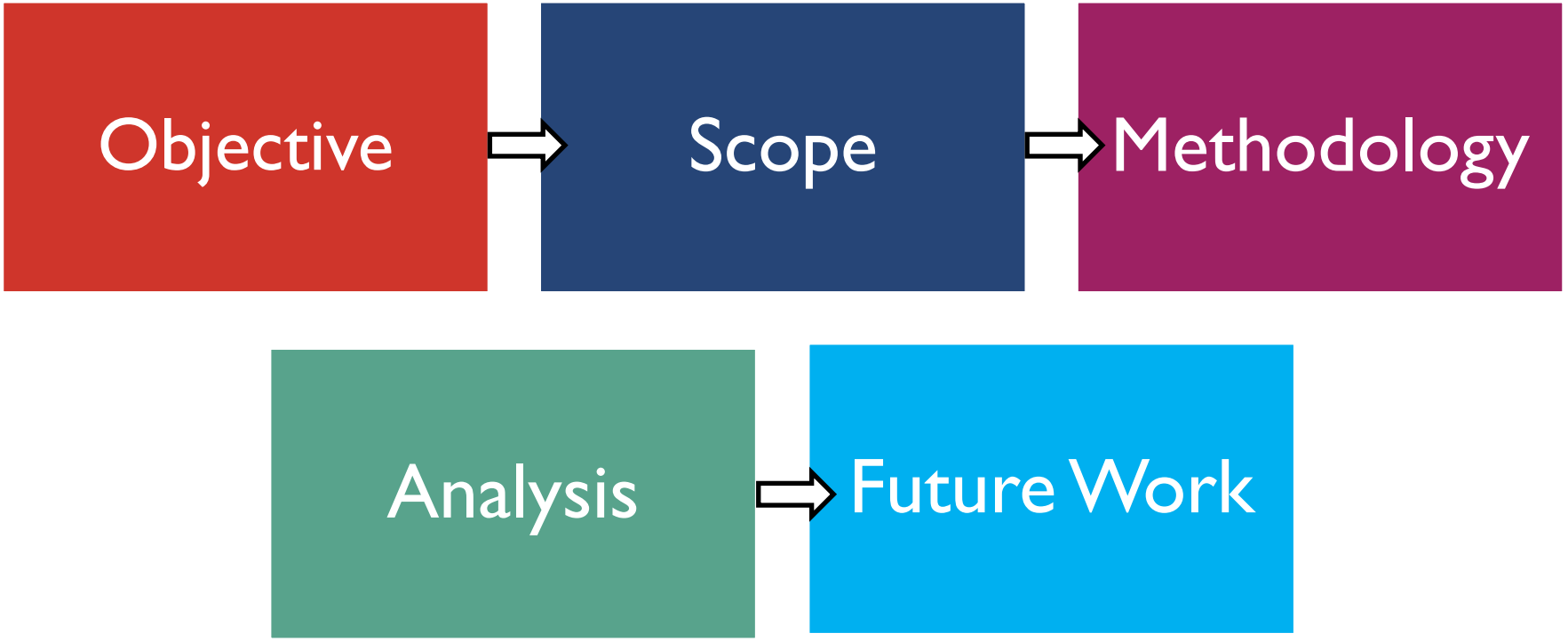
CLUE Symposium 2023

Understanding freight fluidity on arterial roads and its correlation with collisions

Prateek Jain
MASc. Candidate, York University

11th May, 2023

AGENDA



LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

FREIGHT FLUIDITY

The term ‘Freight Fluidity’ represents a quantitative performance measure of multi-modal supply chains in a geographic area of interest to inform decision making (Transport Canada).

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

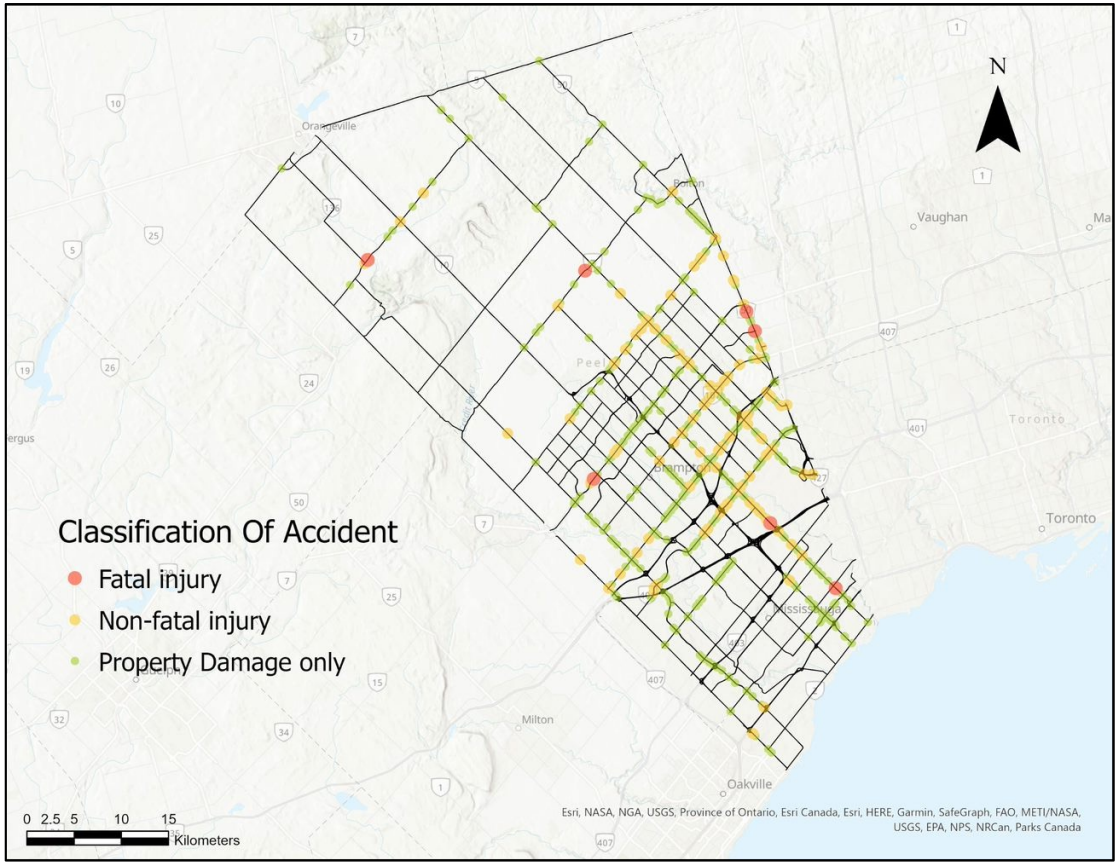
Image references:
[1] CBC. 2017. 'Quick clear squads' to be a permanent fixture on Toronto's busiest roadways, city says | CBC News. [online] Available at: <https://www.cbc.ca/news/canada/toronto/toronto-traffic-gridlock-quick-clear-squads-1.4389008>
[2] The Conversation. 2016. *More online shopping means more delivery trucks. Are cities ready?*. [online] Available at: <https://theconversation.com/more-online-shopping-means-more-delivery-trucks-are-cities-ready-67686

COLLISIONS

Desired Goal:

Eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all

In simple words….***no loss of life is acceptable***



LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

RESEARCH OBJECTIVES

GOAL

- Help policy makers and transport officials in Region of Peel make better informed decisions to avoid delays and enhance freight mobility
- Establish spatial correlations (if any) between mobility and collision

OBJECTIVES

- Identify the areas of concern which constrain the movement of trucks along key trade routes
- Evaluate the mobility measures to study severity and impact
- Provide a foundation for fluidity analysis in Peel Region

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

SCOPE

STUDY AREA

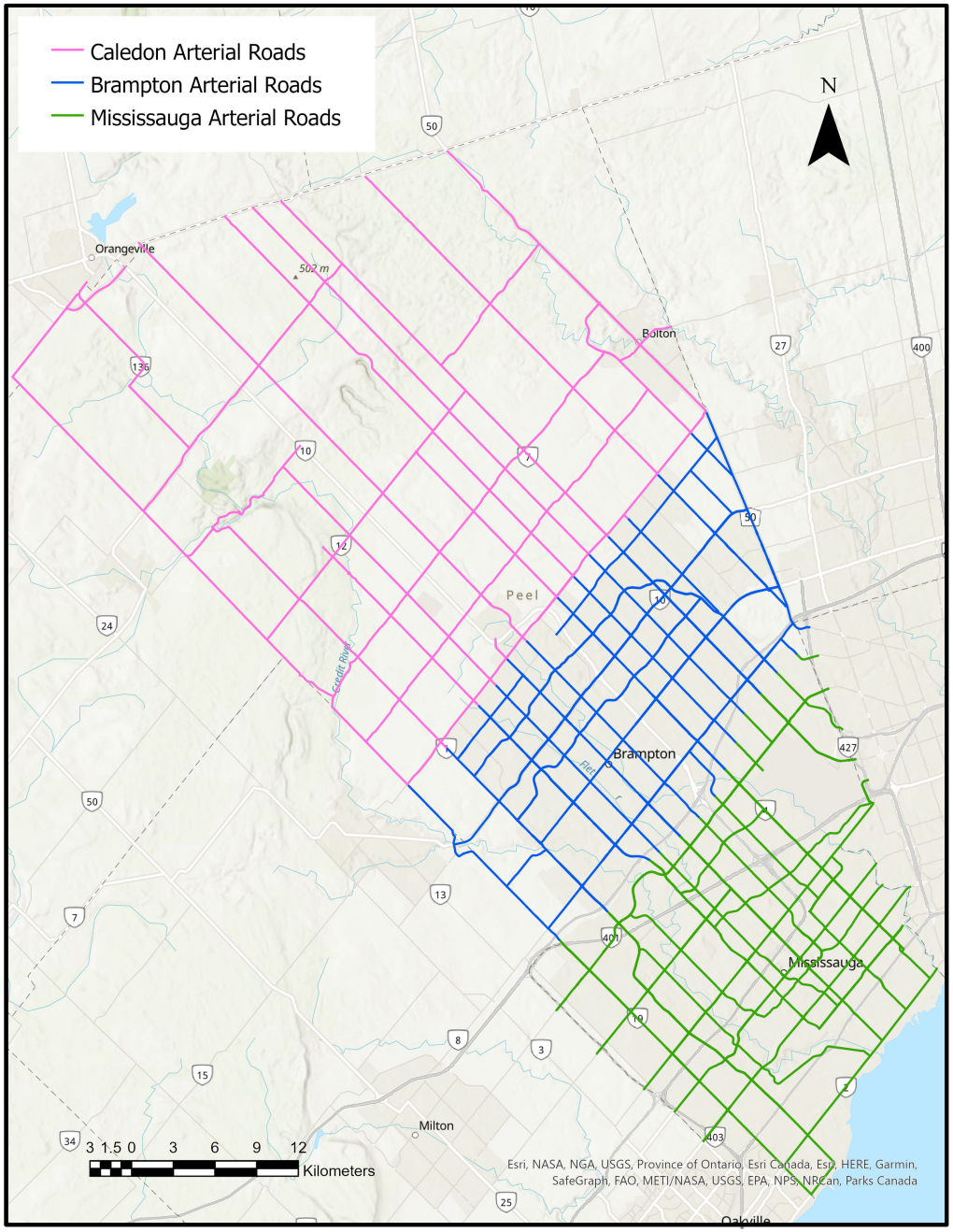
- Arterial Roads within the Region of Peel

TRANSPORTATION MODE

- Freight transportation

TIME WINDOW

- Pre-Pandemic (2019)
- During Pandemic (2020)
- 24-hour



MOBILITY MEASURES

1. Travel Time Index

TTI = Average travel time / Free flow travel time

2. Planning Time Index

PTI = 95th percentile travel time / Free flow travel time

3. Buffer Index

BI = (95th percentile travel time – Average travel time) / Average travel time

SOURCE OF INFORMATION

1. Arterial Road Classification
   - Source: Streets data portal – Region of Peel

2. Collision Data
   - Source: Permanent Count Station (PCS) data from Region of Peel Open Data portal

3. Travel Time Delay Calculation
   - Source: Traffic feeds obtained from HERE data using the Freight Data Warehouse

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

METHODOLOGY

1. Focus on Arterials

2. Dashboard

3. Consideration of Pandemic

4. Correlation with Collision

LASSONDE SCHOOL OF ENGINEERING

YORK UNIVERSITÉ UNIVERSITY

DASHBOARD

Data Import

- Python Scripting

Transformation

- Geospatial joins between collision and mobility measures data.

Visualization

- ArcGIS Dashboard

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

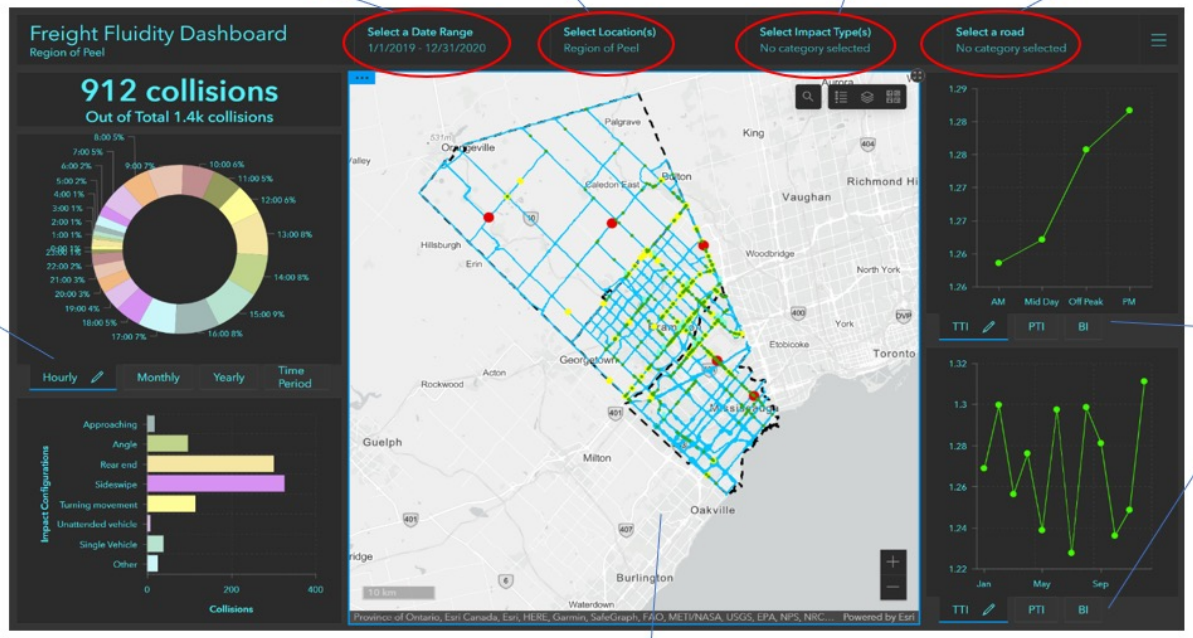
DASHBOARD

1. Select a Date Range between 1st January 2019 to 31st December 2020.

2. Select Location(s) – Mississauga, Brampton and/or

3. Select Impact Type(s) – pertaining to collision.

4. Select any particular road(s) of interest.



User can change the temporal values – Hourly, Monthly, Yearly or Time Period

User can change and analyse the mobility measures – TTI, PTI or BI

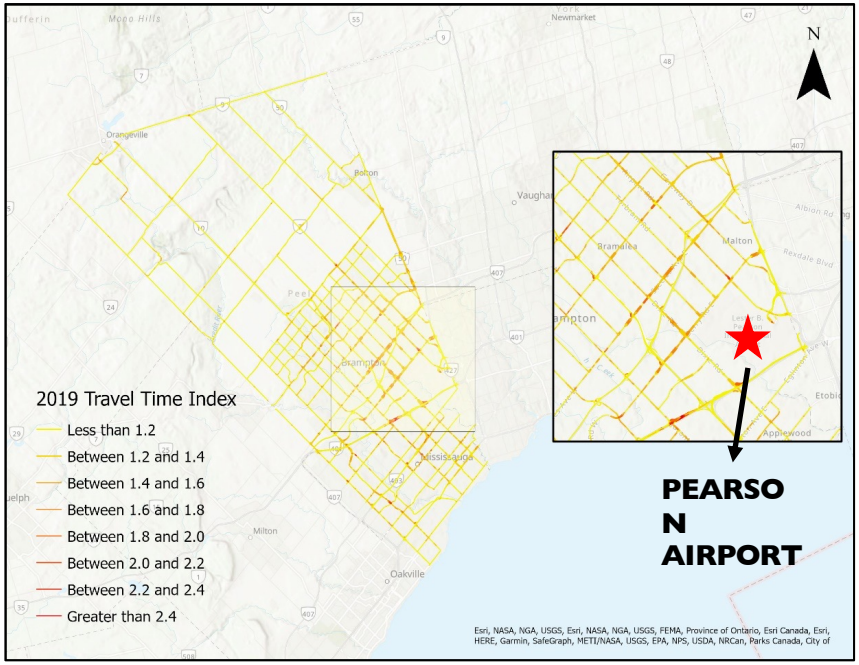
Zooming In/Out of the map will automatically update information for that extent.

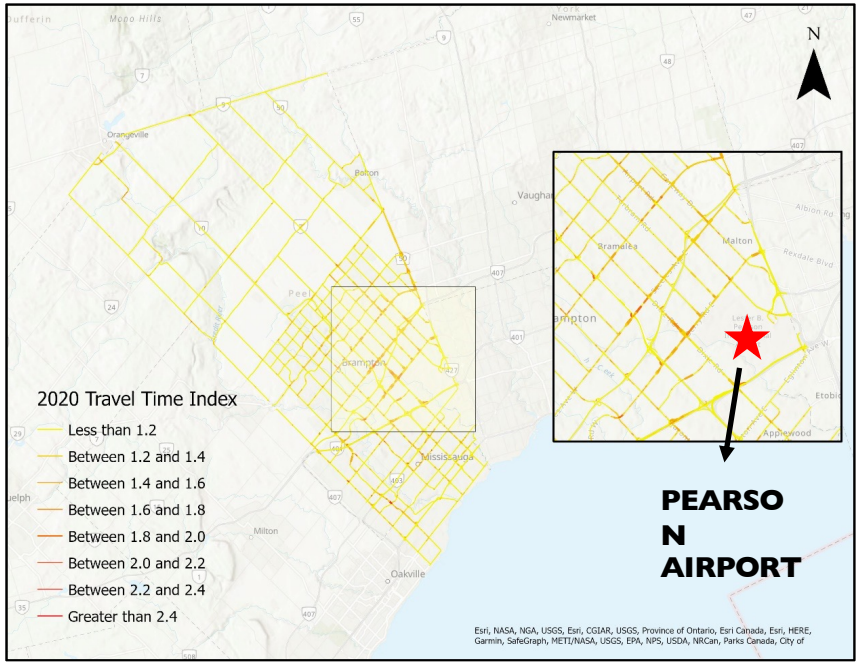
Dashboard Link:
https://www.arcgis.com/apps/dashboards/5497a91141824 0b9ab8610ba7bd8845d

LASSONDE SCHOOL OF ENGINEERING

YORK UNIVERSITÉ UNIVERSITY

MOBILITY MEASURES - COMPARISON



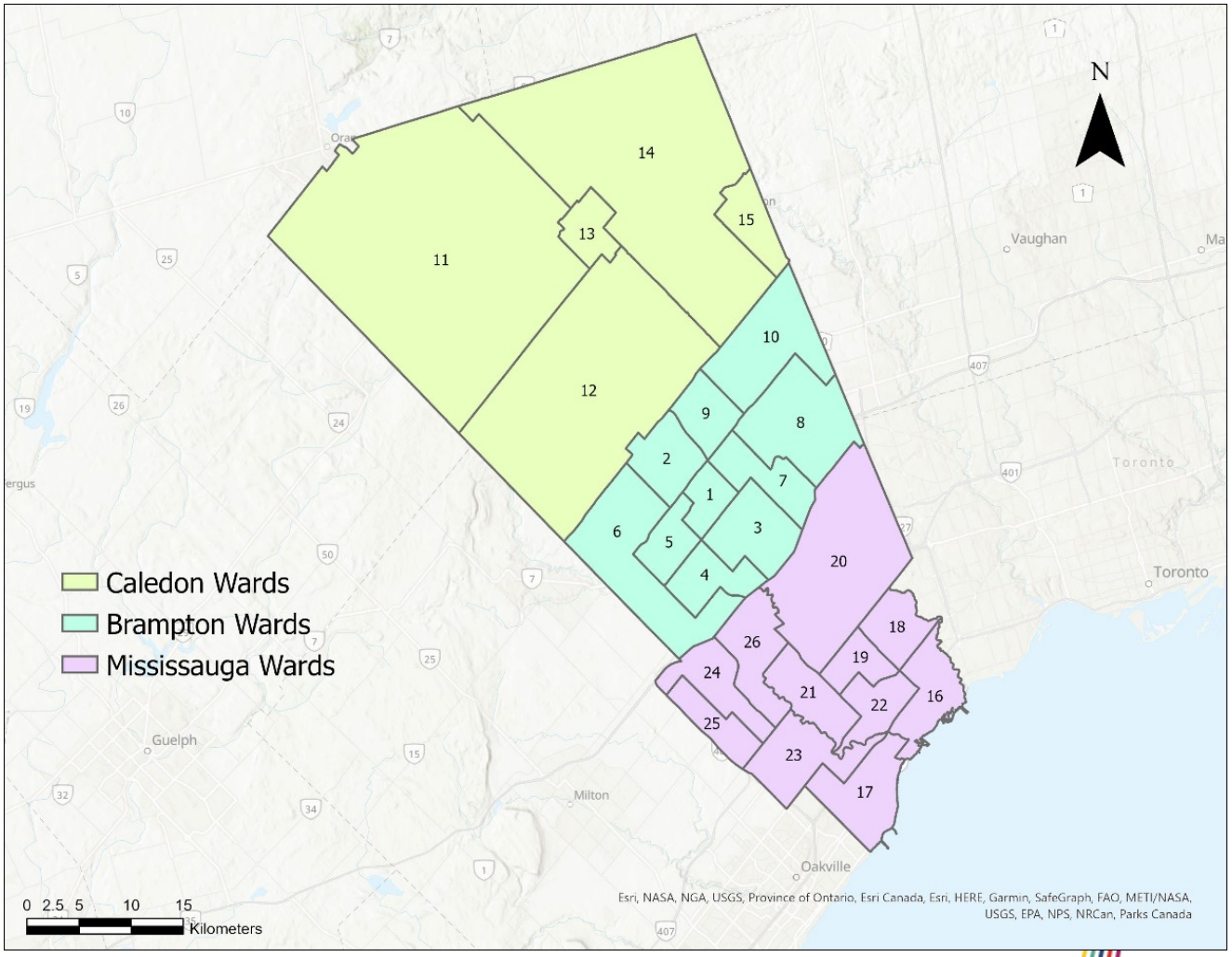


Inference

- TTI decreased by 2.8% between 2019 and 2020, thereby showing less congestion around Pearson Airport.

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

WARD LEVEL ANALYSIS



LASSONDE SCHOOL OF ENGINEERING

YORK UNIVERSITÉ UNIVERSITY

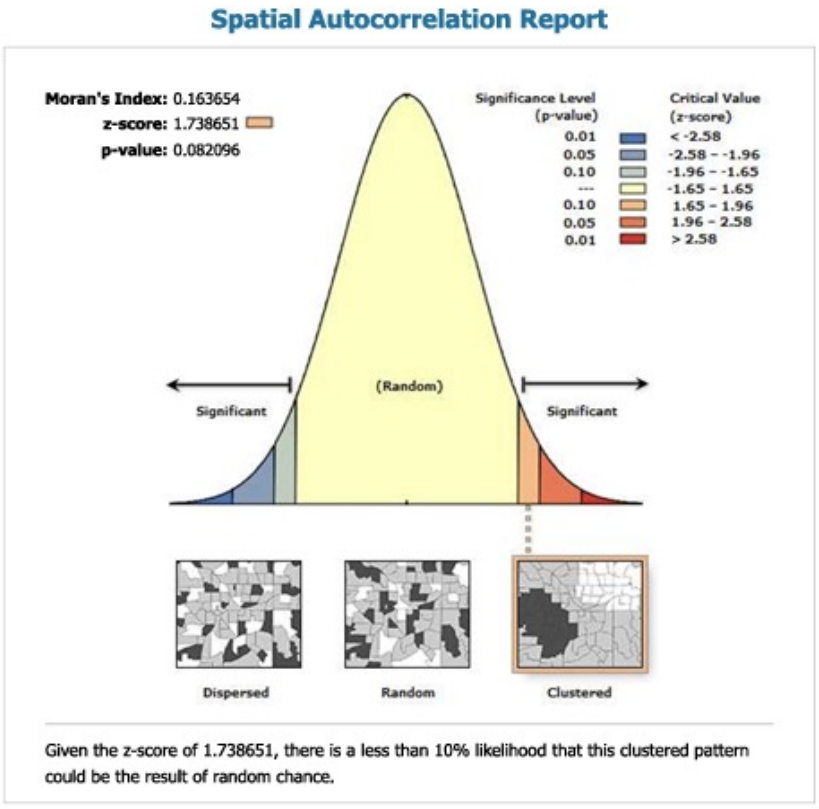
COLLISION VS MOBILITY CORRELATION

Ward	Municipality	TTI vs Collision	PTI vs Collision	BI vs Collision	No. of collisions
1	Brampton	0.414	0.809	0.825	18
2	Brampton	0.951	0.877	0.534	4
3	Brampton	0.078	0.194	0.285	56
4	Brampton	-0.532	-0.543	-0.568	4
5	Brampton	0.515	0.499	0.476	14
6	Brampton	0.343	0.459	0.490	25
7	Brampton	-0.079	-0.073	-0.045	26
8	Brampton	-0.083	-0.151	-0.153	87
9	Brampton	0.245	-0.127	-0.218	14
10	Brampton	0.573	-0.162	-0.112	13
11	Caledon	N/A	N/A	N/A	4
12	Caledon	0.211	0.333	0.465	20
13	Caledon	N/A	N/A	N/A	2
14	Caledon	0.192	0.360	0.348	20
15	Caledon	-0.083	0.409	0.642	34
16	Mississauga	-0.153	-0.157	-0.079	19
17	Mississauga	0.957	0.981	0.984	6
18	Mississauga	0.923	0.995	0.999	4
19	Mississauga	0.900	0.564	-0.079	4
20	Mississauga	-0.004	0.116	0.168	160
21	Mississauga	N/A	N/A	N/A	2
22	Mississauga	N/A	N/A	N/A	4
23	Mississauga	-0.211	0.257	0.341	6
24	Mississauga	-0.383	-0.368	-0.272	7
25	Mississauga	N/A	N/A	N/A	0
26	Mississauga	0.198	0.264	0.272	20

- Correlation between Collisions and Mobility Measures for all wards in Peel Region.

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

SPATIAL AUTOCORRELATION – MORAN'S I



Global Moran's I Summary

Moran's Index:	0.163654
Expected Index:	-0.043478
Variance:	0.014193
z-score:	1.738651
p-value:	0.082096

Year	Collision	TTI	PTI	BI
2019	-0.002224	0.190843	0.363641	0.291402
2020	0.141994	0.241907	0.165492	0.163654

- Moran's Index is positive for values showing high level of spatial cluster .
- When high values repel other high values, Moran's Index will be negative

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

FUTURE WORK

- Synthesize the relationship between performance measures and collisions

Hypothesis 1	↑ Speed	↓ Delay	↑ Severe Collisions
Hypothesis 2	↓ Speed	↑ Delay	↑ Minor Collisions

- Consider other factors in the study area

- Expand the research beyond Region of Peel

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

FUTURE WORK

- Expand the research beyond Region of Peel
- Enable real-time data update in the dashboard
- Bolster the correlation hypothesis by comparing results from other cities
- Suggest improvements to areas of concerns

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

ACKNOWLEDGEMENT

- City Logistics for the Urban Economy (CLUE)
- York University
- Smart Freight Centre
- NSERC Alliance
- Region of Peel

LASSONDE SCHOOL OF ENGINEERING

YORK UNIVERSITÉ UNIVERSITY

CLUE Symposium 2023

Understanding freight fluidity on arterial roads and its correlation with collisions

Prateek Jain
MASc. Candidate, York University

11th May, 2023