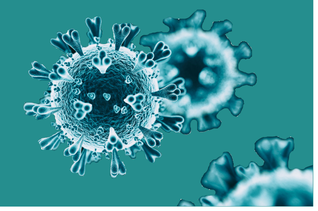
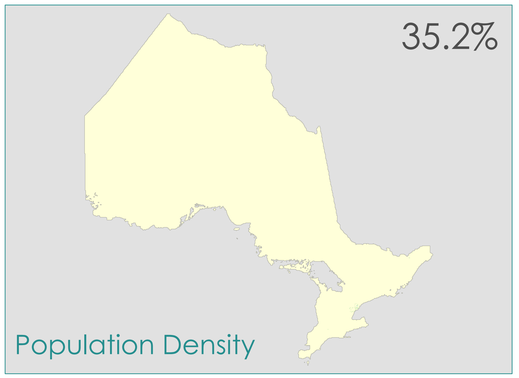
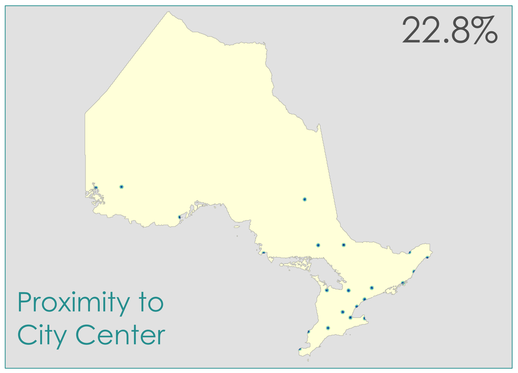
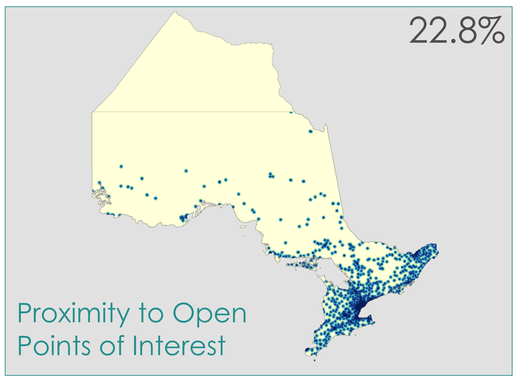
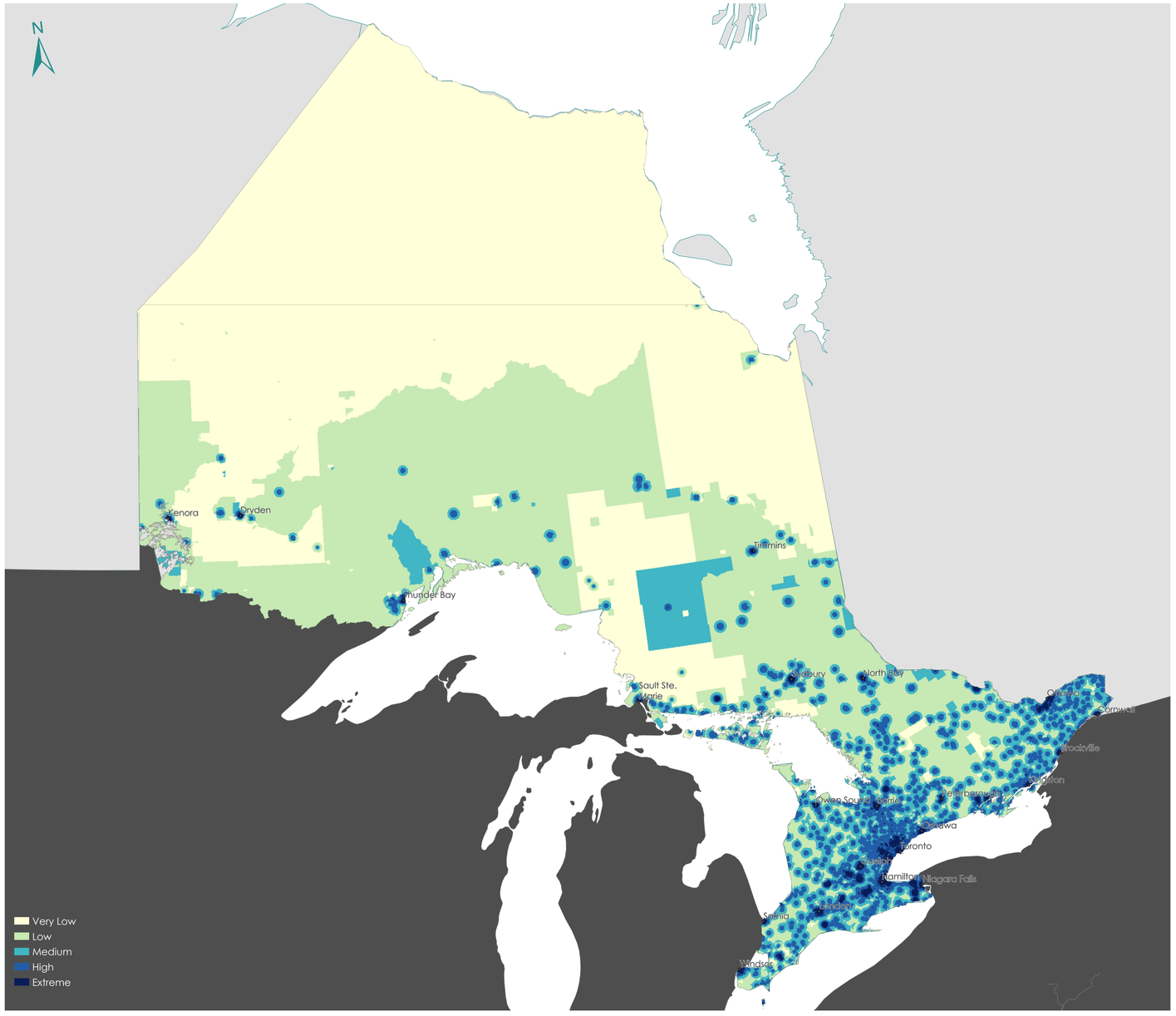
Vulnerable Populations of COVID-19 Contraction

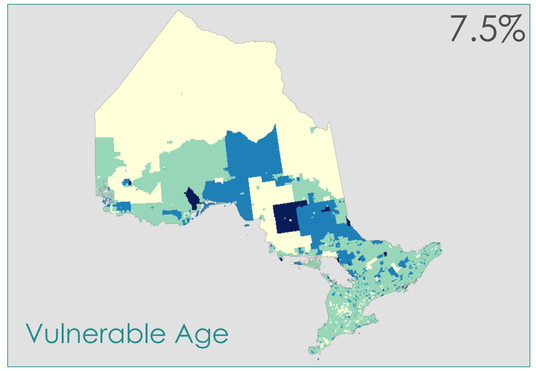


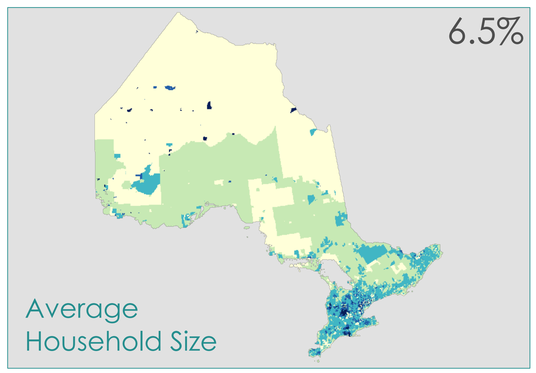


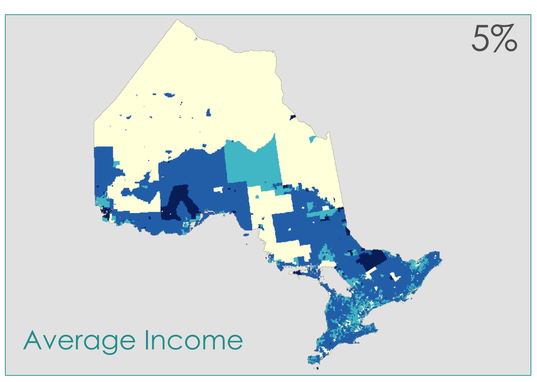












INTRODUCTION

Coronaviruses are very common and are typically associated with mild illness (similar to the common cold). Many coronaviruses exist in both animals and humans. However, COVID-19 is a new string of coronavirus that has not been previously contracted and present in humans. Previous coronaviruses that have been spread from animals to humans include the SARS epidemic in 2003 and MERS outbreak since 2012.

COVID-19 has already killed approximately 120,000 people world-wide and has infected over 1.9 million people with cases still on the rise as of April 13th, 2020). Although there have been studies conducted to display data spatially of active cases globally, at-risk areas have not been identified for the province of Ontario. By spatially representing at-risk areas of infection of COVID-19, policymakers can better distribute resources as they brace for impact of this virus.

This is a unique, worrisome, and serious pandemic that deserves further investigation into identifying at-risk areas of infection.

METHODS

STEP ONE: IDENTIFY IMPORTANT CRITERIA

Using a variety of government sources and newly released information concerning population demographics of the constantly-changing epidemiology reports, criteria to identify the most vulnerable populations of COVID19 were created.

Factors of area contributed to these criteria including: population density, proximity to city centers, and proximity to communal points of interest (POI) that remain open (grocer's, post office's, banks, etc.)

Other demographic factors that were considered important included: susceptible age, average household size, and average income.

Criteria	Reclass (1-9)	weight
Age	20to29	0.1
	30to39	0.15
	40to49	0.17
	50to59	0.25
	60to69	0.2
	70to79	0.13
Total		1

Description	Rank (1-9)	Weights
0-25% of the total population	1	0.075
25-50% of the total population	3	
50-75% of the total population	7	
75-100% of the total population	9	

STEP TWO: EVALUATE THE CRITERIA

Criteria was then further evaluated by description to form subcategories of importance among the primary criteria.

Using Analytical Hierarchy Process (AHP), weights were assigned as seen in the two tables below.

Note: Age needed to be created as a separate MCDA process since the percentage of the population of vulnerable populations were located in different age categories among the original dissemination areas.

Criteria	Description	Rank (1-9)	Weights
Population Density	< 0.0011053	1	0.352
	between 0.0011054 and 0.0134156	3	
	between 0.0134157 and 0.088728	5	
	between 0.088729 and 0.245632	7	
	between 0.245633 and 1	9	
Average Household Size	< 0.350877	1	0.067
	between 0.350878 and 0.438596	3	
	between 0.438596 and 0.508772	5	
	between 0.508771 and 0.614035	7	
	between 0.614036 and 1	9	
Average After Tax Income	between 0 and 0.697432	1	0.05
	between 0.697433 and 0.880734	3	
	between 0.880736 and 0.935892	5	
	between 0.935983 and 0.974257	7	
	between 0.974258 and 1	9	
Proximity to Urban Center	> 10km	1	0.228
	between 10km and 8km	3	
	between 8km and 6km	5	
	between 6km and 4km	7	
	< 2km	9	
Proximity to POIs	> 10km	1	0.228
	between 10km and 8km	3	
	between 8km and 6km	5	
	between 6km and 4km	7	
	< 2km	9	

STEP THREE: CREATE WEIGHTED SURFACES

Each criteria surface was created using standardization techniques to create a percent of the total population for each dissemination area.

Each surface was reclassified as a rank ranging from 1-9 (where a value of 9 indicates most vulnerable and 1 represents least vulnerable populations).

These were then converted to a raster for the final MCDA step.

The weighted sum tool was then used to produce an overlay of all combined surface with their combined weights.

RESULTS

Overall, populations that are most at-risk of the impacts of COVID-19 are located where there are close proximity to communal areas such as city centers where there are high population densities. And by extension - proximity to necessity resources such as banks and grocery stores also provide cause for vulnerability.

There is also cause for concern in households with a higher household size since more people will be exiting and re-entering the home after various necessary shops. Also, places where the average age is between 30 and 79 are also extremely at risk. Statistics shows that these populations have the most confirmed cases of COVID-19.

Another primary concern is for areas with lower average income. People in high income areas who are laid off from work or must provide day care for their kids will be more likely to stay home. Whereas, lower income areas will need to find available work and risk contracting the virus.

Through Multi-Criteria Decision Analysis, a real, active, and important issue can be assessed to produce a surface identifying the most vulnerable areas of COVID-19. This model can be used by decision-makers to plan for future spread of this virus and keep the most vulnerable populations safe.

Rylie Nellis

This project was conducted in partial fulfillment of the Fleming College GIS Application Specialist Program for Spatial Analysis II (2020). Sources: ESRI: World Countries Boundaries, Major Cities/2014; StatsCanada: Canadian boundary file, Dissemination Areas of Ontario/2016; OSM: Open Points of Interest/2014.