

The Crossroads of Safety

**Environmental Factors &
Severity of Traffic
Collision**

**WIL MACWILLIAM:
TEAM LEAD &
DATA REPORTER**

**TANVI GERA:
DATA ANALYST &
VISUAL DESIGNER**

**PRIYANSHI SHARMA:
GEO-DATA ANALYST &
QUALITY CONTROL**



PRESENTATION OVERVIEW



1. Introduction & Project Scope

- SUBJECT OF ANALYSIS
- PROBLEM STATEMENT

2. Data Preparation

- DATA SOURCING
- DATA CLEANING
- FEATURE ENGINEERING

3. Analysis Findings

- EXPLORATORY DATA ANALYSIS IN PYTHON
- DIAGNOSTIC ANALYSIS IN POWER BI

4. Conclusion

- KEY TAKEAWAYS
- WHERE TO GO FROM HERE



PROJECT SCOPE

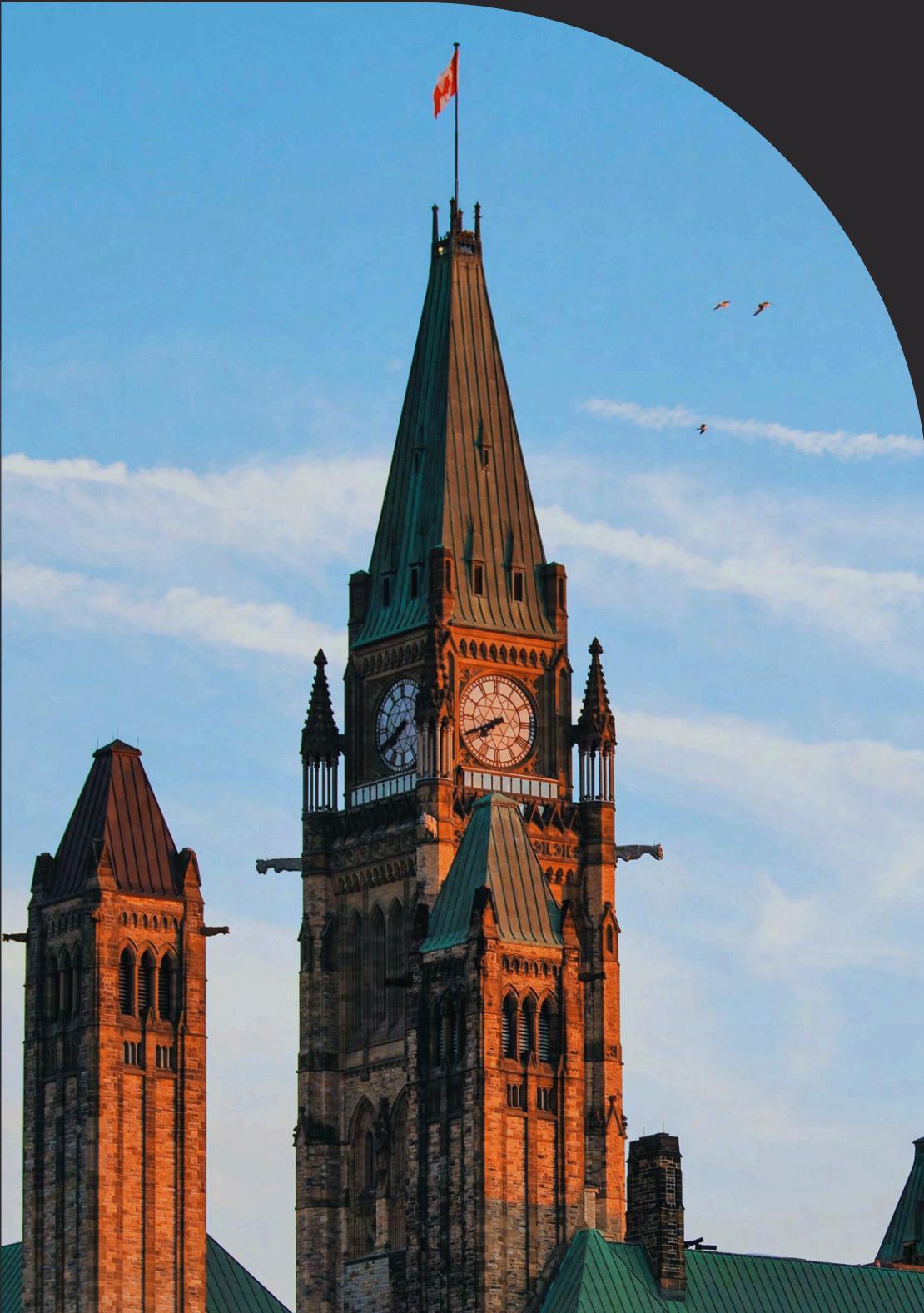
SUBJECT OF ANALYSIS

Analyze municipal data on traffic collisions in Ottawa spanning 2013-2022

GOALS

Explore how the following environmental factors influence collision severity

- Weather
- Road Surface Conditions
- Time of Year and Day
- Angle of Impact and Vehicles Involved
- Cyclist/Pedestrian Involvement



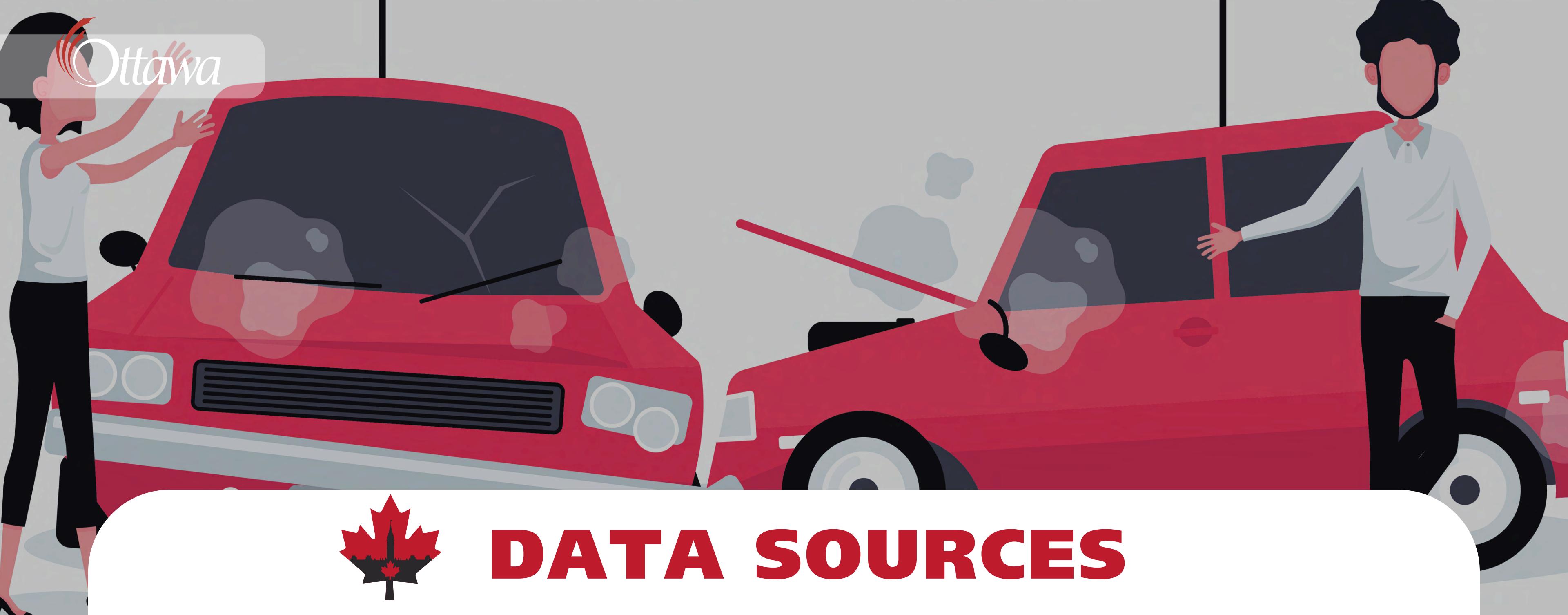


PROBLEM STATEMENT



**WHAT CAN WE LEARN FROM THE LAST DECADE OF
DATA ON TRAFFIC COLLISIONS ACROSS OTTAWA,
FROM THE SUBURBS TO THE DOWNTOWN CORE?**

**CAN INSIGHTS FROM THIS DATA BE USED TO SHAPE
A TRAFFIC SAFETY PLAN GOING FORWARD THAT
ACCOUNTS FOR A FUTURE OF CLIMATE
UNCERTAINTY?**



DATA SOURCES

<https://open.ottawa.ca/datasets/ottawa::traffic-collision-data/about>

<https://ottawa.weatherstats.ca/download.html>

<https://open.ottawa.ca/datasets/ottawa::landmarks-oc-transpos-travel-planner/about>

https://climate.weather.gc.ca/climate_data/

Query	Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8			Q9			Q10			Q11			Q12			Q13			Q14			Q15			Q16			Q17			Q18			Q19			Q20			Q21			Q22			Q23			Q24			Q25			Q26			Q27			Q28			Q29			Q30			Q31			Q32			Q33			Q34			Q35			Q36			Q37			Q38			Q39			Q40			Q41			Q42			Q43			Q44			Q45			Q46			Q47			Q48			Q49			Q50			Q51			Q52			Q53			Q54			Q55			Q56			Q57			Q58			Q59			Q60			Q61			Q62			Q63			Q64			Q65			Q66			Q67			Q68			Q69			Q70			Q71			Q72			Q73			Q74			Q75			Q76			Q77			Q78			Q79			Q80			Q81			Q82			Q83			Q84			Q85			Q86			Q87			Q88			Q89			Q90			Q91			Q92			Q93			Q94			Q95			Q96			Q97			Q98			Q99			Q100			Q101			Q102			Q103			Q104			Q105			Q106			Q107			Q108			Q109			Q110			Q111			Q112			Q113			Q114			Q115			Q116			Q117			Q118			Q119			Q120			Q121			Q122			Q123			Q124			Q125			Q126			Q127			Q128			Q129			Q130			Q131			Q132			Q133			Q134			Q135			Q136			Q137			Q138			Q139			Q140			Q141			Q142			Q143			Q144			Q145			Q146			Q147			Q148			Q149			Q150			Q151			Q152			Q153			Q154			Q155			Q156			Q157			Q158			Q159			Q160			Q161			Q162			Q163			Q164			Q165			Q166			Q167			Q168			Q169			Q170			Q171			Q172			Q173			Q174			Q175			Q176			Q177			Q178			Q179			Q180			Q181			Q182			Q183			Q184			Q185			Q186			Q187			Q188			Q189			Q190			Q191			Q192			Q193			Q194			Q195			Q196			Q197			Q198			Q199			Q200			Q201			Q202			Q203			Q204			Q205			Q206			Q207			Q208			Q209			Q210			Q211			Q212			Q213			Q214			Q215			Q216			Q217			Q218			Q219			Q220			Q221			Q222			Q223			Q224			Q225			Q226			Q227			Q228			Q229			Q230			Q231			Q232			Q233			Q234			Q235			Q236			Q237			Q238			Q239			Q240			Q241			Q242			Q243			Q244			Q245			Q246			Q247			Q248			Q249			Q250			Q251			Q252			Q253			Q254			Q255			Q256			Q257			Q258			Q259			Q260			Q261			Q262			Q263			Q264			Q265			Q266			Q267			Q268			Q269			Q270			Q271			Q272			Q273			Q274			Q275			Q276			Q277			Q278			Q279			Q280			Q281			Q282			Q283			Q284			Q285			Q286			Q287			Q288			Q289			Q290			Q291			Q292			Q293			Q294			Q295			Q296			Q297			Q298			Q299			Q300			Q301			Q302			Q303			Q304			Q305			Q306			Q307			Q308			Q309			Q310			Q311			Q312			Q313			Q314			Q315			Q316			Q317			Q318			Q319			Q320			Q321			Q322			Q323			Q324			Q325			Q326			Q327			Q328			Q329			Q330			Q331			Q332			Q333			Q334			Q335			Q336			Q337			Q338			Q339			Q340			Q341			Q342			Q343			Q344			Q345			Q346			Q347			Q348			Q349			Q350			Q351			Q352			Q353			Q354			Q355			Q356			Q357			Q358			Q359			Q360			Q361			Q362			Q363			Q364			Q365			Q366			Q367			Q368			Q369			Q370			Q371			Q372			Q373			Q374			Q375			Q376			Q377			Q378			Q379			Q380			Q381			Q382			Q383			Q384			Q385			Q386			Q387			Q388			Q389			Q390			Q391			Q392			Q393			Q394			Q395			Q396			Q397			Q398			Q399			Q400			Q401			Q402			Q403			Q404			Q405			Q406			Q407			Q408			Q409			Q410			Q411			Q412			Q413			Q414			Q415			Q416			Q417			Q418			Q419			Q420			Q421			Q422			Q423			Q424			Q425			Q426			Q427			Q428			Q429			Q430			Q431			Q432			Q433			Q434			Q435			Q436			Q437			Q438			Q439			Q440			Q441			Q442			Q443			Q444			Q445			Q446			Q447			Q448			Q449			Q450			Q451			Q452			Q453			Q454			Q455			Q456			Q457			Q458			Q459			Q460			Q461			Q462			Q463			Q464			Q465			Q466			Q467			Q468			Q469			Q470			Q471			Q472			Q473			Q474			Q475			Q476			Q477			Q478			Q479			Q480			Q481			Q482			Q483			Q484			Q485			Q486			Q487			Q488			Q489			Q490			Q491			Q492			Q493			Q494			Q495			Q496			Q497			Q498			Q499			Q500			Q501			Q502			Q503			Q504			Q505			Q506			Q507			Q508			Q509			Q510			Q511			Q512			Q513			Q514			Q515			Q516			Q517			Q518			Q519			Q520			Q521			Q522			Q523			Q524			Q525			Q526			Q527			Q528			Q529			Q530			Q531			Q532			Q533			Q534			Q535			Q536			Q537			Q538			Q539			Q540			Q541			Q542			Q543			Q544			Q545			Q546			Q547			Q548			Q549			Q550			Q551			Q552			Q553			Q554			Q555			Q556			Q557			Q558			Q559			Q560			Q561			Q562			Q563			Q564			Q565			Q566			Q567			Q568			Q569			Q570			Q571			Q572			Q573			Q574			Q575			Q576			Q577			Q578			Q579			Q580			Q581			Q582			Q583			Q584			Q585			Q586			Q587			Q588			Q589			Q590			Q591			Q592			Q593			Q594			Q595			Q596			Q597			Q598			Q599			Q600			Q601			Q602			Q603			Q604			Q605			Q606			Q607			Q608			Q609			Q610			Q611			Q612			Q613			Q614			Q615			Q616			Q617			Q618			Q619			Q620			Q621			Q622			Q623			Q624			Q625			Q626			Q627			Q628			Q629			Q630			Q631			Q632			Q633			Q634			Q635			Q636			Q637			Q638			Q639			Q640			Q641			Q642			Q643			Q644			Q645			Q646			Q647			Q		

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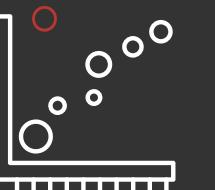


DATA PREPARATION



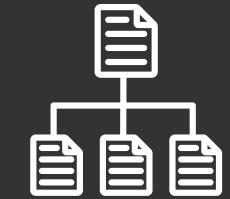
HANDLING MISSING VALUES

- Variance in Annual Data Collected
- Delayed Reporting of Accidents
- Primarily Null Columns



INVESTIGATING OUTLIERS

- 2013 Via Rail / OC-Transpo Bus Crash
- 2019 Westboro Station Bus Crash
- Convoy Protest Jan-Feb 2022



HANDLING DUPLICATE VALUES

- Redundant Geographical Data
- Mostly Categorical Data (highly-repetitive values)



STANDARDIZING DATA

- Minor Formatting Inconsistencies
- Lack of Data Dictionary
- Ambiguity in Collision Classification

DATA PREPARATION

Dataset	Total Rows	Total Columns
Raw Data - Traffic Collisions 2013-2022	131375	30
Almanac Averages & Extremes 1939-2011	366	30
Almanac Averages & Extremes 2011-Present	366	30
Ottawa Daily Weather Stats 2013-2022	11000	72
OC-Transpo Travel Planner Landmarks	3881	12



HANDLING MISSING VALUES

Max_Injury	No_of_Injuries	No_of_Minimal	No_of_Minor	No_of_Major	No_of_Fatal	X
0						207.926
0						492.539
0						335.872
0						635.337
0						337.536
0						259.527
0						347.188
02 - Minor	1					023.634
0						580.109
0						987.809
0						340.477
0						403.686
0						2680.67
0						717.482
0						275.692
0						421.991
01 - Minimal	1	1				642.034
0						318.703
02 - Minor	1					259.909
0						663.124
0						763.963
0						5115.44
0						576.701
02 - Minor	1					649.361
0						279.289
0						368425.095
0						372660.614
0						366998.8
0						365248.213
0						372092.814
02 - Minor	1		1			363651.888

BEFORE

AFTER

Null < 5.5%



< HANDLING DUPLICATE VALUES

No_of_Fatal	X	Y	Latitude	Longitude
372207.926	5030394.03	45.4102363	-75.6388242	
367492.539	5030693.04	45.4133649	-75.6990219	
354335.872	5016730.76	45.2887857	-75.8685024	
374635.337	5032993.55	45.4333873	-75.6074479	
368337.536	5031857.87	45.4237695	-75.6880768	
346259.527	5011872.74	45.245594	-75.9718627	
363347.188	5025563.74	45.3675715	-75.752588	
382023.634	5025555.78	45.365691	-75.5141973	
366580.109	5025045.3	45.3626291	-75.7113852	
372987.809	5034433.18	45.446503	-75.6283027	
373340.477	5031728.83	45.4221362	-75.6241713	
346403.686	5015063.98	45.2743016	-75.9697591	
372680.67	5030107.43	45.4076119	-75.6328248	
374717.482	5010621.62	45.2320853	-75.6095583	
364275.692	5027493.13	45.3848536	-75.7405034	
374421.991	5031315.88	45.4183139	-75.6104114	
368642.034	5022301.38	45.3377552	-75.6854219	
367318.703	5029644.78	45.4039485	-75.7013756	
367259.909	5031252.18	45.4184167	-75.7019229	
366663.124	5029538.64	45.4030518	-75.7097626	
363763.963	5023063.8	45.3450423	-75.7475661	
365115.44	5028654.12	45.3952281	-75.729639	
366576.701	5030720.98	45.4136978	-75.7107183	
333649.361	5023059	45.3468842	-76.131844	
364279.289	5027496.37	45.3848824	-75.7404571	
368425.095	4990116.36	45.0481734	-75.6922967	
372660.614	5032389.31	45.4281451	-75.6327667	
366998.8	5030399.97	45.410772	-75.7053664	
365248.213	5027943.81	45.3888254	-75.7280303	
372092.814	5032474.61	45.4289675	-75.6400105	
363651.888	5026559.37	45.3765044	-75.7485799	

Num_of_Fatal_Injuries	Lat	Long	Classification_Of_Accident
0	45.2881	-75.757	Property Damage Only
0	45.4209	-75.7039	Property Damage Only
0	45.4193	-75.5956	Property Damage Only
0	45.282	-75.9583	Property Damage Only
0	45.4334	-75.6074	Property Damage Only
0	45.4132	-75.6446	Property Damage Only
0	45.389	-75.6175	Property Damage Only
0	45.4568	-75.5009	Property Damage Only
0	45.3557	-75.644	Property Damage Only
0	45.3976	-75.6977	Property Damage Only
0	45.419	-75.6774	Property Damage Only
0	45.419	-75.6774	Property Damage Only
0	45.3309	-75.7015	Property Damage Only
0	45.3138	-75.7996	Property Damage Only
0	45.3627	-75.7115	Property Damage Only
0	45.419	-75.6774	Property Damage Only
0	45.2797	-75.57	Property Damage Only
0	45.3767	-75.6915	Property Damage Only
0	45.3515	-75.8065	Property Damage Only
0	45.3644	-75.7482	Property Damage Only
0	45.4137	-75.7107	Property Damage Only
0	45.3772	-75.7332	Property Damage Only
0	45.4079	-75.6958	Property Damage Only
0	45.4793	-75.5177	Property Damage Only
0	45.419	-75.6774	Property Damage Only
0	45.3439	-75.7293	Property Damage Only
0	45.285	-75.8857	Property Damage Only
0	45.3021	-75.9074	Property Damage Only
0	45.3889	-75.6175	Property Damage Only
0	45.2994	-75.9103	Property Damage Only
0	45.4242	-75.6374	Property Damage Only
0	45.3572	-75.7496	Property Damage Only
0	45.4368	-75.6598	Property Damage Only
0	45.3011	-75.7066	Property Damage Only

BEFORE

AFTER



INVESTIGATING OUTLIERS

2013

2019

2022



STANDARDISING DATA

Anom_ID	Accident_Date	Accident_Time	Location	Geo_ID	Accident_Location	Classification
13-1	2013-05-11	4:25 PM	DONNELLY DR	ZA3R9	01 - Non intersection	03 - P.D. on
13-2				ZB0RE	01 - Non intersection	03 - P.D. on
13-3				ZA41JB	01 - Non intersection	03 - P.D. on
13-4				3617	02 - Intersection relat	03 - P.D. on
13-5				ZAZP6	01 - Non intersection	03 - P.D. on
13-6				IQ7LI	01 - Non intersection	03 - P.D. on
13-7				2031	02 - Intersection relat	03 - P.D. on
13-8				ZA2W5	01 - Non intersection	03 - P.D. on
13-9				2120	03 - At intersection	02 - Non-fat
13-10				ZA7Y2	04 - At/near private d	03 - P.D. on
13-11				ZA289	01 - Non intersection	03 - P.D. on
13-12				ZAY8M	01 - Non intersection	03 - P.D. on
13-100				ZA3R7	04 - At/near private d	03 - P.D. on
13-1000				ZA6LM	01 - Non intersection	03 - P.D. on
13-10000				2358	02 - Intersection relat	03 - P.D. on
13-10001				ZA3SN	01 - Non intersection	03 - P.D. on
13-10002				ZA35F	01 - Non intersection	03 - P.D. on
13-10003				10859	03 - At intersection	03 - P.D. on
13-10004				2114	03 - At intersection	03 - P.D. on
13-10005				ZA2YW	01 - Non intersection	03 - P.D. on
13-10006				ZAA56	04 - At/near private d	03 - P.D. on
13-10007				ZA2R8	01 - Non intersection	03 - P.D. on
13-10008				10851	02 - Intersection relat	02 - Non-fat
13-10009				6Q260	01 - Non intersection	03 - P.D. on
13-1001				2358	03 - At intersection	02 - Non-fat
13-10010						

A	B	C	D	E	F
Accident_ID	Accident_Time	Location	Location_Type	Num_of_Vehicle	Num_of_Pedestrians
2013-6291				2	0
2013-6694				2	0
2013-6898				2	0
2013-7079				2	0
2013-7077				2	0
2013-7126				2	0
2013-7315				2	0
2013-7512				2	0
2013-7589				2	0
2013-7688				2	0
2013-7720				2	0
2013-7721				2	0
2013-7722				2	0
2013-7893				2	0
2013-7986				2	0
2013-8929				2	0
2013-9025				2	0
2013-9358				2	0
2013-9475				2	0
2014-6482				2	0
2014-6615				2	0
2014-6668				2	0
2014-6669				2	0
2014-6718				2	0
2014-6950				2	0
2014-6947				2	0
2014-6949				2	0
2014-7183				2	0

BEFORE

AFTER

DATA ANALYSIS PROCESS

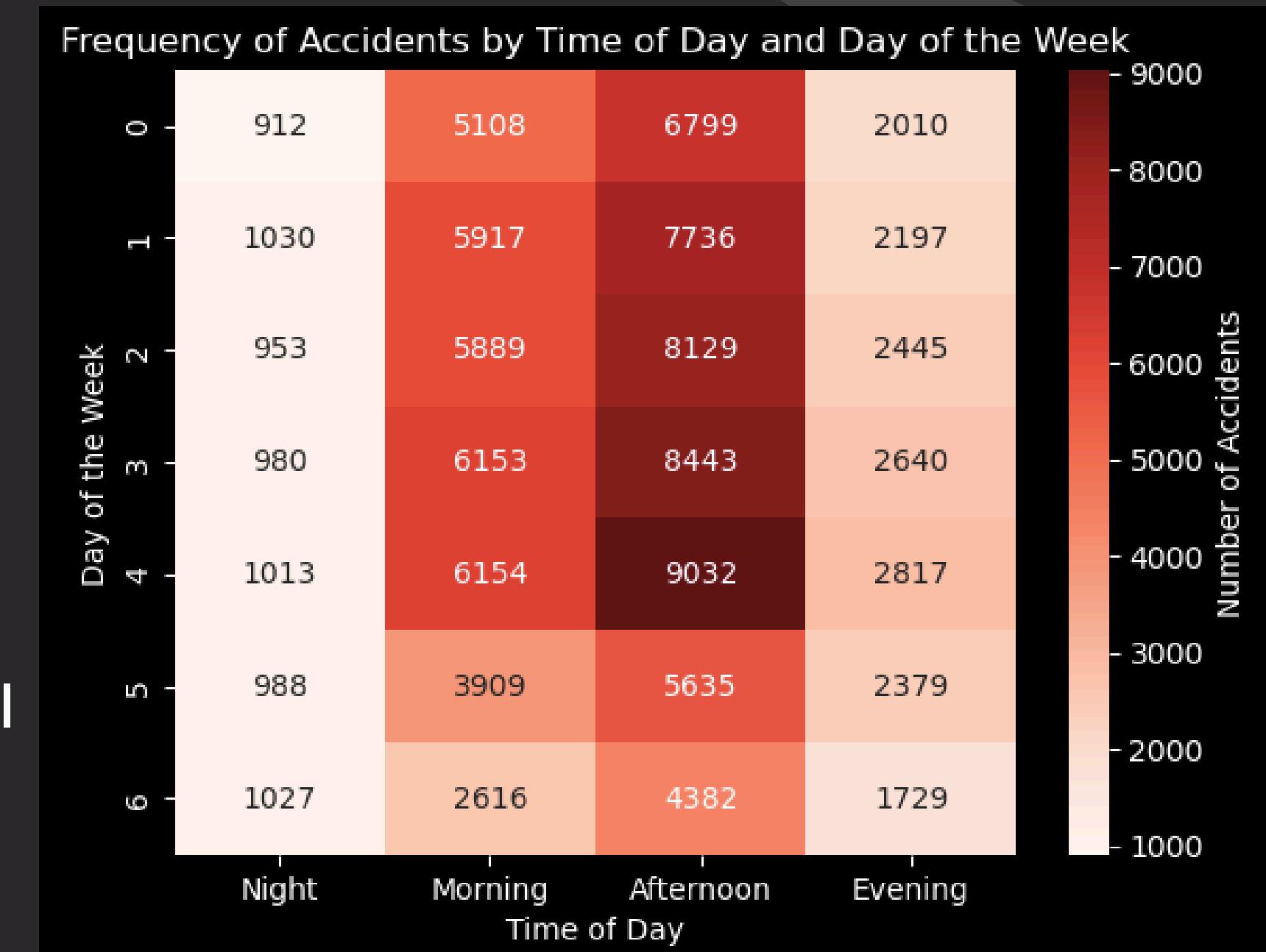
Final Dataset:

- 24,012 Total Injuries & Fatalities
- 124225 Total Rows (Collisions)
- 58 Total Columns
 - 13 Categorical
 - 37 Numeric
 - 9 Flags

Step 1 → Exploratory Analysis in Python

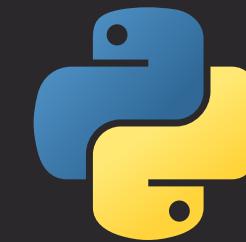
Step 2 → Deep Descriptive Analysis Power BI

Step 3 → Identify Key Influencing Factors
& Visualize Their Impact





DATA VISUALIZATION



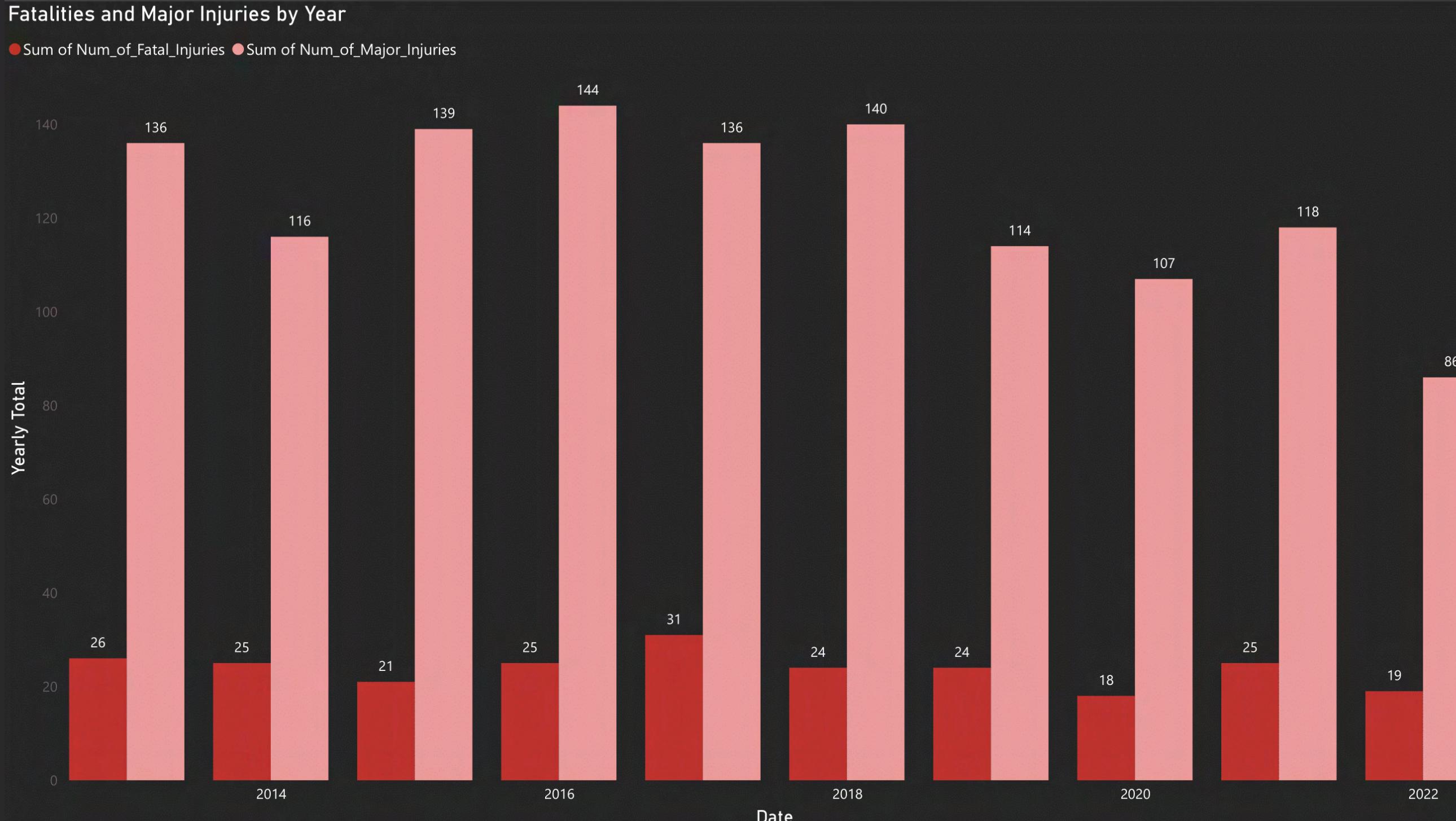
python™

Power BI



INITIAL INSIGHTS

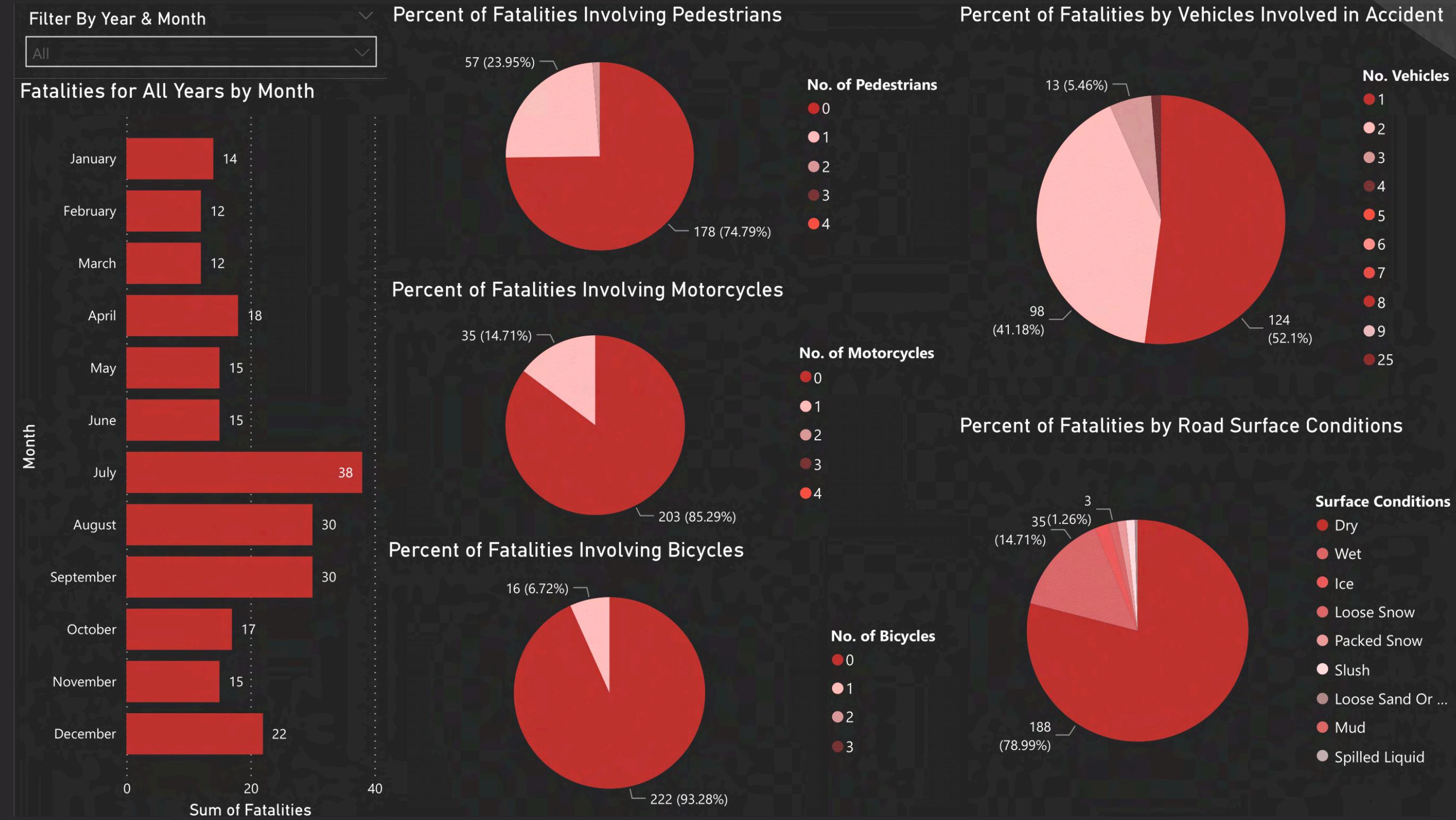
Injuries & Fatalities Overview





INITIAL INSIGHTS

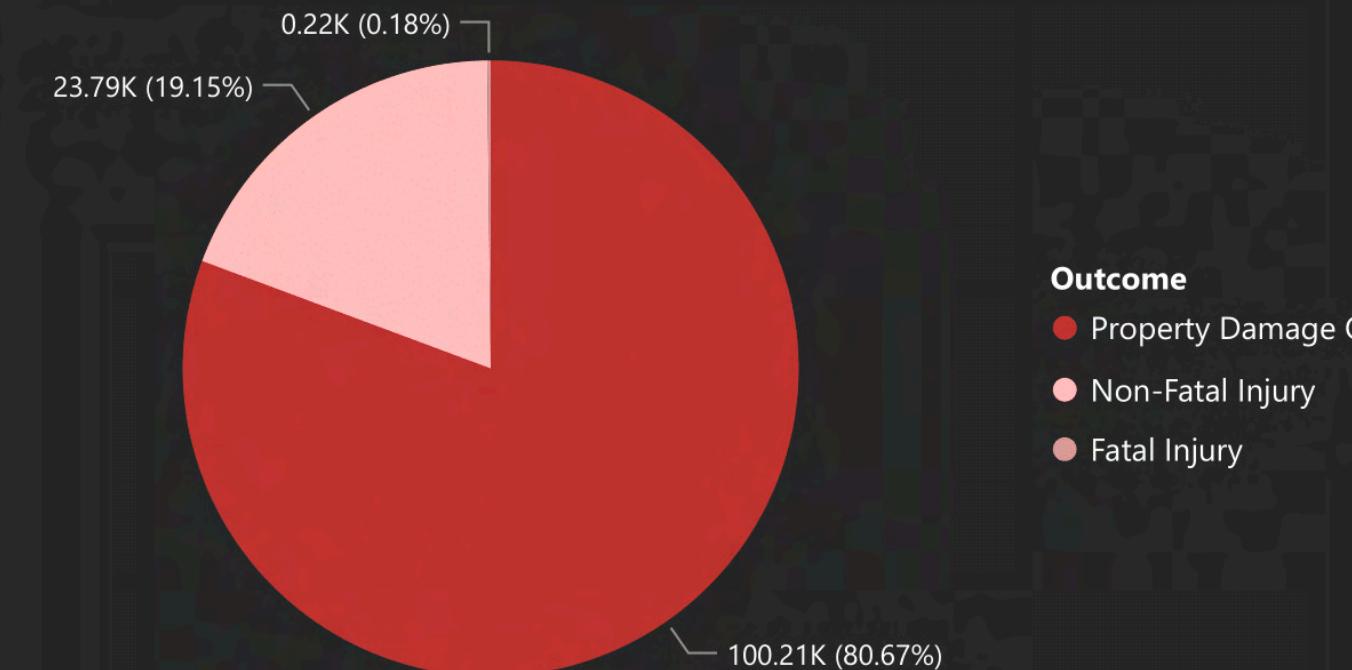
Who is Involved



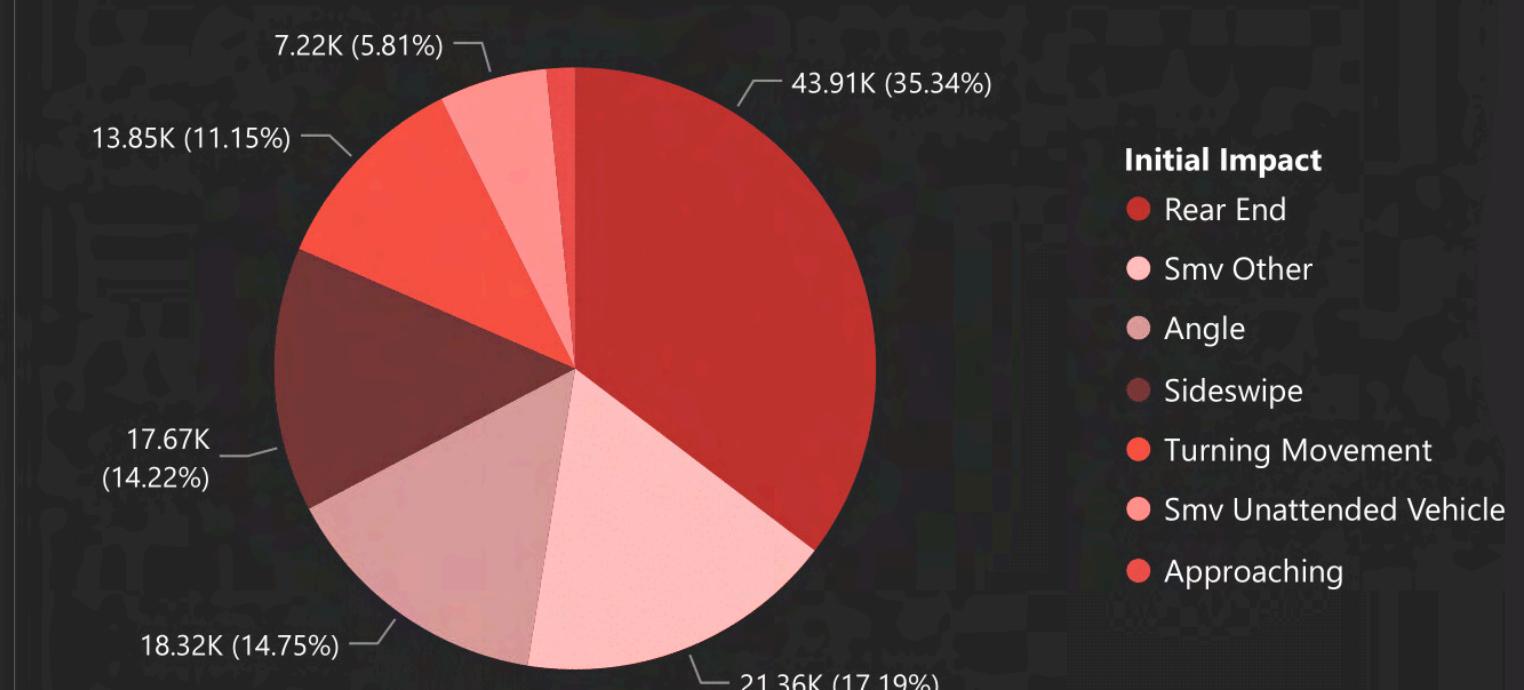
INITIAL INSIGHTS

Big Picture

Classification of Accidents by Outcome Severity



Classification of Accidents by Impact Type



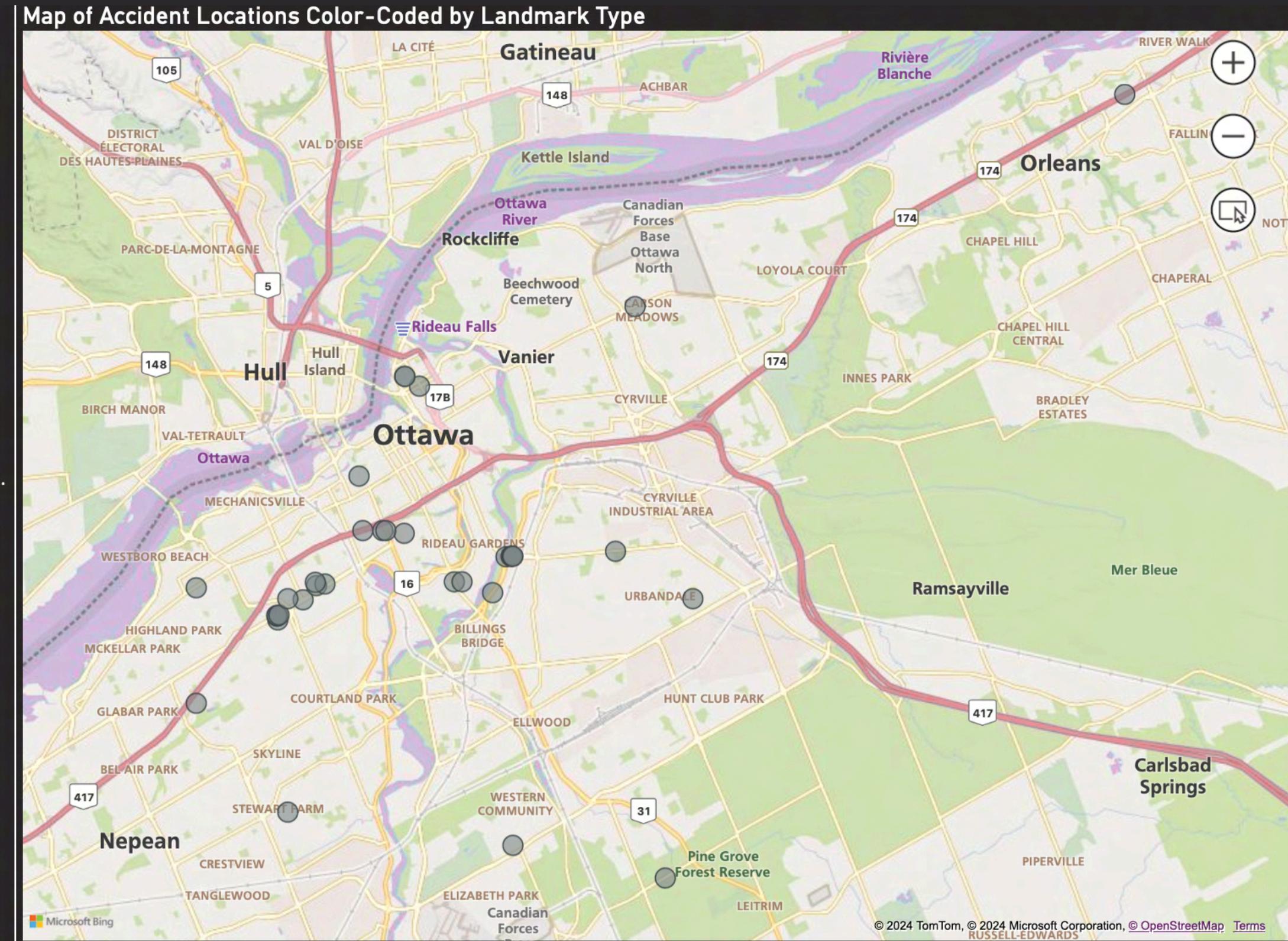
- Initial Impact**
- Rear End
 - Smv Other
 - Angle
 - Sideswipe
 - Turning Movement
 - Smv Unattended Vehicle
 - Approaching



DEEP ANALYSIS FINDINGS

Finding Problem Areas

- Landmark Type**
- Select all
 - Transit Stations and Park & Rides
 - Airports
 - Arenas
 - Authorized bus ticket outlets
 - Beaches
 - Cemetaries
 - Cinemas and Theatres
 - City Service Centres
 - Civic and Tourism
 - Colleges and Universities
 - Community Centre and Recreation...
 - Correctional Facilities
 - Day Care Centres and Nurseries
 - Elementary Schools
 - Embassies & High Commissions
 - Events
 - Fast food restaurants
 - Fire Stations
 - Funeral homes
 - Hospitals
 - Hotels
 - Libraries
 - Medical Clinics

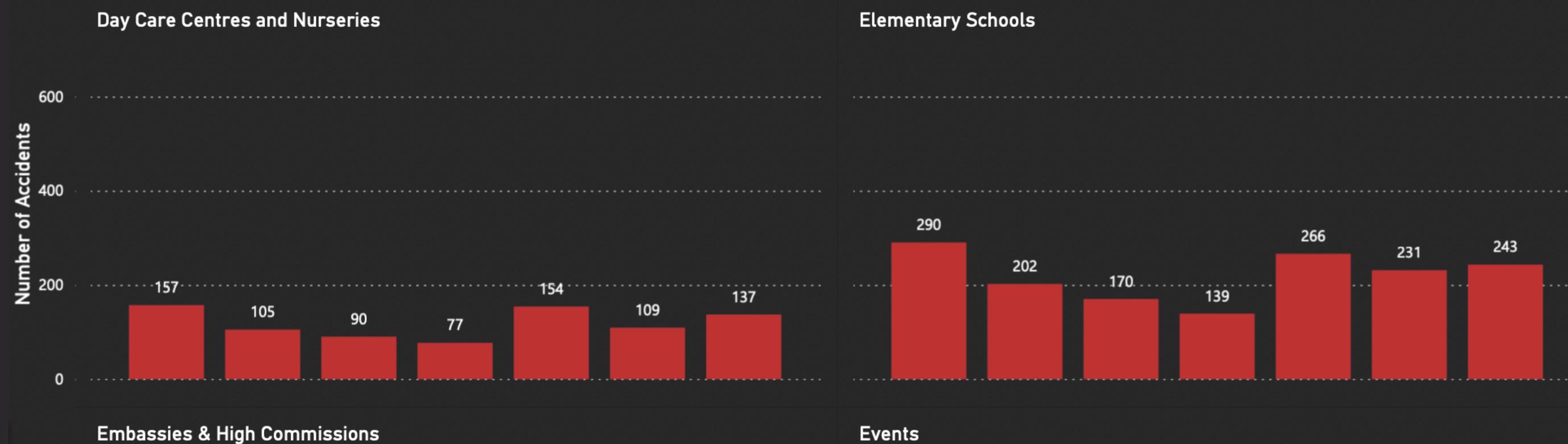
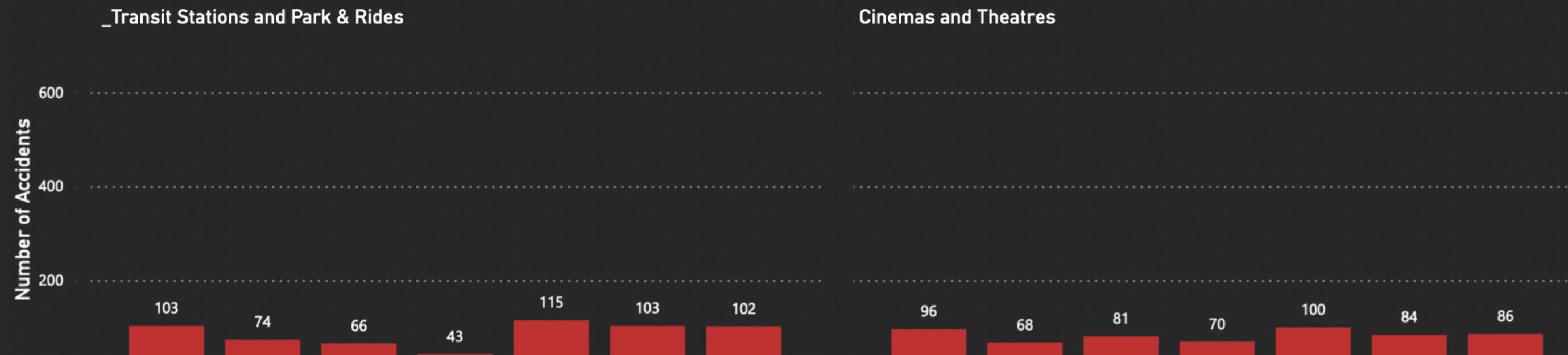




DEEP ANALYSIS FINDINGS

Nearby Landmarks

Weekly Analysis of Accident Frequency by Landmark Type

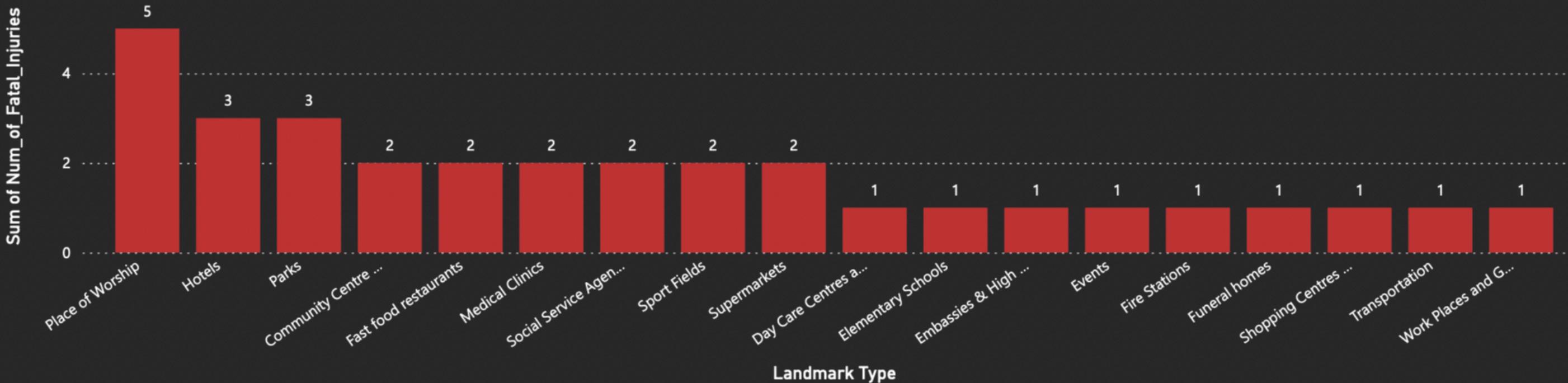




DEEP ANALYSIS FINDING

Landmarks Associated with Major Injuries and Fatalities

Number of Fatal Injuries by Landmark Type



Number of Pedestrians Involved in Accidents by Landmark Type



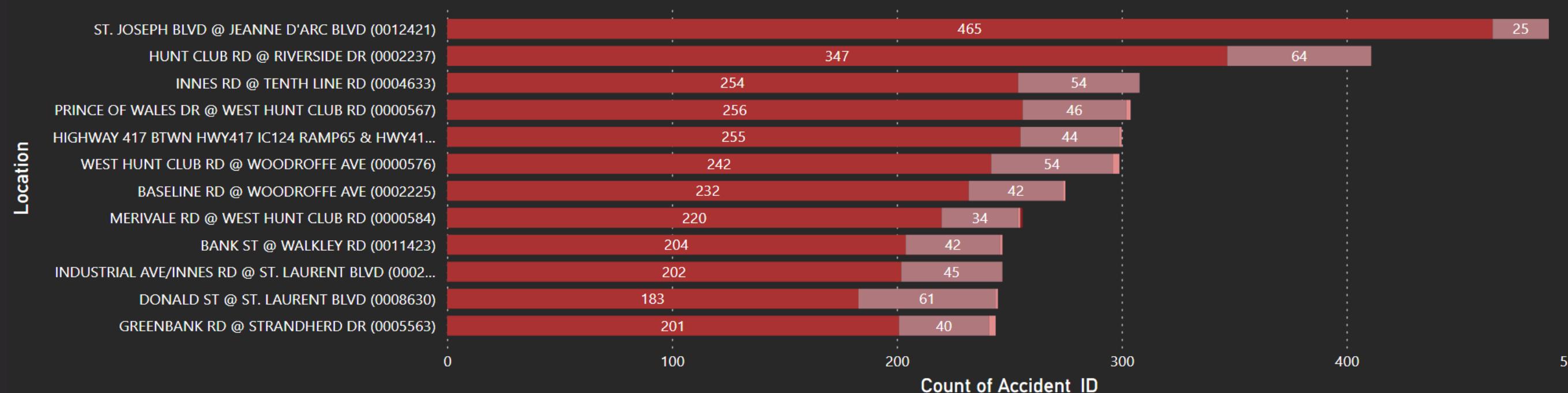


DEEP ANALYSIS FINDINGS

Injuries and Fatalities at Problem Locations

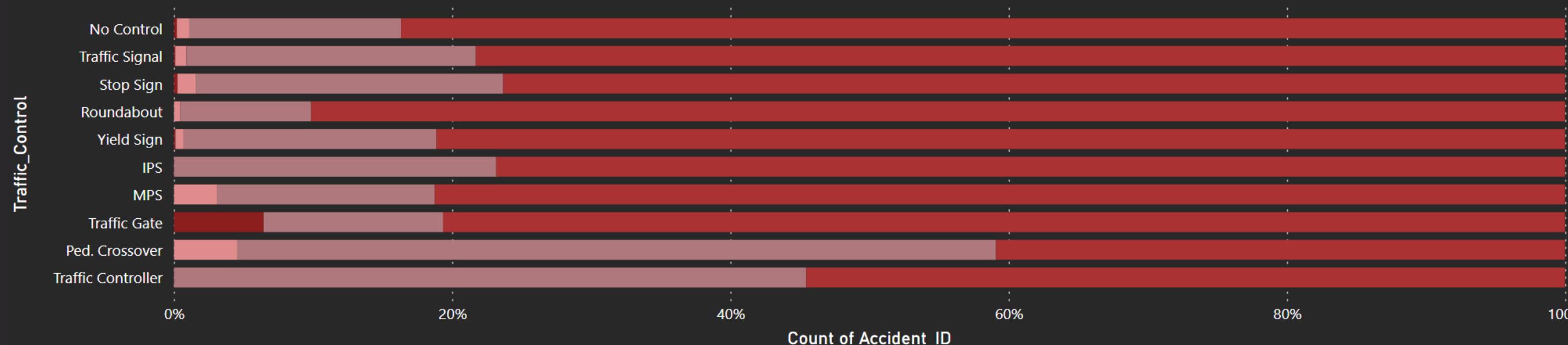
Count of Accident_ID by Location and Collision_Outcome

Collision_Outcome ● Fatal Injury ● Major Injury ● Minor/Minimal Injury ● Property Damage Only



Count of Accident_ID by Traffic_Control and Collision_Outcome

Collision_Outcome ● Fatal Injury ● Major Injury ● Minor/Minimal Injury ● Property Damage Only

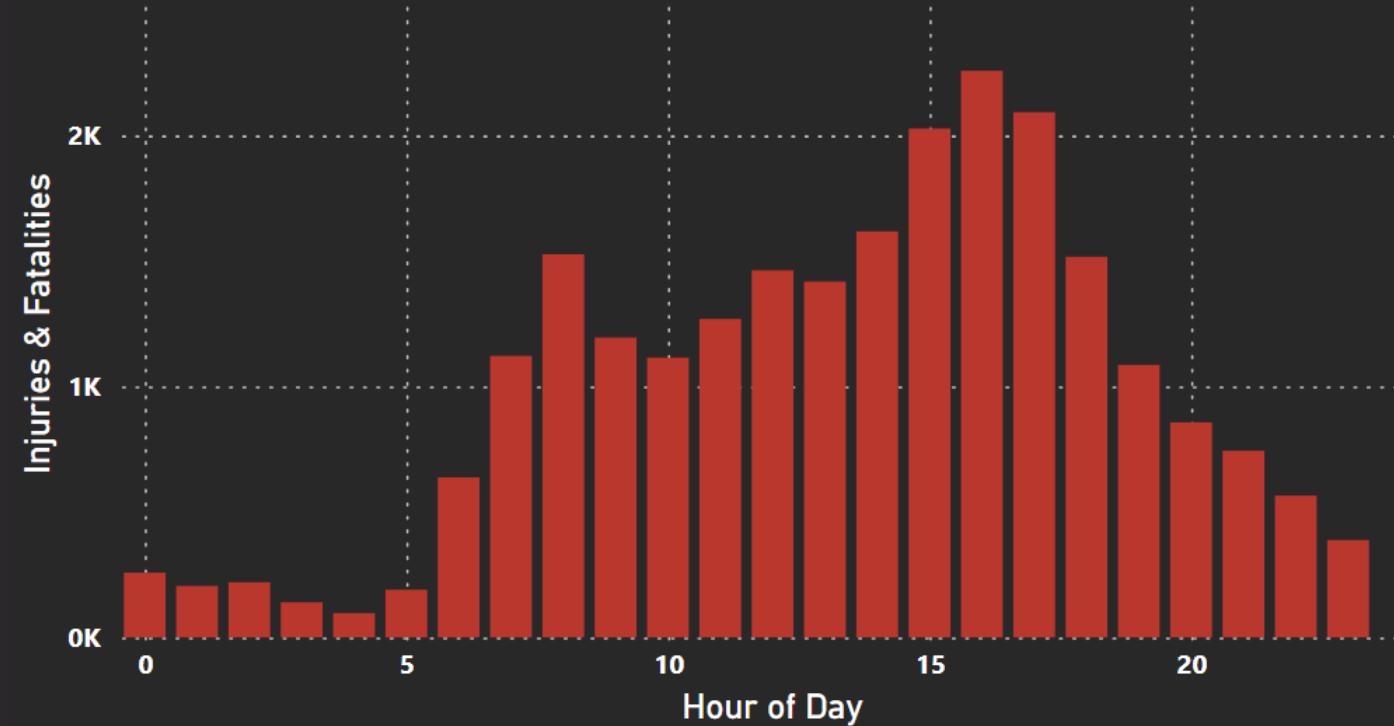




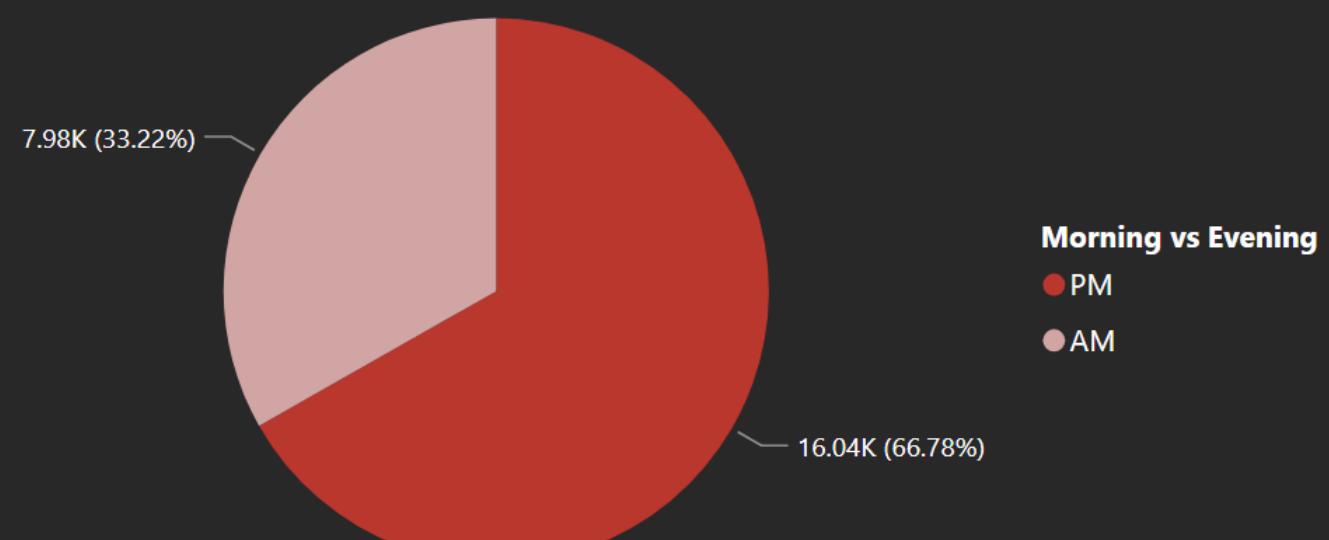
UNEXPECTED INSIGHTS

Time of Fatalities

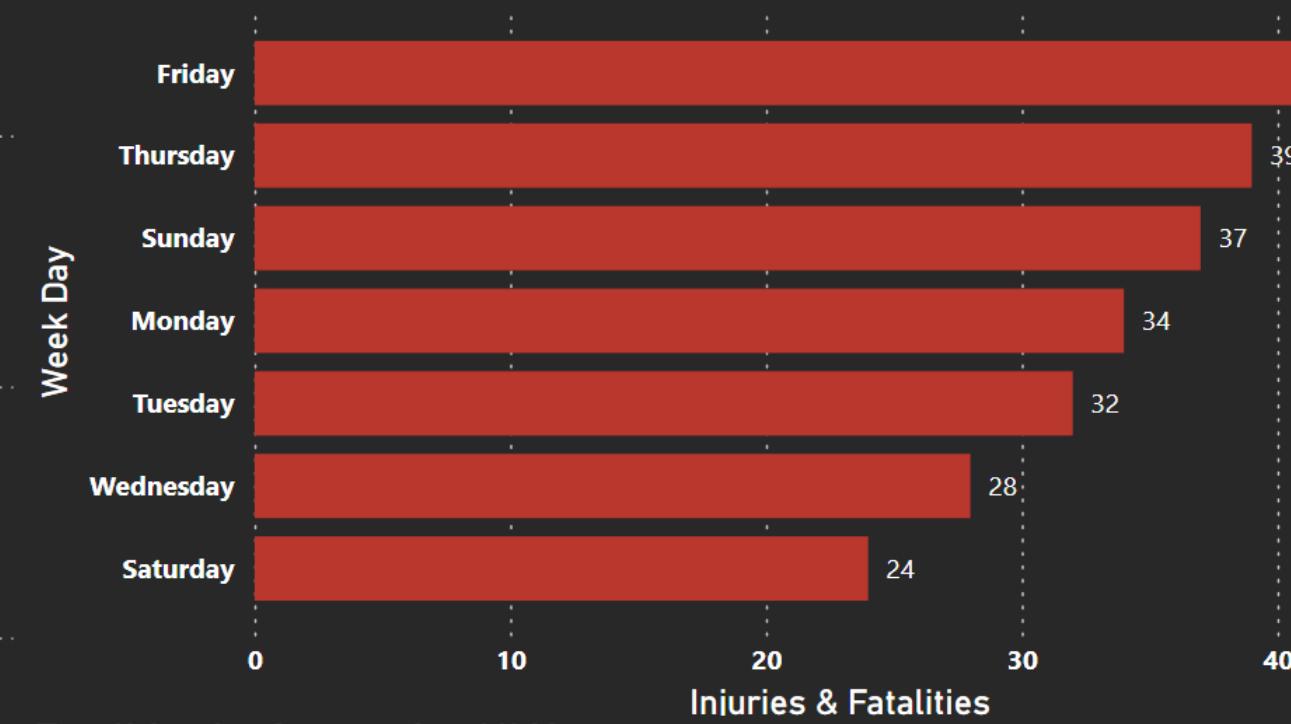
All Years Injuries and Fatalities by Time of Day



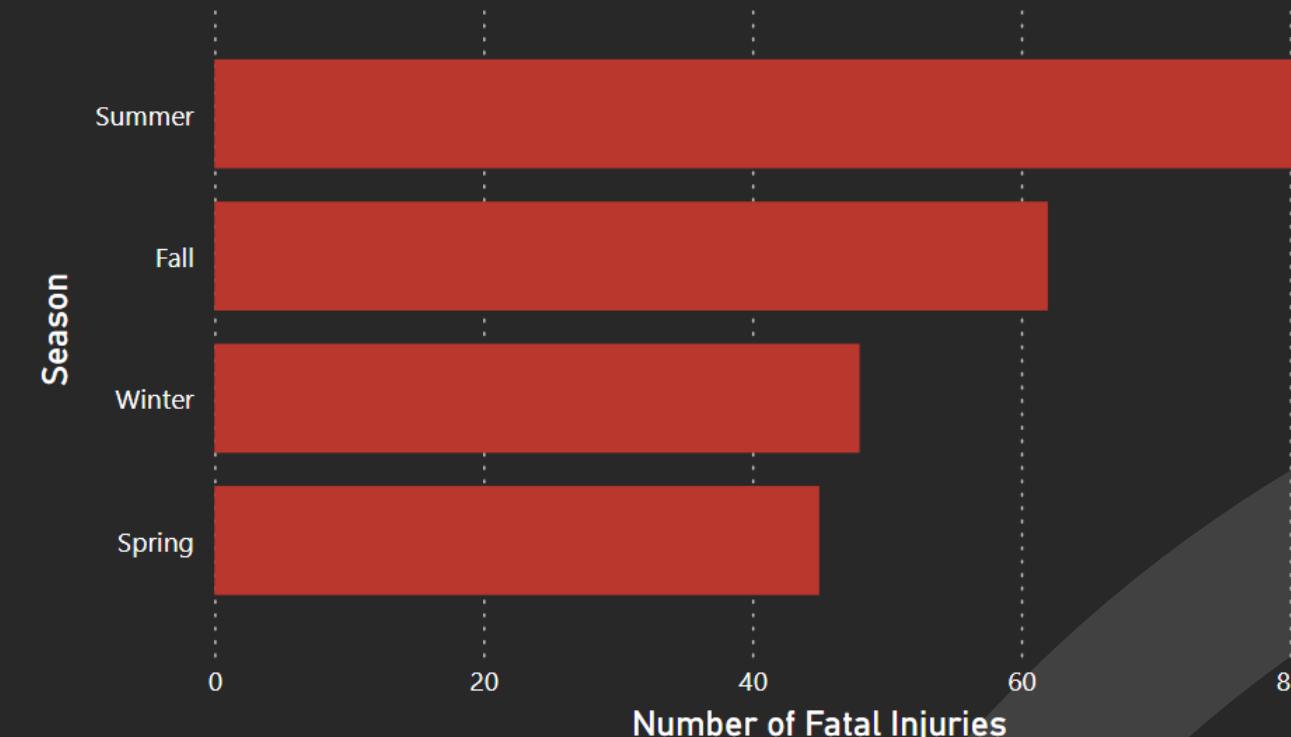
Major Injuries and Fatalities - Morning vs Evening



Weekday Injuries and Fatalities for All Years



Fatalities by Season for All Years



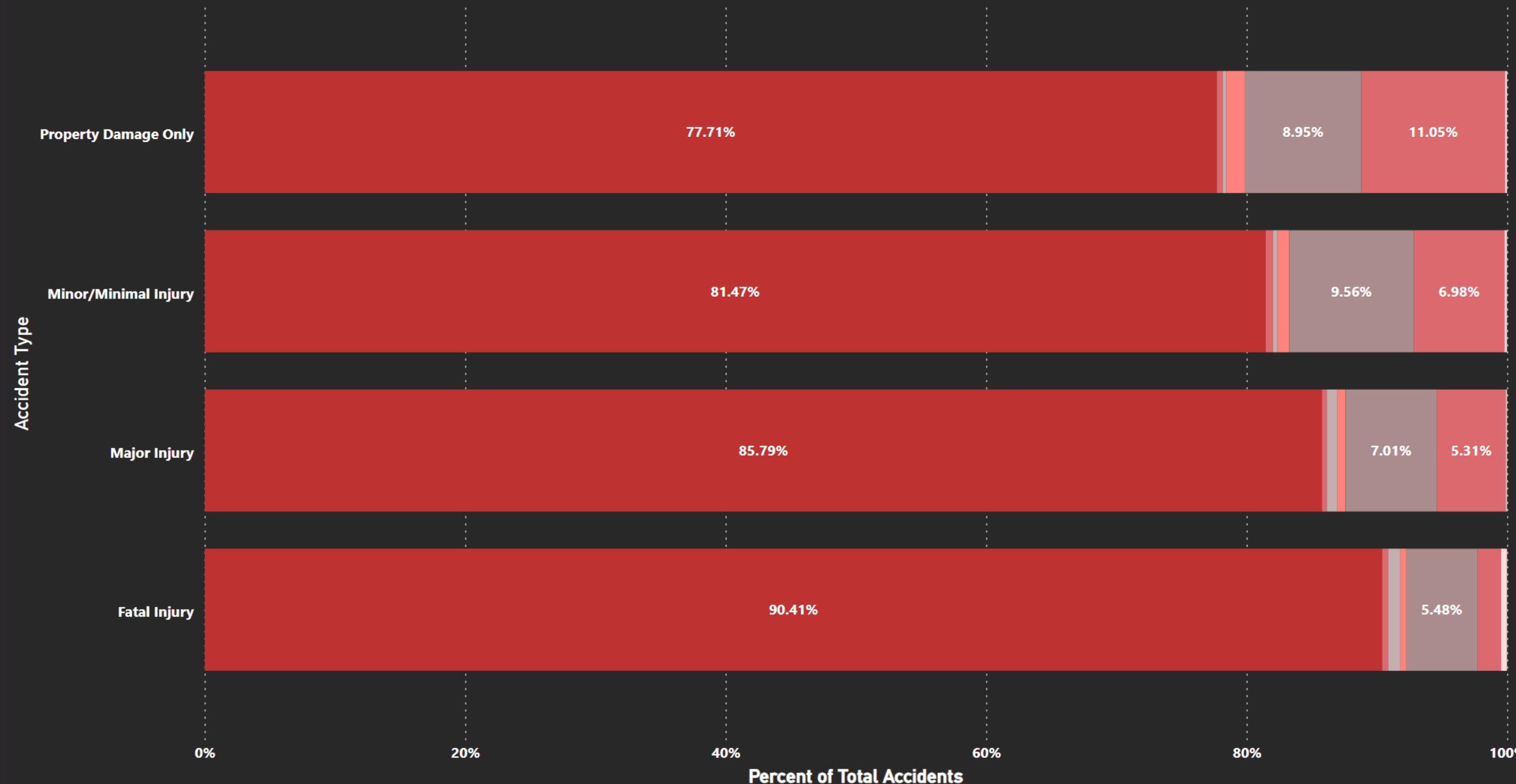


UNEXPECTED INSIGHTS

Fatalities & Clear Weather

Weather Conditions for All Accidents Divided by Severity of Outcomes

Weather Condition ● Clear ● Drifting Snow ● Fog, Mist, Smoke, Dust ● Freezing Rain ● Rain ● Snow ● Strong Wind

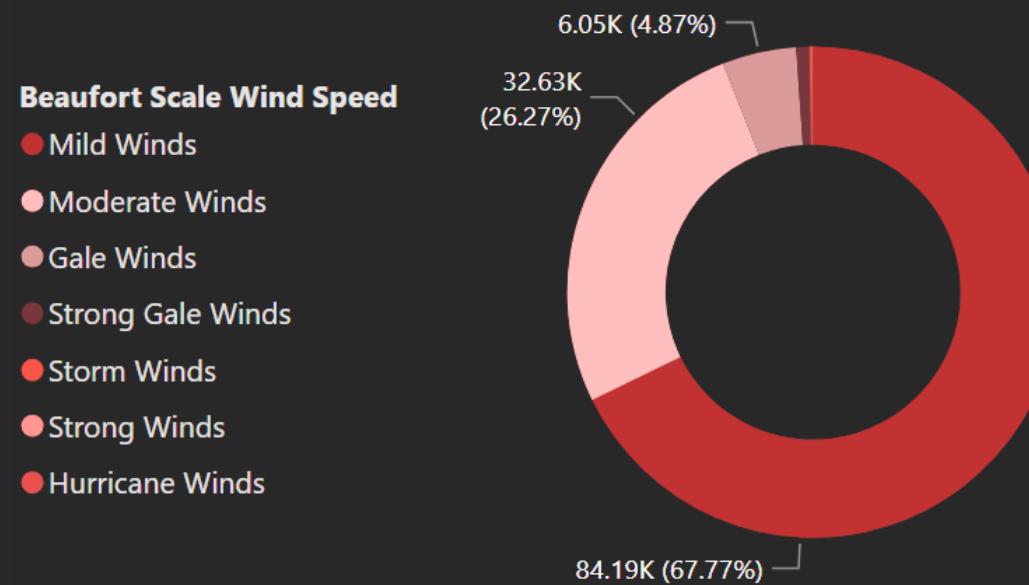




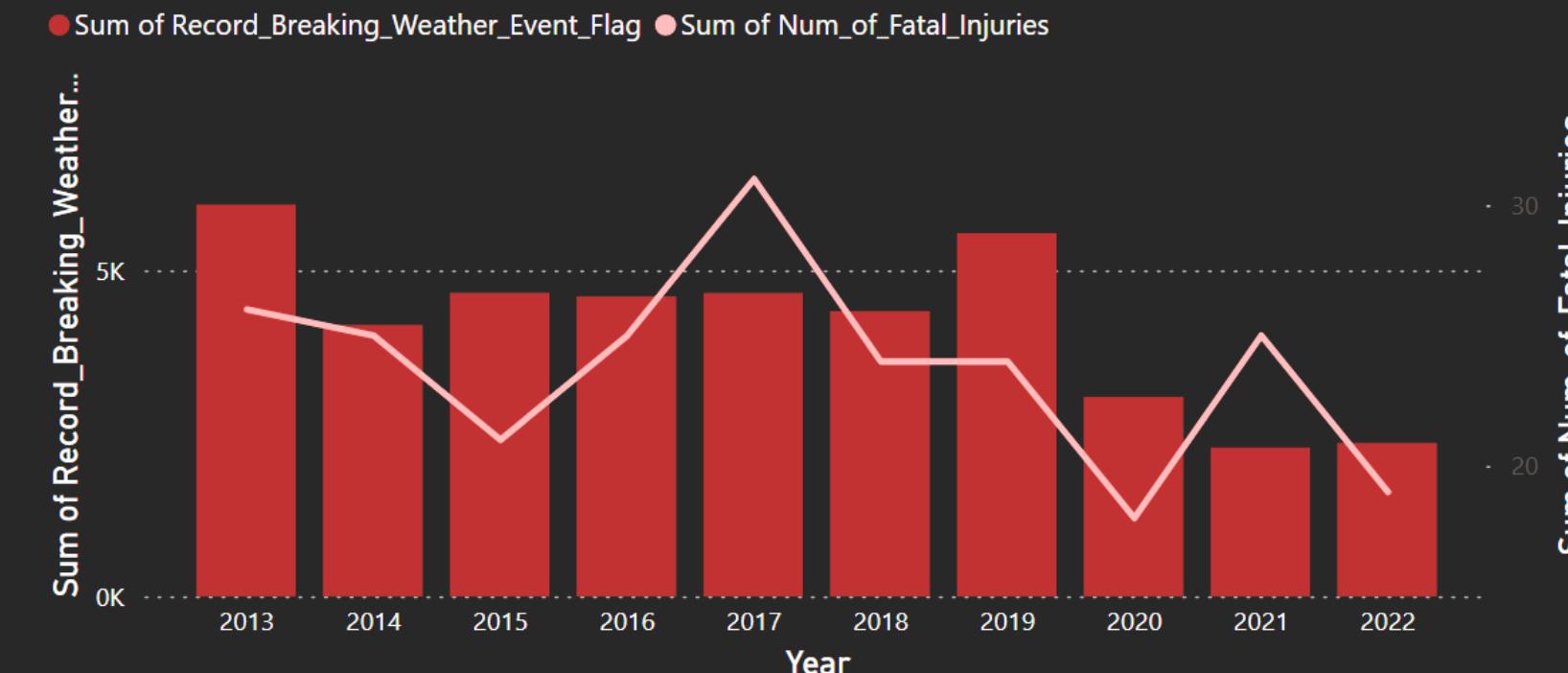
UNEXPECTED INSIGHTS

Weather

Wind Conditions Experienced During All Accidents

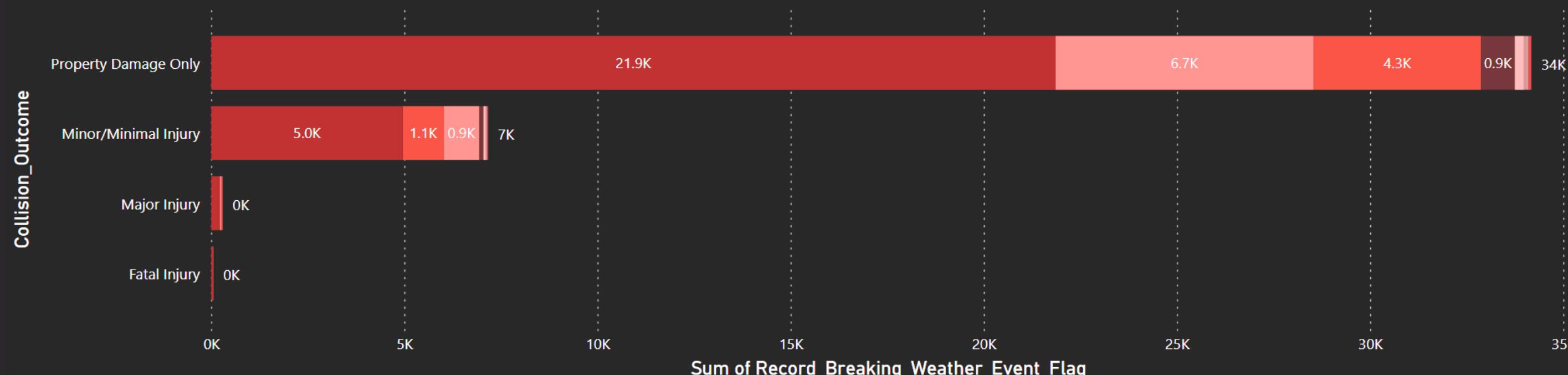


Count of Total Accidents & Fatalities on Days With Record Breaking Weather



Sum of Record_Breaking_Weather_Event_Flag by Collision_Outcome and Environment_Condition

Environment_Condition ● Clear ● Drifting Snow ● Fog, Mist, Smoke, Dust ● Freezing Rain ● Rain ● Snow ● Strong Wind





UNEXPECTED INSIGHTS

Impact of the Pandemic

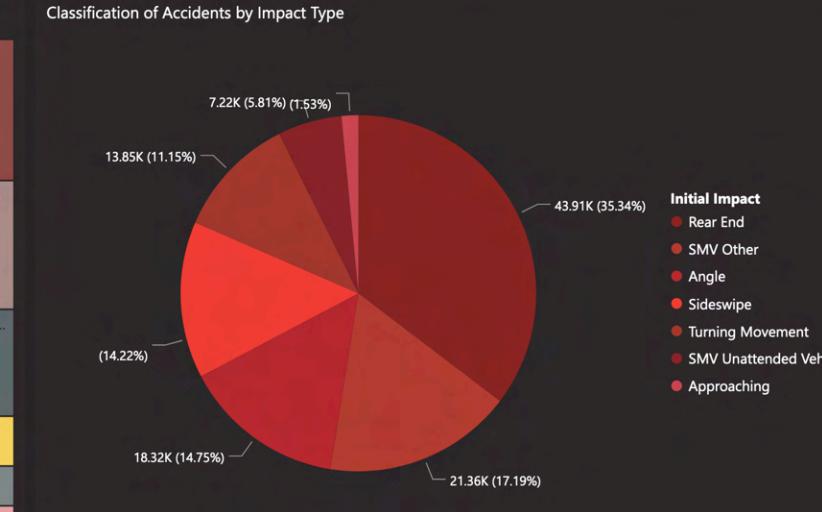
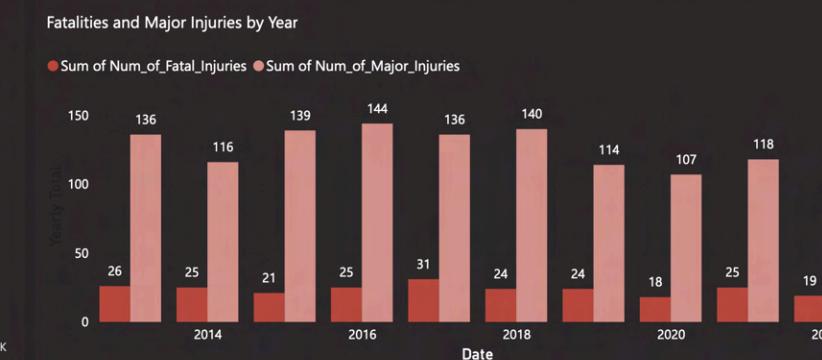




TRAFFIC COLLISION ANALYSIS DASHBOARD

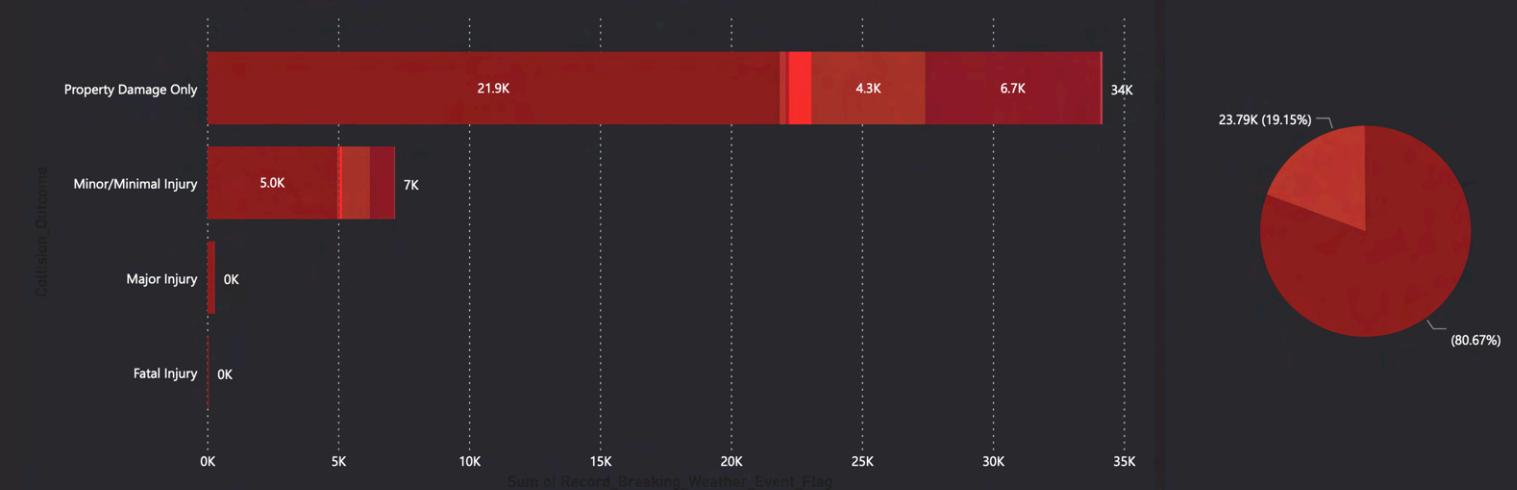
The Crossroads of Safety

A Visual Data Analysis Exploring the Influence of Environmental Factors on the Severity of Ottawa's Traffic Collision

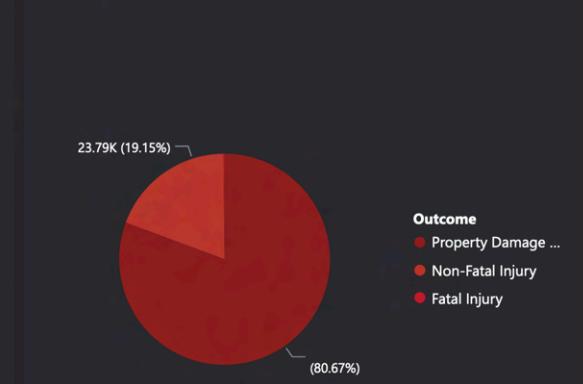


Sum of Record-Breaking Weather Event Flags by Collision Outcome and Environment Condition

Environment_Condition ● Clear ● Drifting Snow ● Fog, Mist, Smoke, Dust ● Freezing Rain ● Rain ● Snow ● Strong Wind

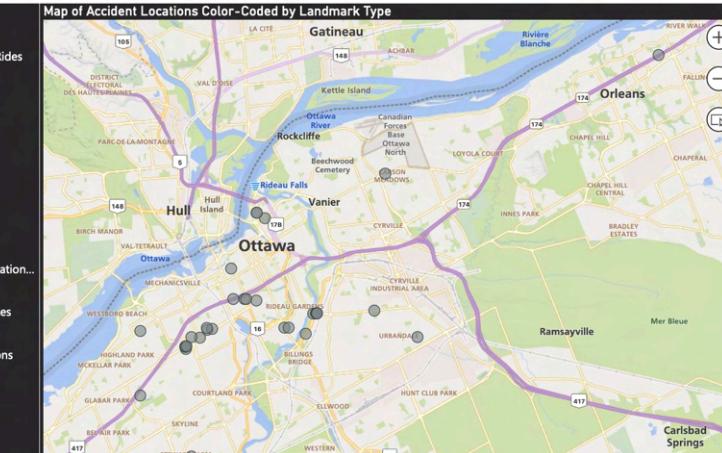


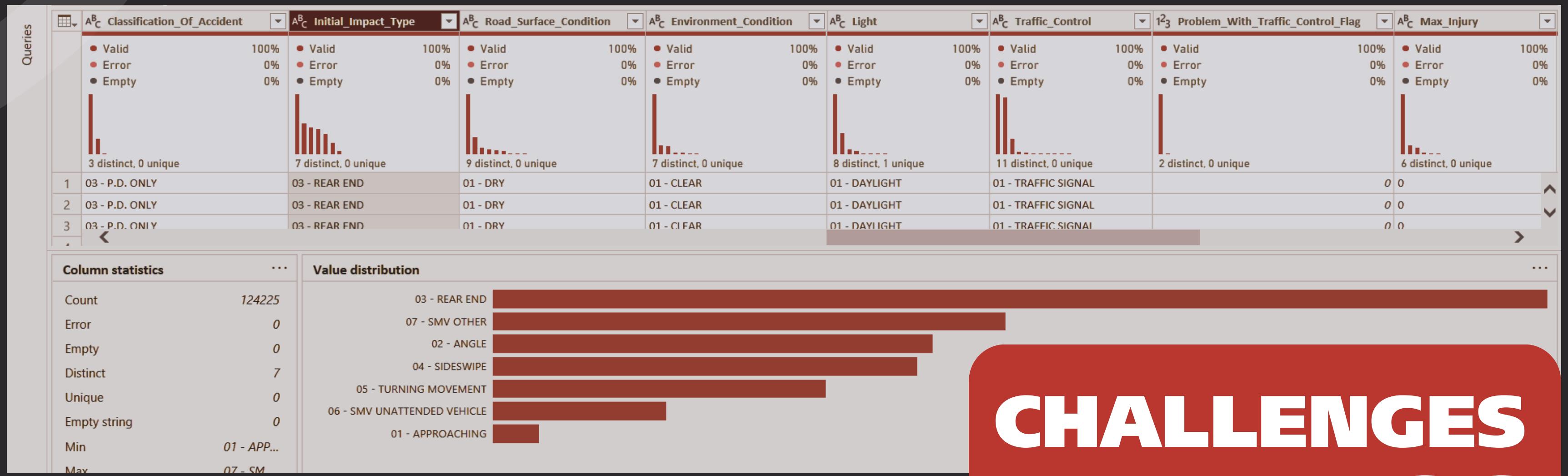
Classification of Accidents by Outcome Severity



Collision Analysis Dashboard
PAGE 10

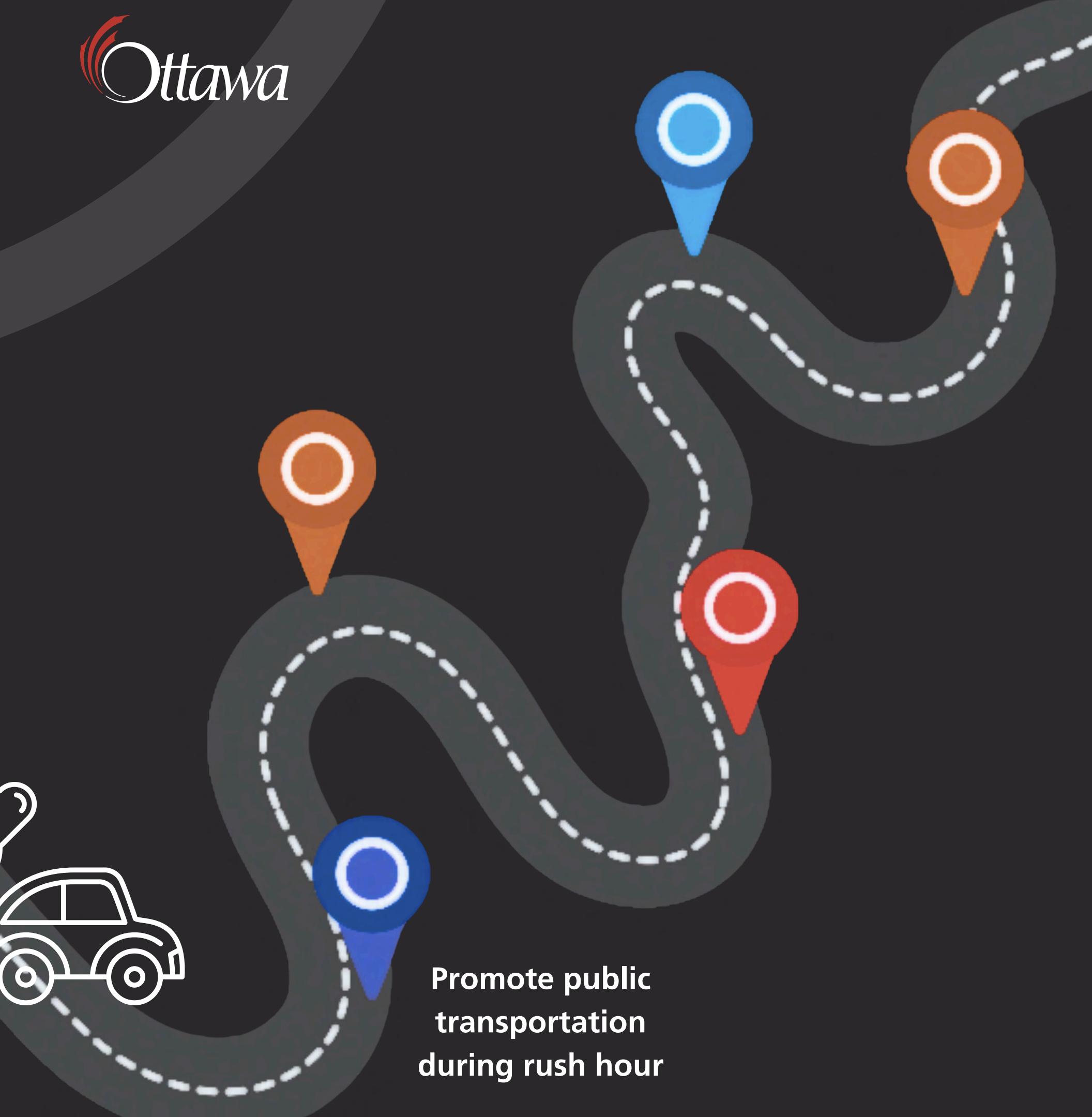
- Landmark Type
- Select all
 - Transit Stations and Park & Rides
 - Airports
 - Arenas
 - Authorized bus ticket outlets
 - Beaches
 - Cemetaries
 - Cinemas and Theatres
 - City Service Centres
 - Civic and Tourism
 - Colleges and Universities
 - Community Centre and Recreation...
 - Correctional Facilities
 - Day Care Centres and Nurseries
 - Elementary Schools
 - Embassies & High Commissions
 - Events
 - Fast food restaurants
 - Fire Stations
 - Funeral homes





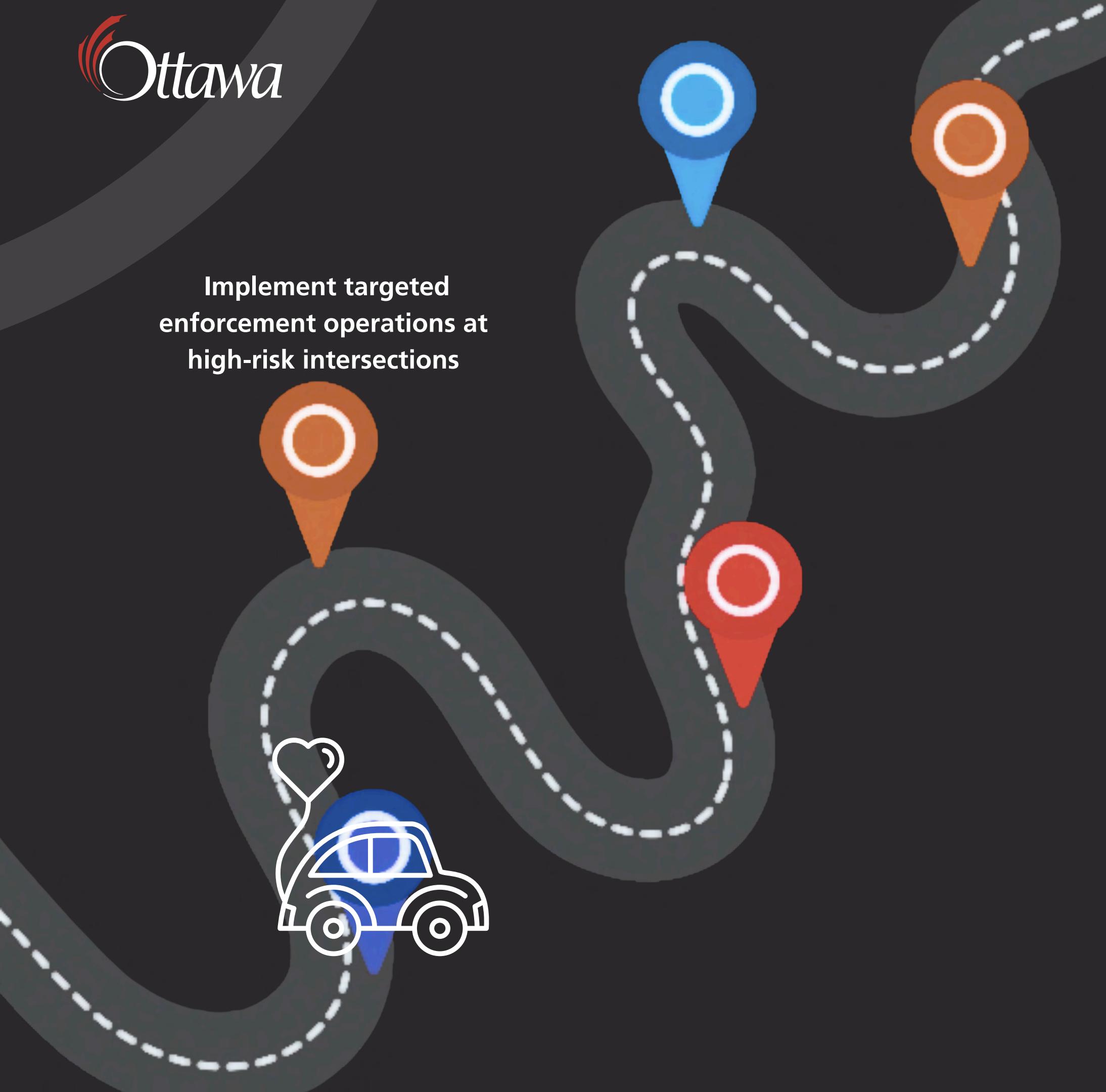
CHALLENGES IN ANALYSIS

-  **Data Overload** → too many parameters = model confusion
-  **Target Variables** → how to predict all forms of negative outcomes
-  **Reduce Noise** → must narrow down scope of analysis to improve model performance
-  **Finding Balance** → how to retain depth of detail while filtering out irrelevant columns



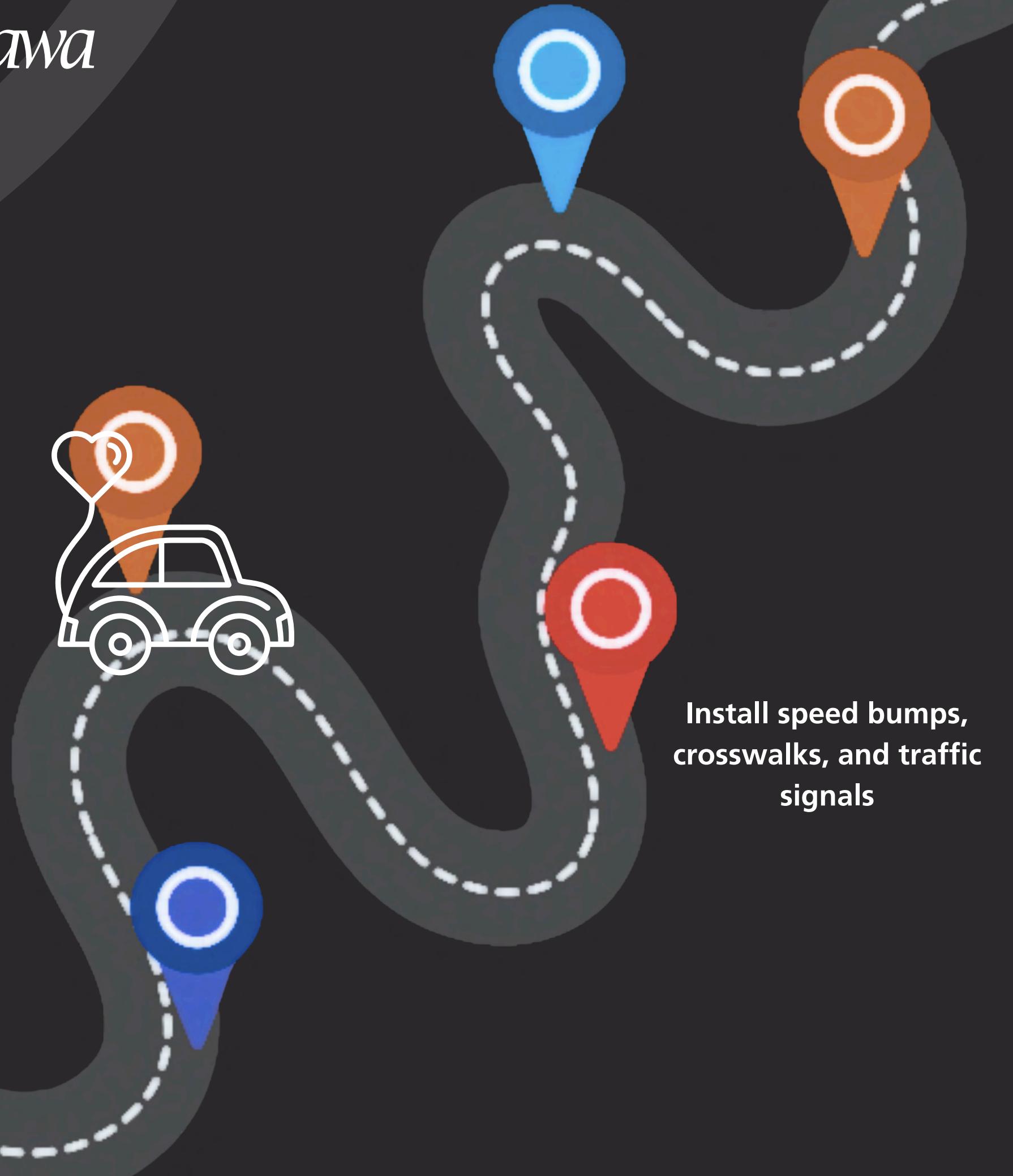
Driving Towards Safety: A Data Driven Approach to Collision Reduction in Ottawa

Promote public
transportation
during rush hour

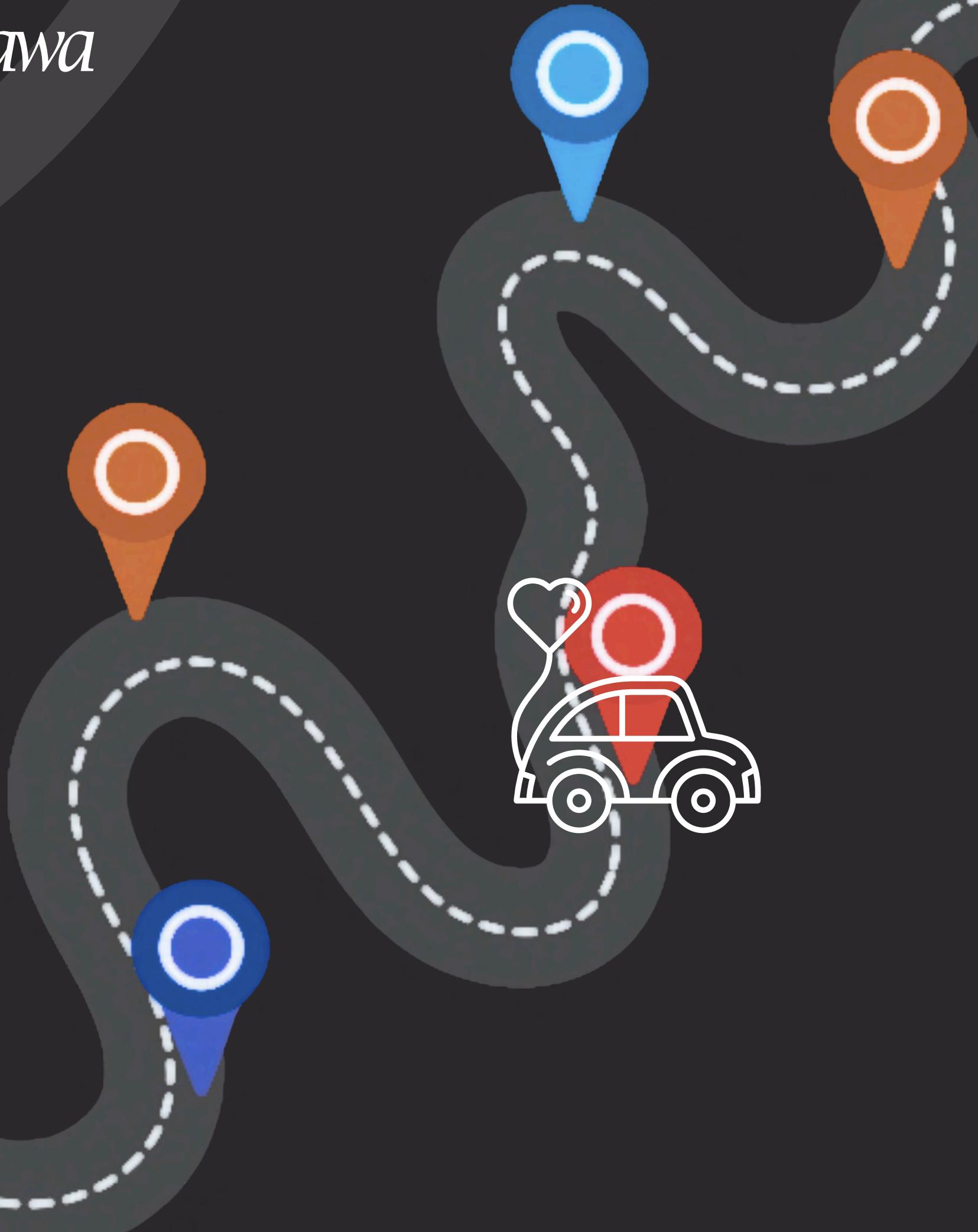


Implement targeted enforcement operations at high-risk intersections

Driving Towards Safety: **A Data Driven Approach to Collision Reduction in Ottawa**



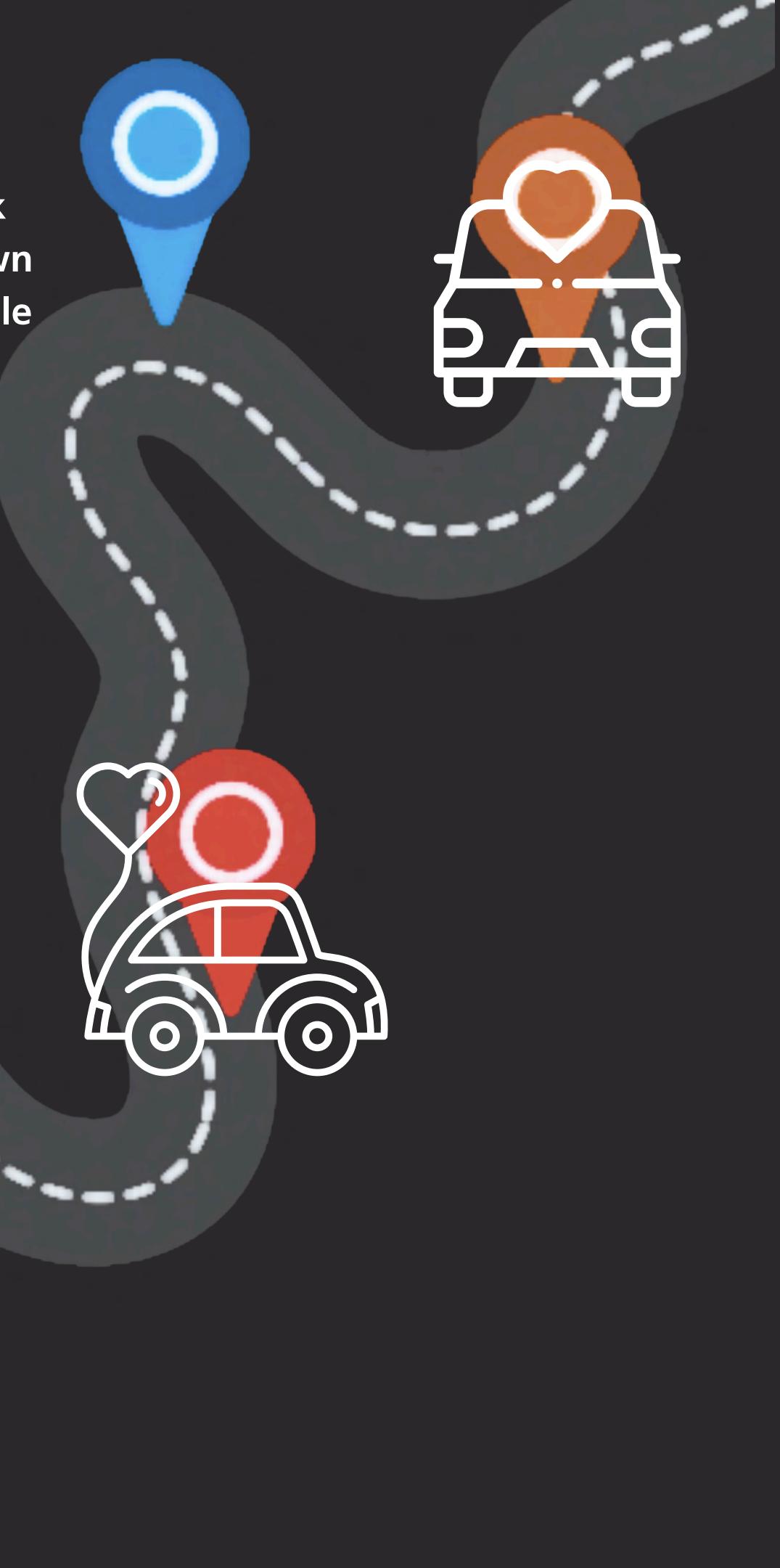
Driving Towards Safety: A Data Driven Approach to Collision Reduction in Ottawa



Improving bike lanes
and educating both
drivers and cyclists on
safe road sharing

Driving Towards Safety: A Data Driven Approach to Collision Reduction in Ottawa

Prioritize midblock
crossings, countdown
timers, and accessible
signals



Driving Towards Safety: A Data Driven Approach to Collision Reduction in Ottawa

Prioritize midblock crossings, countdown timers, and accessible signals

Implement targeted enforcement operations at high-risk intersections



Improving bike lanes and educating both drivers and cyclists on safe road sharing

Install speed bumps, crosswalks, and traffic signals

Promote public transportation during rush hour

STAY SAFE

