GIS Based Traffic Safety Analysis for Identification of High Collision Locations in the City of Regina Road Network

Asma Chowdhury

Environmental Systems Engineering, University of Regina

Kwei Quaye, PhD, PEng.

Traffic Safety and Driver Services, Saskatchewan Government Insurance

University of Regina | Faculty of Engineering and Applied Science

ite REGINA 2015 JUNE 7-10 Supporting a Healthy Vibrant Community

INTRODUCTION

- Regina, the capital city of Saskatchewan, is the eighteenth largest city of Canada by population. The city is the fourth fastest growing census metropolitan area in Canada.

- A total of 30,173 collisions were reported across the province of Saskatchewan by the Traffic Accident Information System of Saskatchewan Government Insurance (SGI) in 2012. Regina recorded 4,586 collisions, 1,558 injuries and 7 deaths in 2012 (TAIS Annual Report, 2013).

- In 2013, the overall collision numbers in province increased to 31,734 and Regina recorded 5,786 collisions, 1,405 injuries and 8 deaths in 2013 (TAIS Annual Report, 2014).

RESEARCH OBJECTIVE

- There is a need to understand where, when and how traffic collisions occurred to improve road safety and reduce traffic accidents in the City of Regina road network.

- By knowing where and when traffic accidents usually occur, traffic safety measures could be taken in an improved manner.

- Therefore, the objective of this study was to identify high collision road locations for the city of Regina road network using GIS and spatial data analysis.
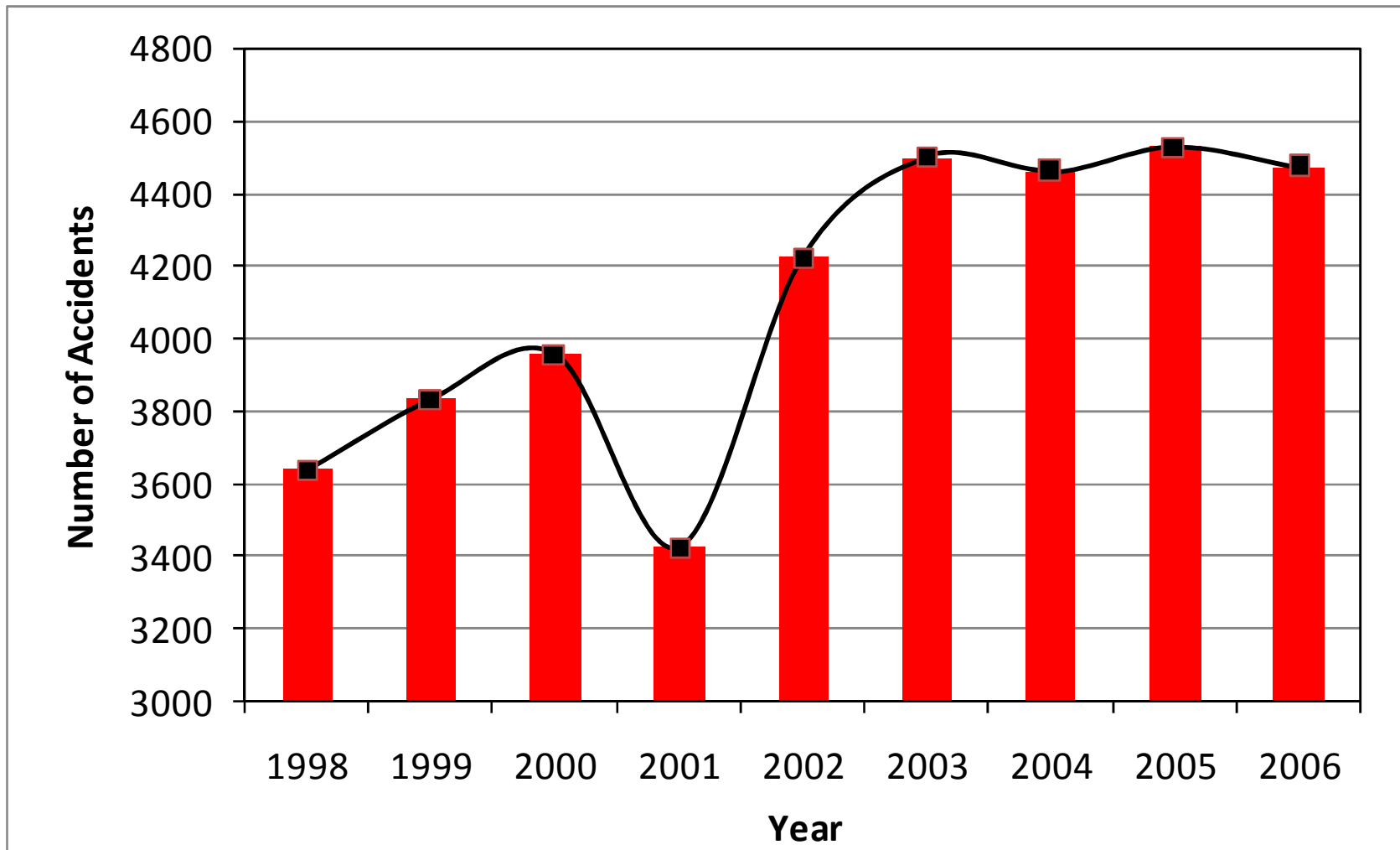
DATA COLLECTION AND PROCESSING

- This study used eight years of collision data (1998–2006) for the City of Regina. Two different databases and a traffic volume map were used for this project.

- A roadway network base map for the City of Regina (ArcGIS shapefile format) was collected from TerraServer of The Environmental Research and Response Applications (TERRA) Laboratory, University of Regina.

- A Geodatabase of collision history (1998–2006) for the City of Regina was collected from the Traffic Accident Information System (TAIS) of Saskatchewan Government Insurance (SGI).

- The annual traffic flow map was collected from the City of Regina to select high traffic volume roads in the city network.

- This research illustrates the application of GIS methods to accident analysis so the data being used is a bit dated (i.e., 1998-2006)
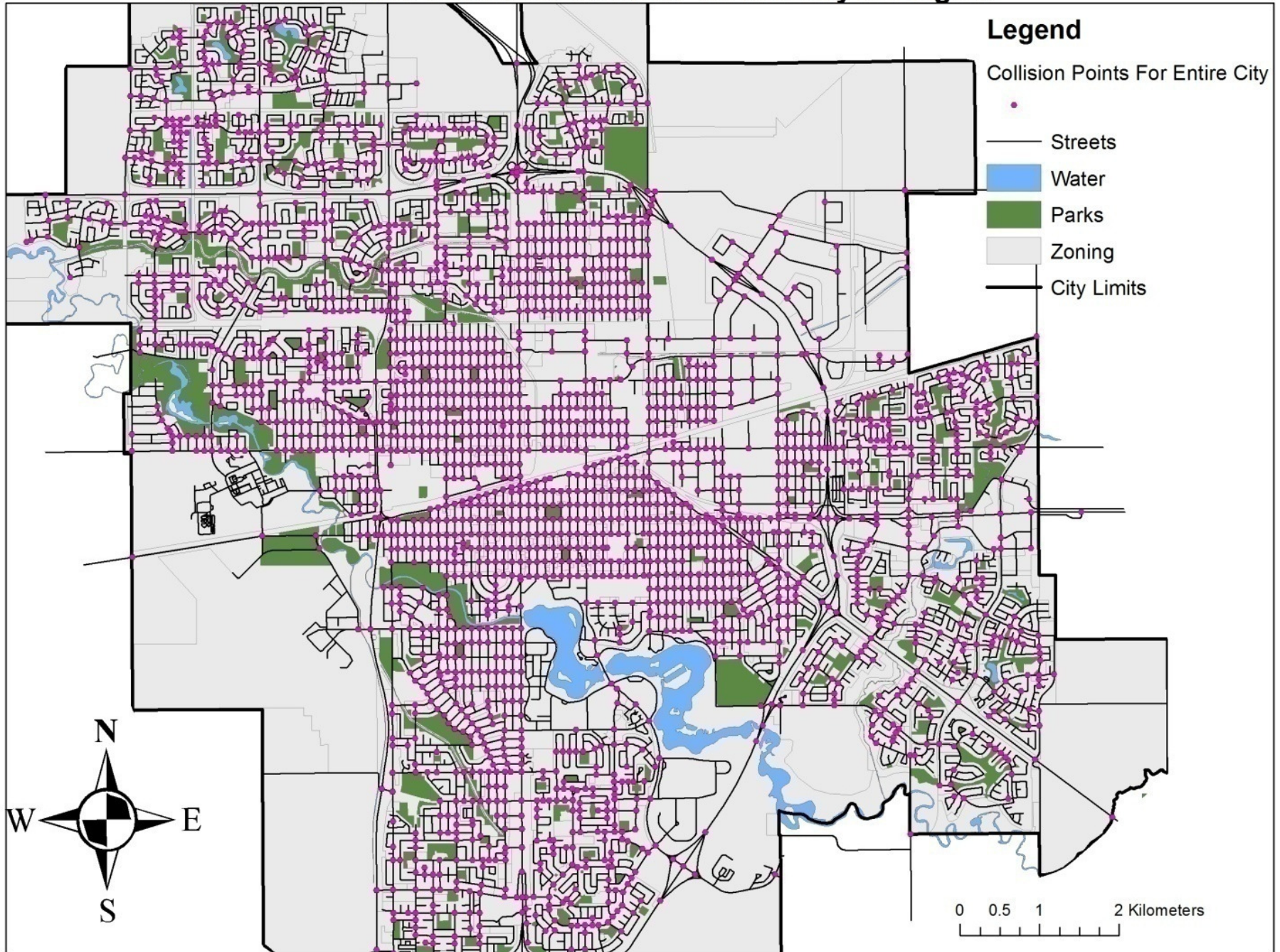
RESEARCH METHODOLOGY

- The analysis of this study was divided into two major sections.

- In the first section, initially the Spatial Analyst tools were used to identify the hot zones in the entire city for fatal collisions only, fatal and injury collisions, and total collisions.

- Subsequently, Spatial Statistics tools were used in conjunction with Kernel Density Estimation (KDE) to identify statistically significant hot spots and cold spots. KDE analysis was also conducted for day and night time collisions for the entire city.

- In the second section, the top twenty roads were selected from the city road network based on the traffic volume and the required data was reclassified accordingly.

- Finally, KDE was used to identify intersection of high collision occurrence on these selected roadways.
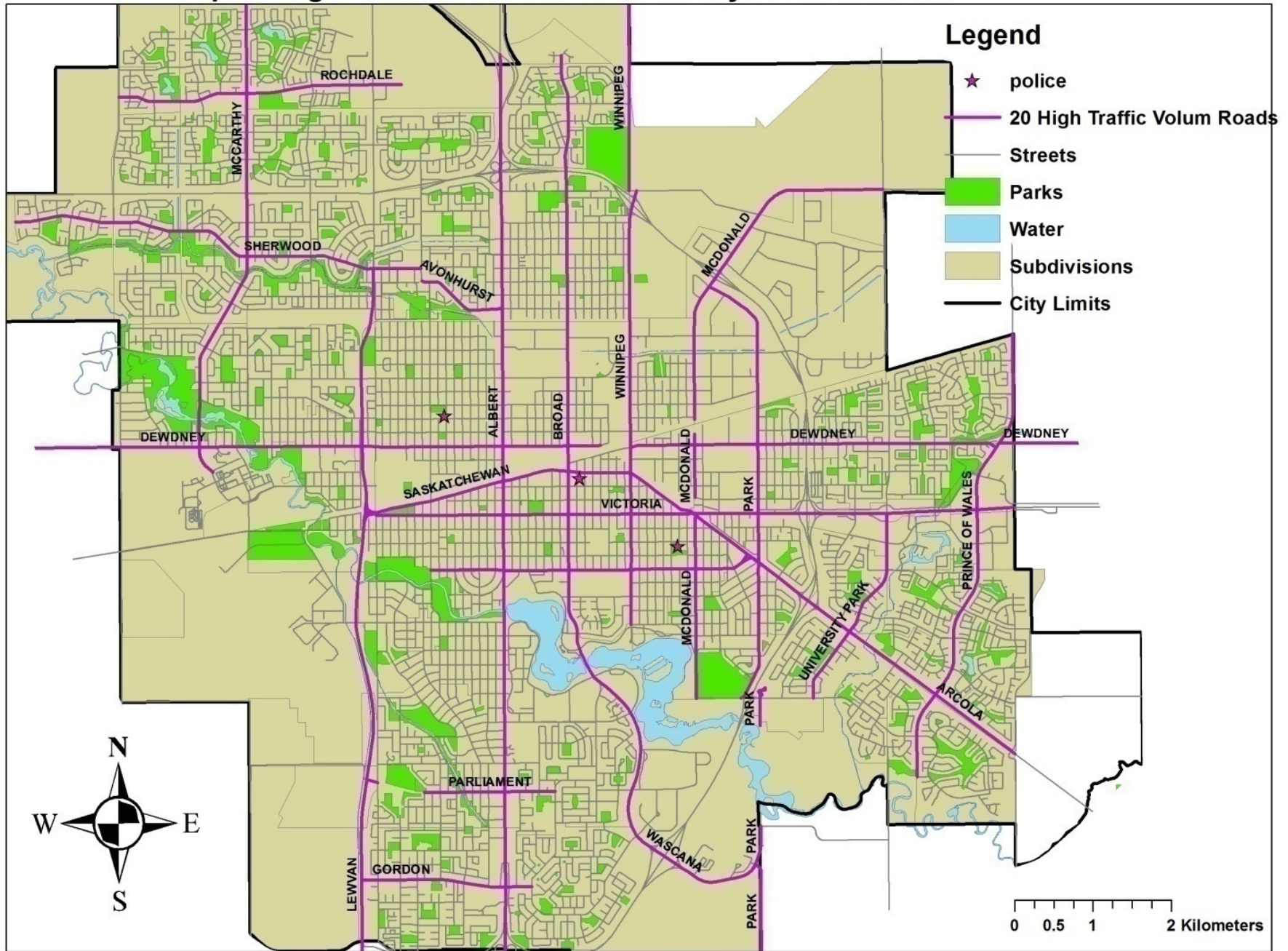
Collision Record and Road Network for the City of Regina

Legend

Collision Points For Entire City
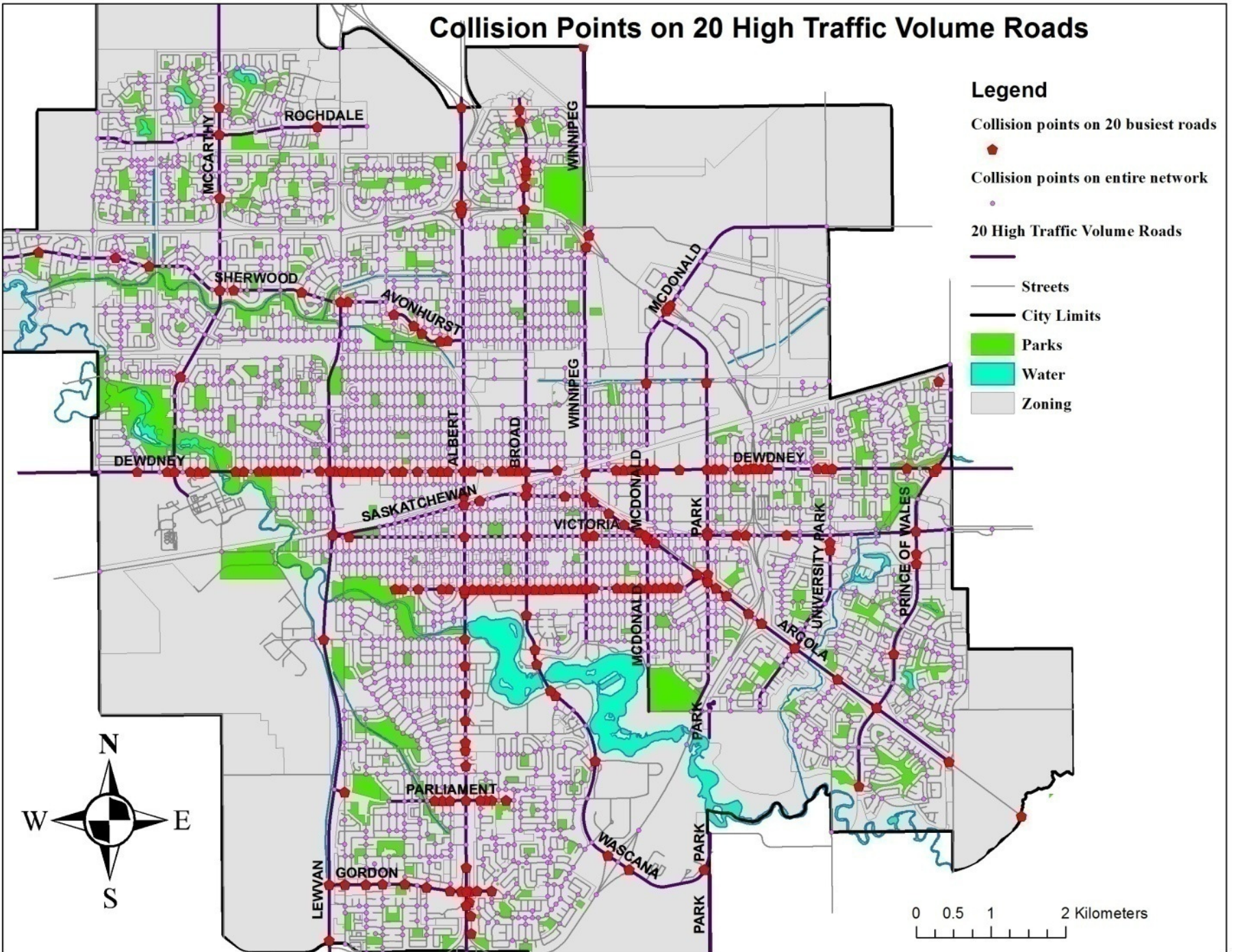·

— Streets

Water

Parks

Zoning

— City Limits

N
W E
S

0 0.5 1   2 Kilometers

Top 20 High Traffic Volume Roads in City Road Network

Legend

★ police
— 20 High Traffic Volum Roads
— Streets
■ Parks
■ Water
■ Subdivisions
— City Limits

ROCHDALE
MCCARTHY
WINNIPEG
SHERWOOD
AVONHURST
MCDONALD
WINNIPEG
ALBERT
BROAD
DEWDNEY
DEWDNEY
DEWDNEY
SASKATCHEWAN
MCDONALD
VICTORIA
PARK
PRINCE OF WALES
MCDONALD
UNIVERSITY PARK
ARCOLA
PARK
PARLIAMENT
WASCANA
PARK
LEWVAN
GORDON
PARK

N
W E
S

0 0.5 1   2 Kilometers

Selected top 20 roads with high traffic volume roads in the City network by City of Regina's Traffic flow map

Collision Points on 20 High Traffic Volume Roads

ROCHDALE

MCCARTHY

SHERWOOD

AVONHURST

WINNIPEG

MCDONALD

WINNIPEG

ALBERT

BROAD

DEWDNEY

DEWDNEY

SASKATCHEWAN

VICTORIA

MCDONALD

PARK

UNIVERSITY PARK

PRINCE OF WALES

MCDONALD

ARGOLA

PARLIAMENT

PARK

WASCANA

LEWVAN

GORDON

PARK

Legend

Collision points on 20 busiest roads

Collision points on entire network

20 High Traffic Volume Roads

—— Streets

—— City Limits

Parks

Water

Zoning

N
W   E
S

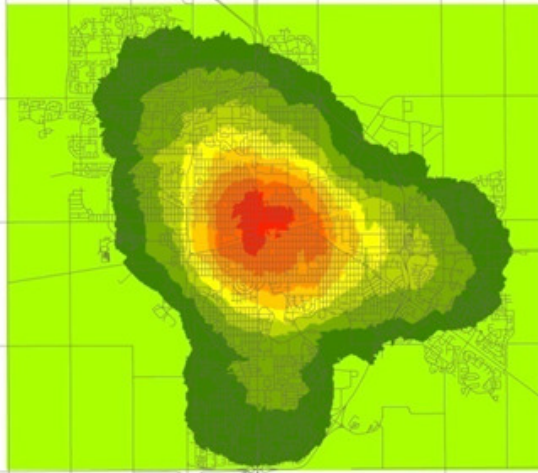0   0.5   1   2 Kilometers

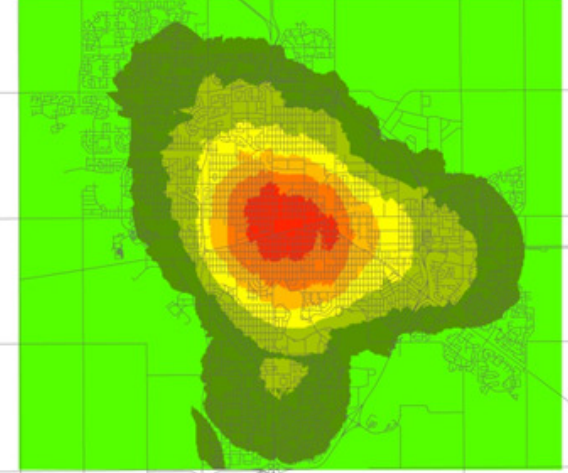# KERNEL DENSITY AND POINT DENSITY ANALYSIS

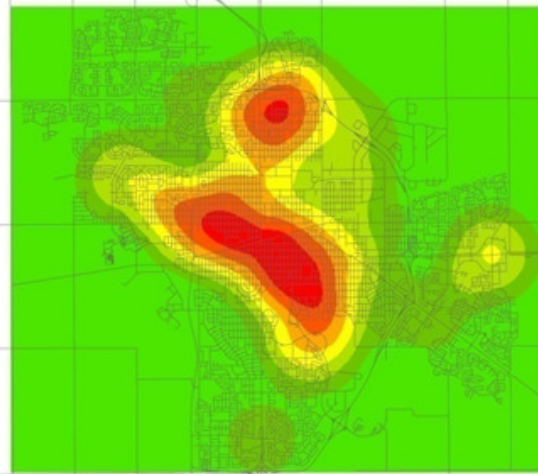Point Density - Fatal Collisions
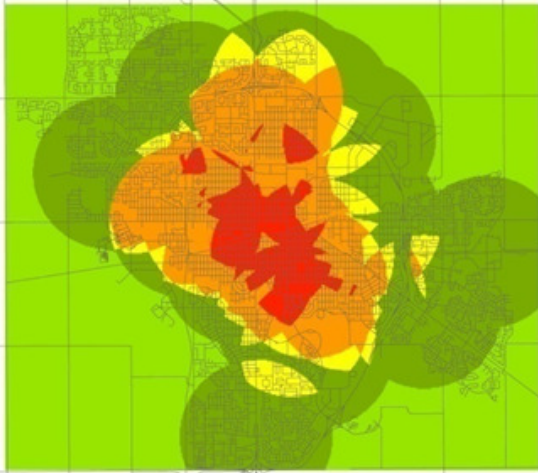
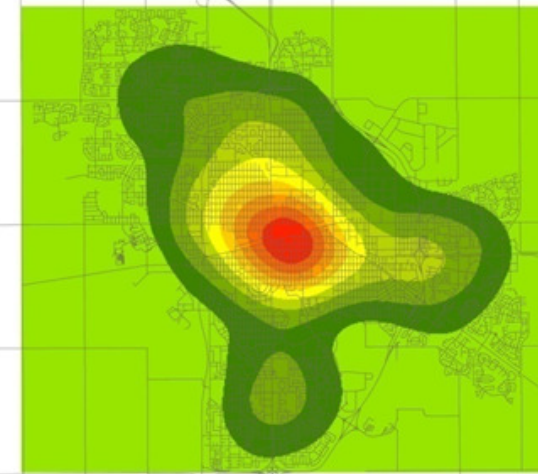Point Density - Fatal and Injury Collisions
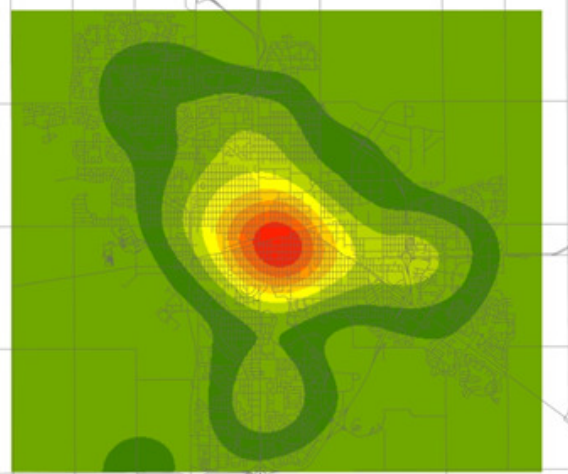
Point Density - Total Collisions
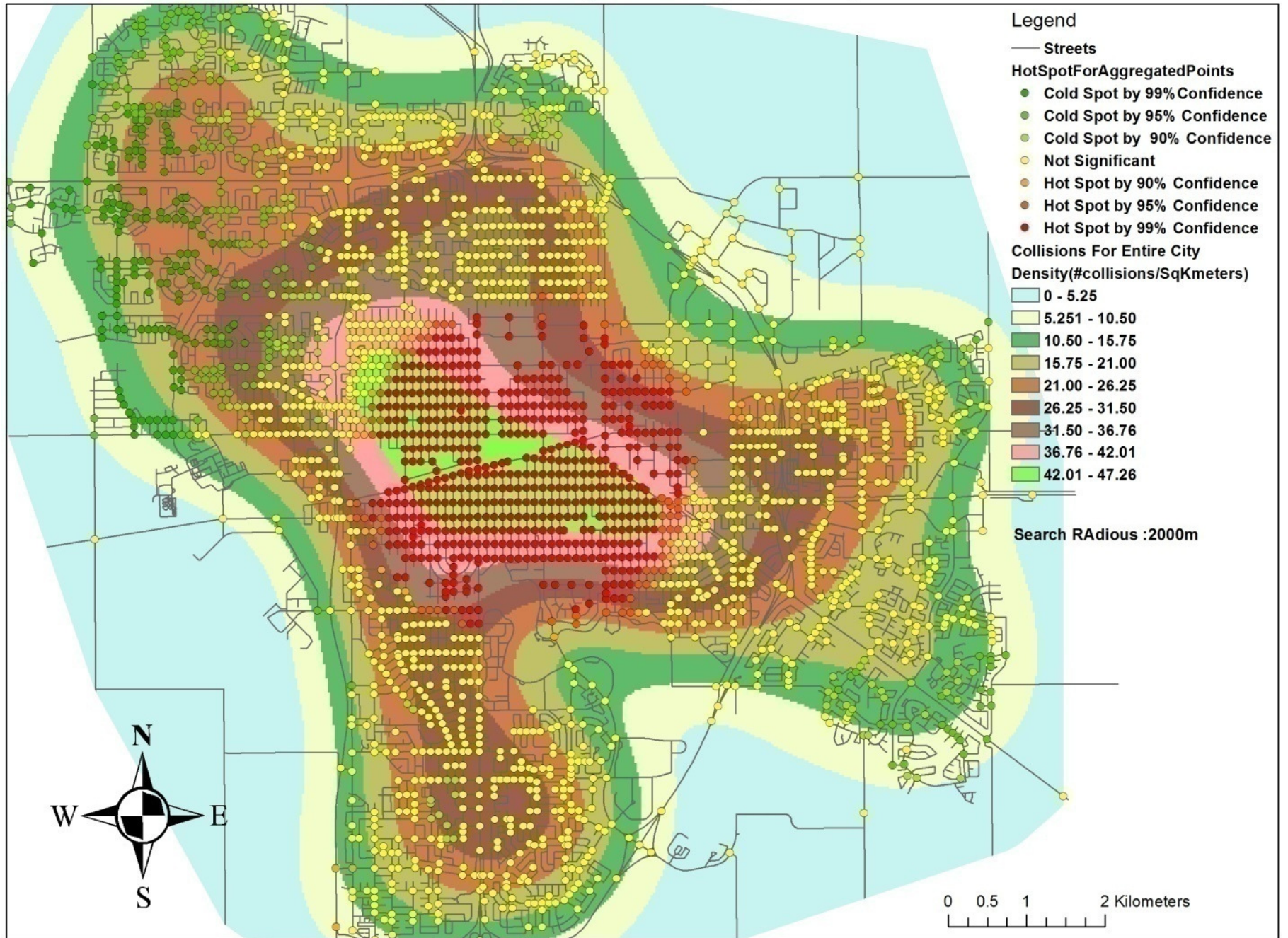
Kernel Density - Fatal Collisions

Kernel Density - Fatal and Injury Collisions

Kernel Density - Total Collisions

Hot Spots and Kernel density for the City of Regina

Legend

Streets

HotSpotForAggregatedPoints
- Cold Spot by 99% Confidence
- Cold Spot by 95% Confidence
- Cold Spot by 90% Confidence
- Not Significant
- Hot Spot by 90% Confidence
- Hot Spot by 95% Confidence
- Hot Spot by 99% Confidence

Collisions For Entire City
Density(#collisions/SqKmeters)
- 0 - 5.25
- 5.251 - 10.50
- 10.50 - 15.75
- 15.75 - 21.00
- 21.00 - 26.25
- 26.25 - 31.50
- 31.50 - 36.76
- 36.76 - 42.01
- 42.01 - 47.26

Search RAdious :2000m

0   0.5   1   2 Kilometers

Day Time Collision density Map of the City of Regina

Legend

— Streets

Water

Parks

— City Limits

Day Time(6a.m.To6p.m.)collisions
Density(#Collisions/SqKmeters)

0 - 174.67

174.67 - 349.35

349.35 - 524.02

524.02 - 698.70

698.70 - 873.37

873.37 - 1,048.05

1,048.05 - 1,222.73

1,222.73 - 1,397.40

1,397.40 - 1,572.08

0   0.5   1   2 Kilometers

Night Time Collision density Map of the City of Regina

Legend

— Streets

Water

Parks

— City Limits

NightTime(6p.m.To6a.m.)collisions
Density(#Collisions/SqKilometers)

- 0 - 54.35
- 54.35 - 108.71
- 108.71 - 163.07
- 163.07 - 217.43
- 217.43 - 271.79
- 271.79 - 326.15
- 326.15 - 380.51
- 380.51 - 434.86
- 434.86 - 489.22

N
W   E
S

0   0.5   1   2 Kilometers

Hot Spot Map for 20 High Traffic Volume Roads

Legend

20 High Traffic Volume Roads

Streets

City Limits

HotSpotFor20BusiestRoads
Density(NoofCollisions/SqKmeters)

- 0 - 110.23
- 110.23 - 220.47
- 220.47 - 330.71
- 330.71 - 440.94
- 440.94 - 551.18
- 551.18 - 661.42
- 661.42 - 771.66
- 771.66 - 881.89
- 881.89 - 992.14

Search Radious :500m

ROCHDALE

MCCARTHY

SHERWOOD

AVONHURST

WINNIPEG

MCDONALD

DEWDNEY

ALBERT

BROAD

SASKATCHEWAN

VICTORIA

MCDONALD

DEWDNEY

WINNIPEG

PARK

UNIVERSITY PARK

PRINCE OF WALES

ARCOLA

MCDONALD

PARK

PARLIAMENT

LEWVAN

GORDON

WASCANA

PARK

PARK

N
W   E
S

0   0.5   1   2 Kilometers

SUMMARY AND CONCLUSIONS

- The downtown area of the city has been classified as the hot zone of Regina by the both tools. Another hot zone was detected for fatal collisions only in the northeast neighbourhood of the city.

- Hot Spot Analysis, a Spatial Statistics tool, was used for identifying statistically significant hot and cold spots. The resultant map was compared with an analysis conducted by the Kernel density tool for the entire road network.

- Almost all hot spots were found to be located in the downtown area, which was similarly classified as a hot zone from the analysis with the Kernel density tool.

SUMMARY AND CONCLUSIONS

- The downtown area was found as a hot zone during the day time whereas two additional zones were observed as hot zones, while still including the downtown area for night time. These two additional zones are located on Dewdney east - Arcola neighbourhood and Whitmore - Albert park neighbourhood.

- The analysis identified over 30 hot spots in different roadways of the city network. The intersection at Albert Street and Saskatchewan Drive was ranked as the top hot spot.

- Most of the hot spots are found to be located within and nearby of the downtown area on different roadways. It was observed that the hot spots are primarily located in two major roadways: Albert Street which runs north/south; Victoria Avenue which runs east/west.

SUMMARY AND CONCLUSIONS

- In the east area of the city, the intersections of Arcola Avenue - University park Drive and Princes of Wales Drive - Victoria Avenue were identified as hot spots.

- The intersection of Albert Street - Parliament Avenue, in the south area of the city, was identified as hot spots.

- All hot spots are located on the Lewvan Drive in the west part of the city. Intersection at McCarthy and Rochdale Boulevard is the major point of high collision occurrence in the city of Regina's Northwest area.

- There are three intersections equipped for red light cameras in the city of Regina's road network since 1999. All of these 3 intersections were also detected as hot spots on this study.

RECOMMENDATIONS AND PATH FORWARD

- This GIS based analysis provided hot zones for the entire city and also identified hot zones on different time scales. Therefore, it gives a baseline for traffic safety units of the Regina Police Services to easily develop plans for community programs and their traffic enforcement services.

- The research outcomes can also be applied for policy and analytical purpose to Red Light Camera and peed Enforcement Programs in the City of Regina road networks.

- This approach could be extended to other types of crash data analysis (e.g. time of occurrence, major contributing factors, environmental factors, and driver factors etc.).

ACKNOWLEDGEMENTS

DISCLAIMER

Any views or interpretation of data analysis presented in this work are solely those of the authors. SGI is not responsible for the interpretation of the data and accepts no liability for the content of this work.