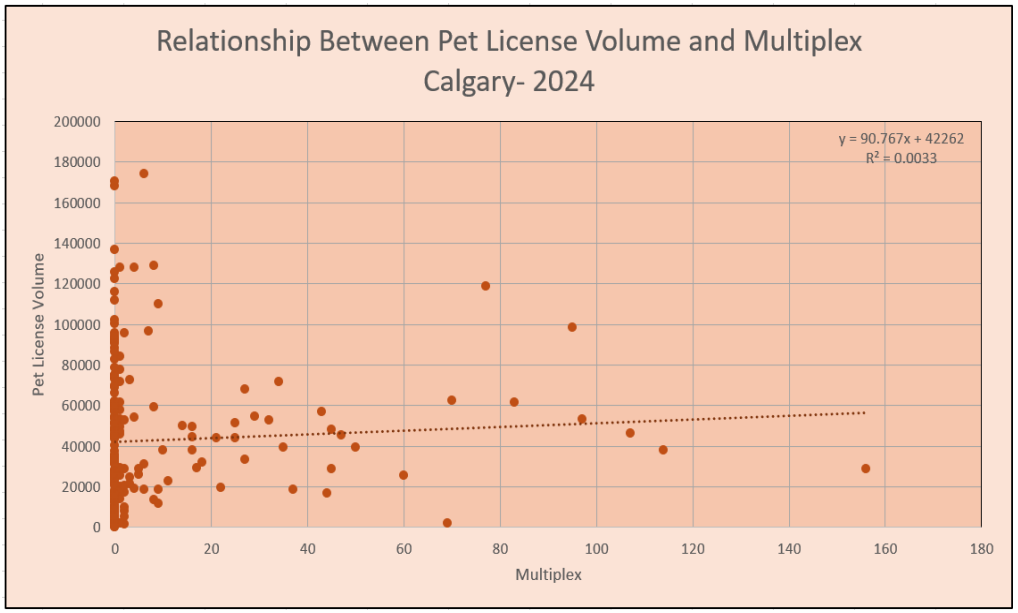
Assumption: The strongest correlation is **0.908213** between house owners and pet density imply that house ownership is the most important factor to determine the pet ownership. Owners of houses are more likely to have the stability and resources to keep pets compared to rental houses.
Impact: Focusing on areas with a higher percentage of owners of houses can be a reliable criterion for selection of a pet store location in Calgary



1.3 Multiplex

Assumption: Correlation with the value of **0.055233** suggests that multiplex have a very low number of pet owners. Which represents that these two variables have almost 0 correlation between them

Impact: Areas with a higher percentage of multiplex is not a suitable market for pet-related businesses

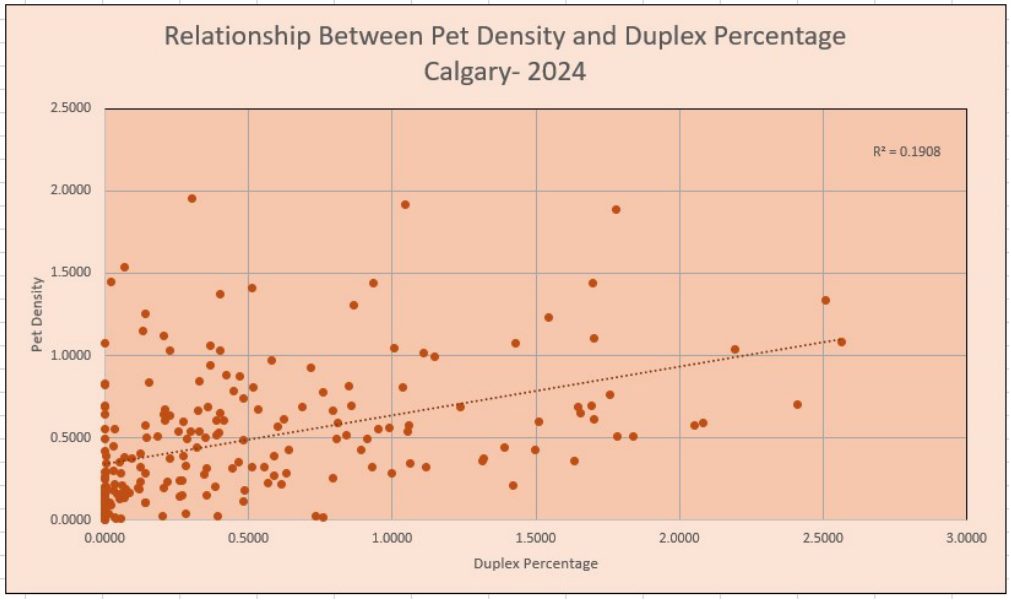


1.4 Duplex

Assumption: A positive moderate correlation with the value of **0.434464** suggests that duplex have a smaller number of pet owners.

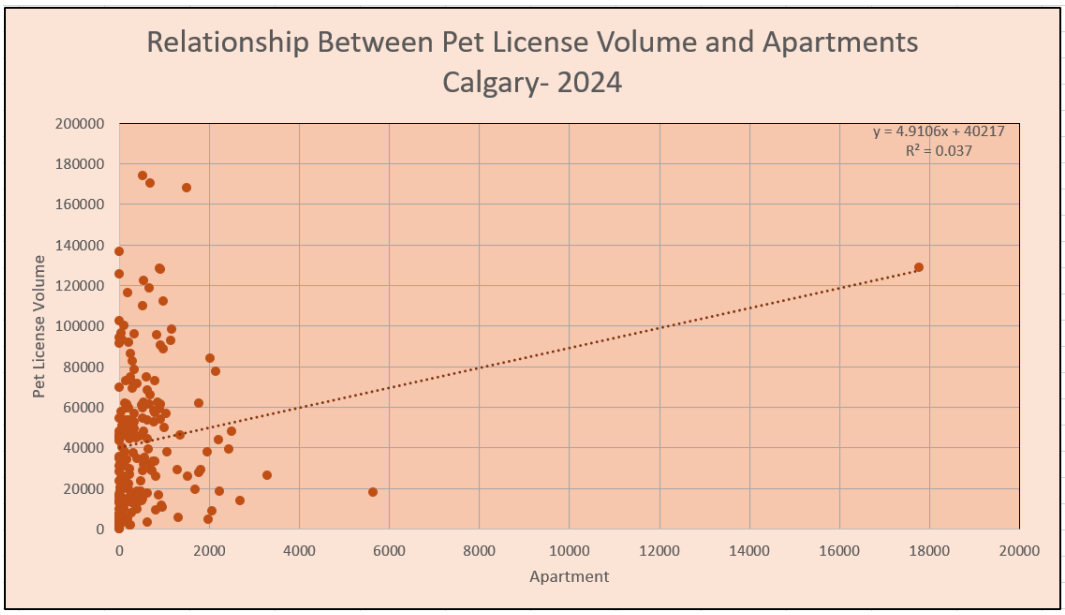
Impact: Areas with a higher percentage of duplex is not a suitable market for pet-related

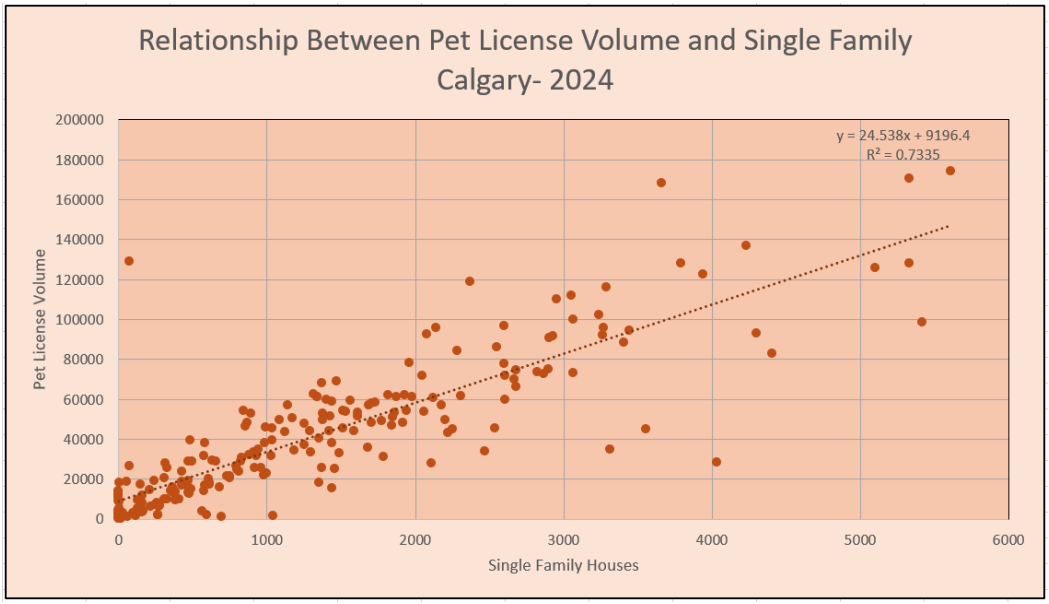
businesses



1.5 Regression

The strong relationship is observed in Single family houses and pet license volume, this factor indicates that single family variable is strong influencer of having pet license. Single family is an excellent fit; so, as the number of single-family houses increases that will influence the number of license volume. The weak relationships are observed in apartments and multiplex houses with pet licenses volume. So, these variables are not suitable fit.





2. GEOS 419 Theisen Polygon, Hot-spot Analysis

Although we have done buffer and network analysis, we also wanted to do more analysis to dig little deeper than just distance and time-based network analysis. Theisen polygon in this case is really good example of what we can do to figure out more accurate service area of each store.
We did service area analysis based on their distance of 1.5km from each location, 5km from big grocery stores and we got service area of those distance from each store (Smith, L. G., Yifei, M., MA, Widener, M. J., & Farber, S., 2022). But some of the people just do not have any other option than going to store that is further than 1.5km because they do not live close enough. Theisen polygon in this case is the perfect technique to figure out actual service area of each store. Difference is that Theisen polygon was created using Cartesian distance while network analysis was created using Euclidean distance.

Hot-spot analysis was used to figure out hot and cold spots of pet density of each community, hot being high pet density, cold being low pet density. With this we could narrow down to fewer communities we want to locate our new pet stores. First law of geography suggests that the everything is related to each other's but than the ones that are near relate more than ones in distant. So, we have figured out the outliers and excluded them from our hotspot analysis as well.

3. GEOS 409 Network Analysis (Service Area)

With road network of Calgary data from GEOS409, we could do network analysis. We did analysis using service area analysis to figure out each store's service area. After literature reviews we have figured out that people will travel around 1.5km to do shopping for more specific and unique items and will travel about 5km with car to do their regular grocery shopping (Smith L.G., 2022). So, we gave 1.5km distance service area for each pet store, 1.5km and 5km to grocery store, 1.5 representing their highly competitive service area and 5km for their mild competitive service area.

CONCLUSION

Multiple candidates and service area

While there are multiple candidates we could put pet store, our analysis suggests that few locations are the least competitive location where we could maximize revenue for the new pet store. There are 4 different service areas in different colors, light orange represents highly competitive service area for big grocery store which means 1.5km from that location, light pink represents 1.5km from pet stores, blue represents 5km from big grocery store which means there is mild competition, and then the green represents our candidate location's service area. Which is 1.5km away from it. Candidate locations were chosen by locating where commercial area is in that community, it does not make sense if we open pet store on top of a house or school.

Best Location

The result did not show which one is the "best location." In this project, we tried to find an optimal location based on spatial information only. On the other hand, there are many risk factors and considerations that might affect the business, so we could not go further. So, we were able to find several places that might be optimal.
We identified 11 locations, each with its own advantages, and disadvantages. Overall, these locations are expected to go similar level of revenue. However, when looking at the map, we can see that most of these locations are clustered in a few specific areas, particularly in the outskirts of the city. Notably, the communities in the SE area seem to have an immediate need for a pet store. Therefore, if we had to choose one location from these 11, we are confident that it would be in the SE. Of course, determining if this is truly the optimal location would require more precise analysis.

What we learned and how we will use this for next steps

With this project, we could learn many GIS technology and techniques and how they can be applied for complicated business project. GIS can benefit businesses in many ways, this project reflects how GIS can be useful for location analysis for business, but this is not the only way GIS can be helpful. While carrying out the project, we could find more factors that can affect business success using GIS such as supply chain optimization, government permit, and competitor analysis.

All those who carried out this project are interested in business, and the project gave us a glimpse of how GIS can be utilized in the world of business. Although, this project is rather very simple compare to what really happens in world of business in the industry, we are confident that we can now adapt better later in the industry with experience we gained from this project, specially for capstone project that we will do next semester on Winter 2025. We have learned from both practical experiences and mistakes. With these many lessons, we are ready to start a new project and believe that we will continue to grow in the future.

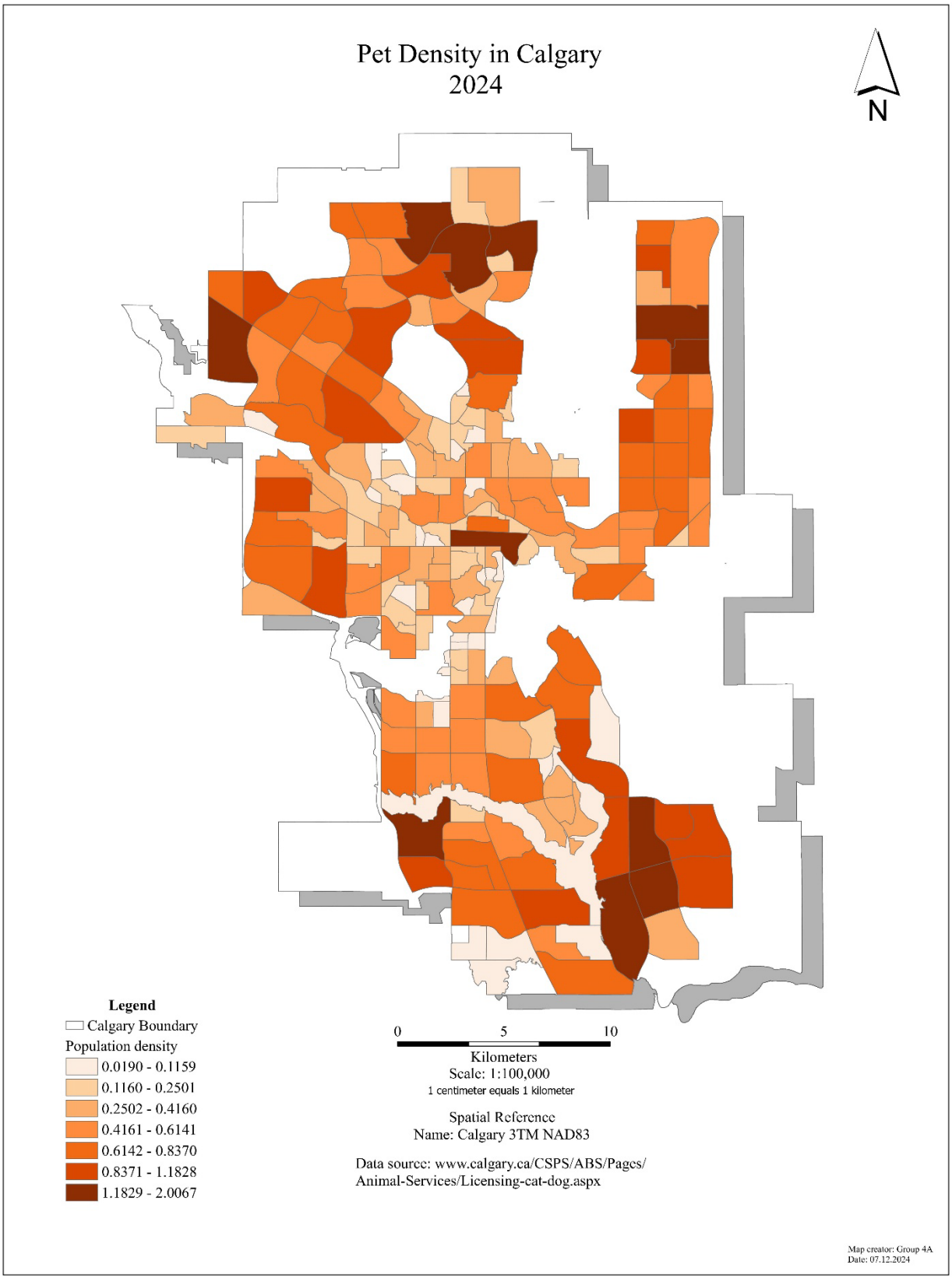


Figure 4 Pet Density Map

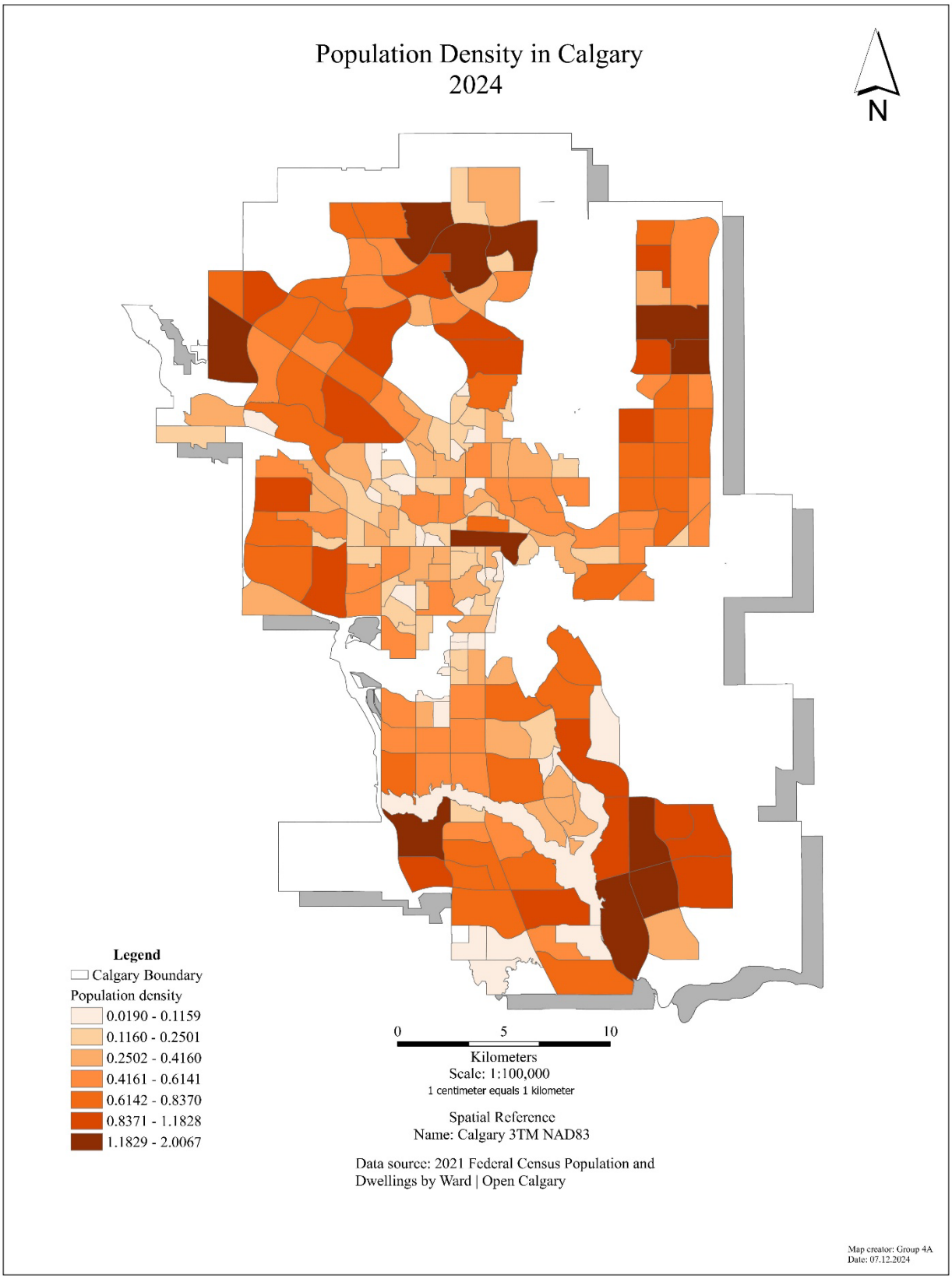


Figure 5 Population Density Map

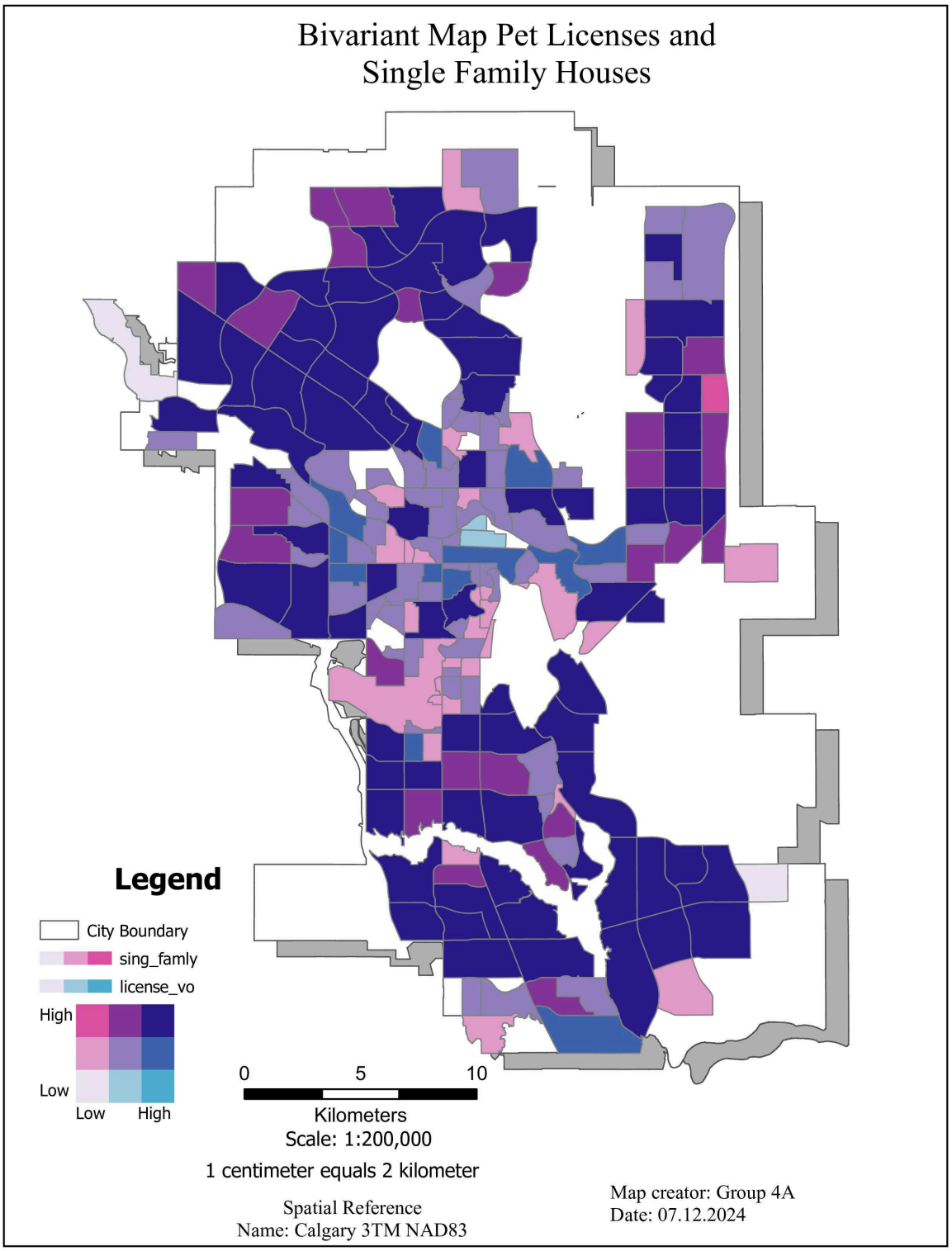


Figure 6 Bivariant Map

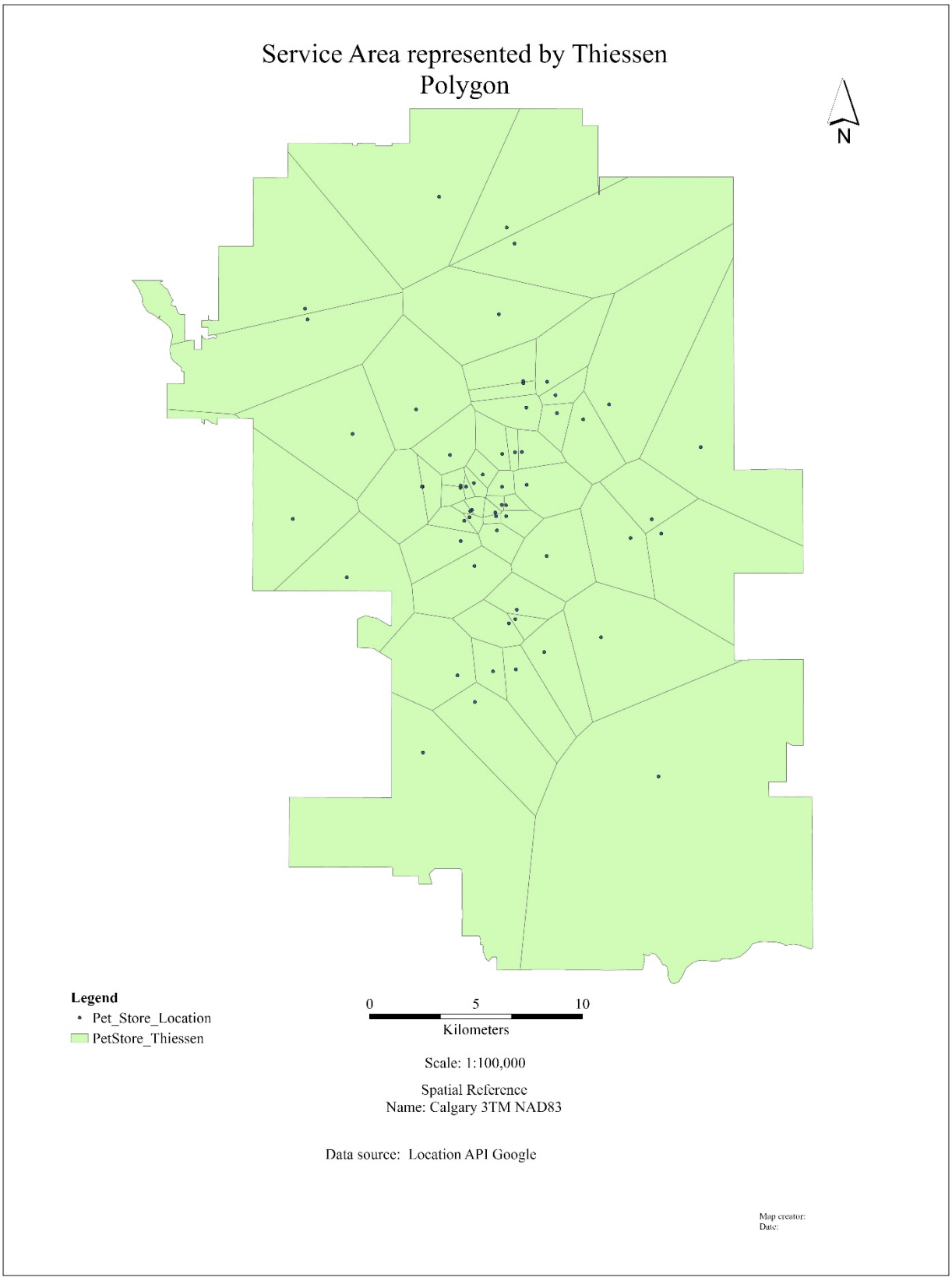


Figure 7 Thiessen Map Polygon

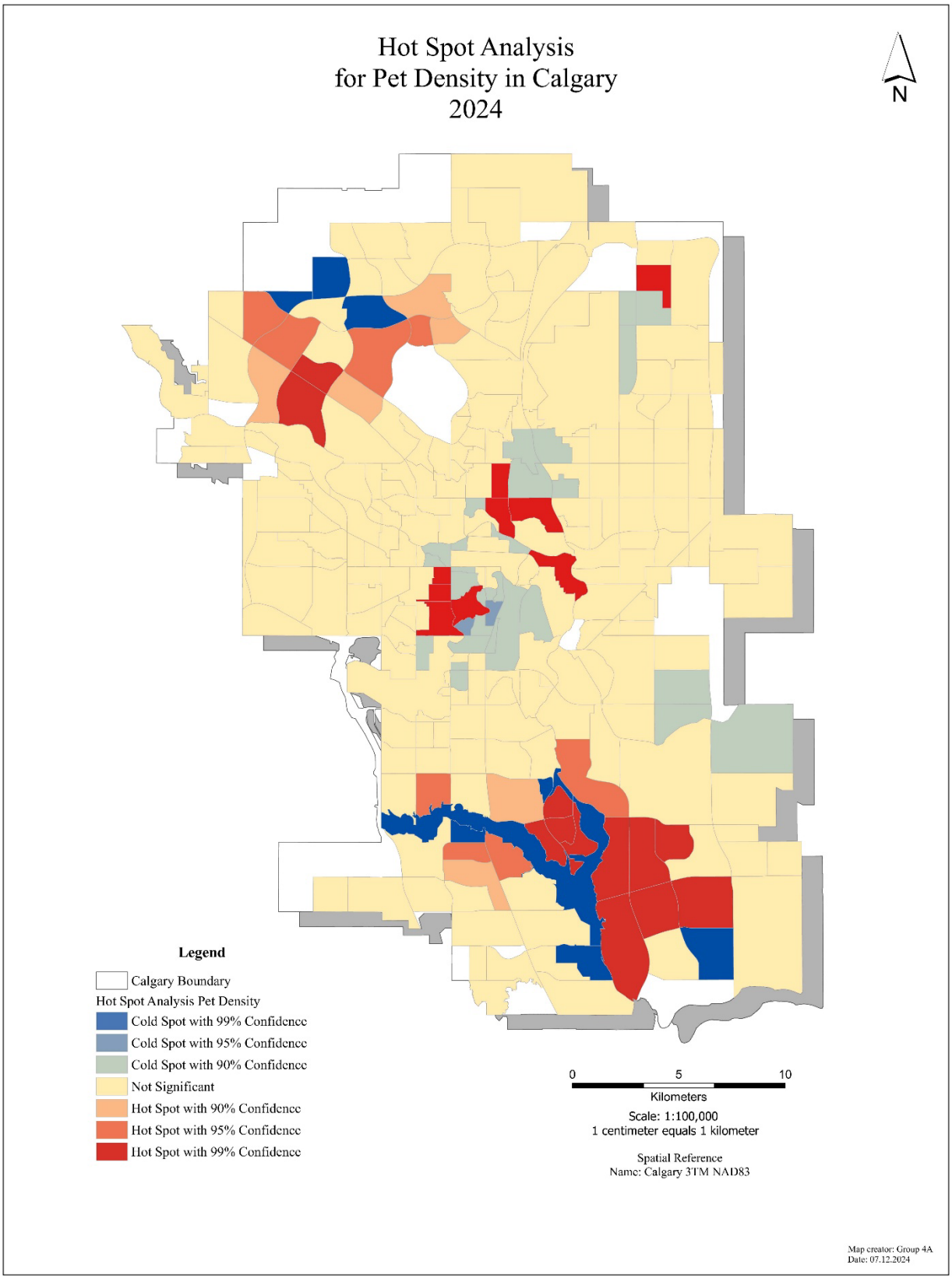


Figure 8 Hotspots

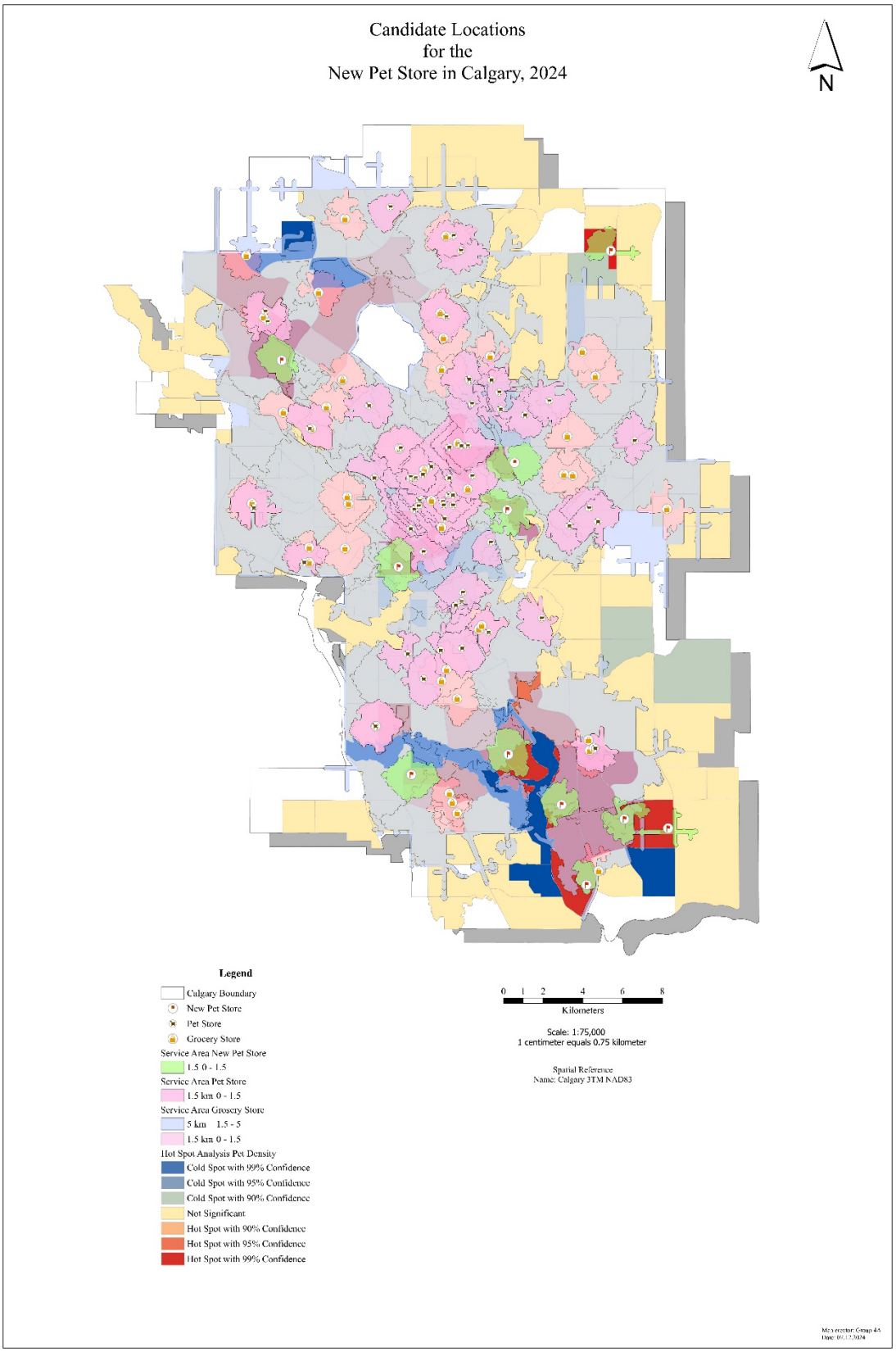


Figure 9 Final Layout

Data Type	Population by Community	Pet License Data	Shop Locations	Community Boundaries	Calgary Road
Source Name	City of Calgary Open Data	Calgary Pet Services	Google Map	City of Calgary Open Data	Adrian Faraguna
Source URL	2021 Federal Census Population and Dwellings by Ward | Open Calgary	http://www.calgary.ca/CSPS/ABS/Pages/Animal-Services/Licensing-cat-dog.aspx	pet store calgary - Google Maps	https://data.calgary.ca/Base-Maps/Community-District-Boundaries/surr-xmvs/about_data	GEOS 409
Date Collected	8/29/2024	10/8/2024	2024-10-05	2024-10-01	N/A
File Format	Shape file	Shape file	Excel	Shape File	Feature Class
Attributes	Community, population	License count, pet type	Address, shop type	Community boundaries	
Projection	WGS 84	WGS 84	WGS 84	WGS 84	NAD 83 3TM 114
Quality Issues	None	Some missing data	Outdated for new shops	High quality	High quality
Data License	Public	Public	Public	Public	Public
Collection Frequency	Annually	Monthly	Annually	Quarterly	N/A
Geographic Coverage	Calgary	Calgary	Calgary	Calgary	Calgary
Temporal Coverage	2024	2024	2024	2024	2024
Resolution/Scale	Community level	Address level	Address level	Community level	1:50,000
Data Completeness	Complete	Partial	Complete	Complete	Complete
Data Accuracy	High	High	Moderate	High	High
Metadata Available	Yes	Yes	Yes	Yes	Yes
Coordinate System	Geographic	Geographic	Geographic	Geographic	Projected
Data Processing Required	No	No	No	No	No
Data Cleaning Status	N/A	In Progress	Not Started	N/A	N/A
Data Currency	Current	Mostly Current	Outdated	Current	Current
Access Permissions	None	None	None	None	None
Intended Use	Identify population centers	Identify pet ownership density	Identify existing shops	Define community boundaries	Road Network
Contact Information	City of Calgary GIS Team	Calgary Pet Services	Google Map	City of Calgary GIS Team	SAIT instructor
Contact Email	gis@calgary.ca	info@calgarypets.ca	None	gis@calgary.ca	adrian.faraguna@sait.ca
Status Tracking	Collected	Collected	Needed	Ready for Analysis	Ready for Analysis
Backup Location	External Hard Drive	External Hard Drive	External Hard Drive	External Hard Drive	External Hard Drive
Data Sensitivity	Moderate	Moderate	Moderate	Moderate	Moderate
Data Format Compatibility	Compatible	Compatible	Compatible	Compatible	Compatible
Review Date	10/24/2024	10/24/2024	10/24/2024	10/24/2024	12/8/2024
Notes	Used for population density analysis	Requires cleaning for incomplete entries	Used for competition analysis	Defines boundaries for analysis	Used for road network analysis

Figure 10 Metadata Table

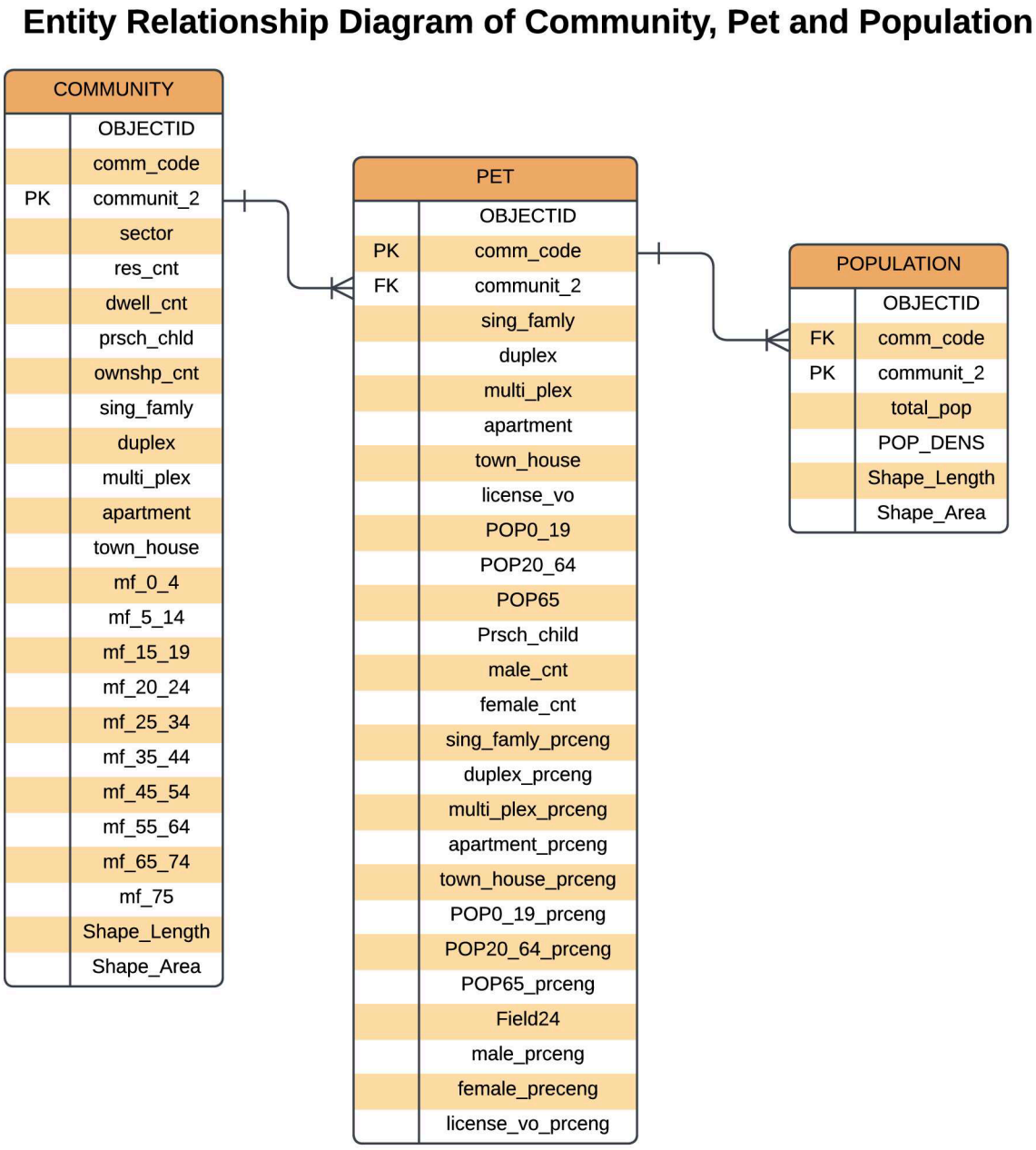


Figure 10 ERD

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