HAZARDOUS ROAD SAFETY LOCATION ANALYSIS: A case study of the Western Cape

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ABSTRACT

It is well known that South Africa has one of the highest road fatality rates in the world. Although regular analysis of road safety data takes place in South Africa, identified measures, based on this analysis, have not led to a major reduction of road fatalities in the past.

Various levels of Government in South Africa have recently set targets to reduce road fatalities. The Provincial Government of the Western Cape (PGWC) has set itself the task to reduce road fatalities by 50% between 2009 and 2014. To be able to assess whether various measures are successful, it is key that the correct number of fatalities is known. Moreover, detailed statistics on the accident types etc. are needed to identify the most promising measures.

Under the umbrella of the SAFELY HOME project, the PGWC has asked the Centre for Transport Studies, at the University of Cape Town (UCT), to carry out a Baseline study. The aim of the study is to establish the exact number of fatal road crashes in the province, as well as the detailed statistics required to identify measures. This paper summarises a selection of the analysis and findings.

1 INTRODUCTION

In 2002, global road traffic injuries accounted for 2.1% of all deaths, making them one of the leading causes of deaths. Most of those killed or injured, due to road crashes globally, are pedestrians in developing countries. They are also breadwinners for their families. In addition to these deaths, an estimated 20 million to 50 million people are injured in road crashes each year. In 2002, an estimated 38.4 million disability adjusted life years (DALYs) were lost because of road crashes (2.6% of all DALYs lost). Clearly, the rates of road traffic deaths vary considerably between regions and countries. In general, rates are higher in low- and middle-income countries than in higher income countries. Altogether, low-income and middle-income countries accounted for 90% of all road traffic deaths in 2002 (WHO, 2004).

In South Africa, fatality rates follow the developing world trends. On an international scale, South Africa is fatality generator number four in the world with 27.97 fatalities per 100 000 inhabitants (IRF, 2006). Figure 1 provides an overview of the road fatality rates around the world. The data labels for a group of countries are based on the average for these countries (rates per 100 000 inhabitants). Data was collected from various data sources.

The year of data collection for various data sources is provided underneath the figure title. This is done throughout the paper.

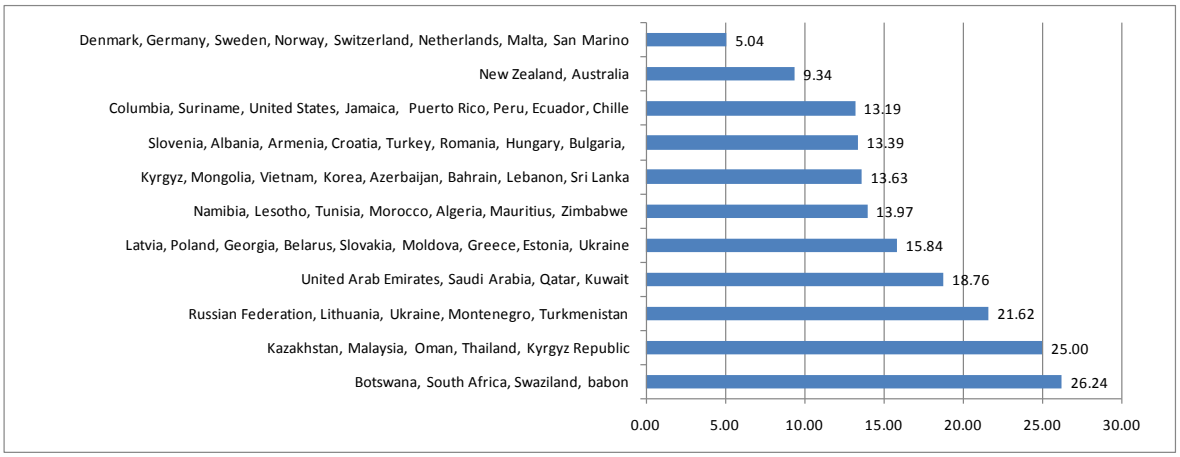

Figure 1: Fatality rates per 100 000 inhabitants

Data source: ECAR, 2009; ECSHD, 2009; ECSSD, 2009; GRSF, 2009; IRF, 2006; and WB, 2009

In South Africa, the numbers of road crashes and road fatalities have been increasing ever since motorised transport was introduced in the country. Figure 2 provides an overview of fatal crashes and fatalities for the last 73 years.

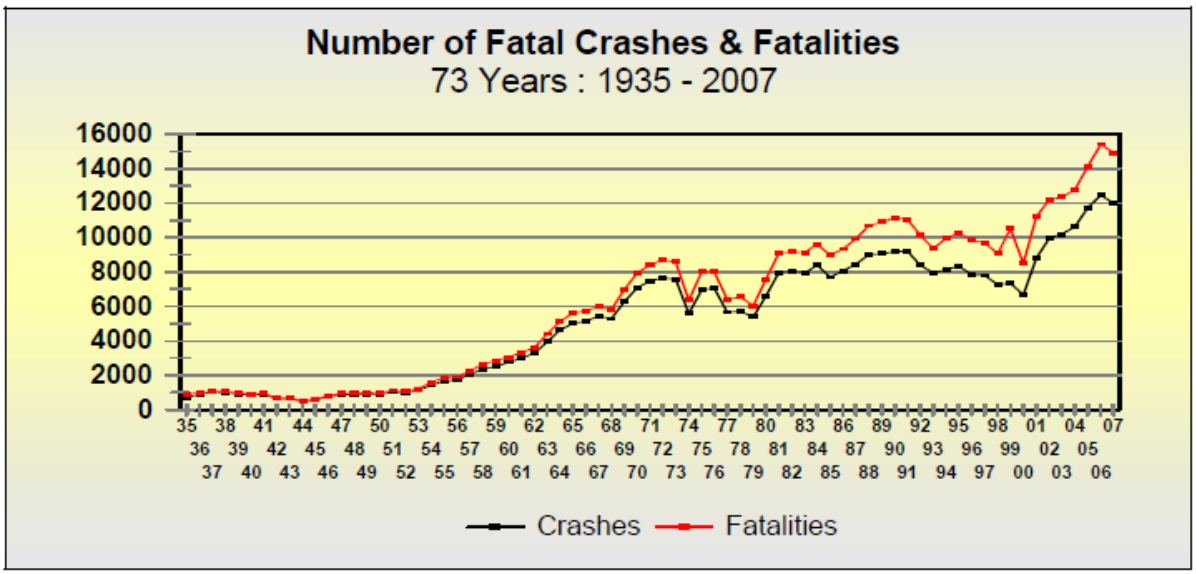

Figure 2: Long term fatal crash and fatality rates in South Africa

Source: RTMC, 2008

2 ROAD FATALITY TRENDS

The Road Traffic Management Corporation (RTMC) was established to initiate and run an effective road management system throughout South Africa and to bring a professional approach and improved confidence into the entire system. The main focus of the RTMC is road safety. One of the RTMC's functions, as agreed in the RTMC Act, is the administrative adjudication of road traffic offences (AARTO). With regards to the establishment of road safety trends in South Africa and the Western Cape, the RTMC produces a core document annually, namely the "Road Traffic Report".

The main focus of this paper is road fatalities. Table 1 provides an overview of the road fatality trends in South Africa and the Western Cape. The data was collated, based on various annual "Road Traffic Reports" from the RTMC.

Table 1: Road fatality trends in South Africa and the Western Cape

Area	Person Type	2005	2006	2007	2008	2009	Change (06 – 09)
SA	Driver		4 472	4 426	3 982	4 066	-9%
	Passenger		5 064	4 916	4 965	5 023	-0.8%
	Pedestrian		5 883	5 578	4 927	4 678	**-20%**
	Total	15 135	15 419	14 920	13 875	13 768	-10.7%
WC	Driver		512	461	468	397	-22.5%
	Passenger		471	503	406	398	-15.5%
	Pedestrian		667	681	649	491	**-26.4%**
	Total	1 588	1 650	1 645	1 523	1 285	**-22.1%**

Source: RTMC, 2008; RTMC, 2009 and RTMC, 2010

The data indicates that fatality rates on South Africa's roads have dropped, between 2006 and 2009, by 10%. The reduction in the Western Cape is significantly higher, at around 15%. However, a closer analysis of this data raises concerns about the integrity (see also Table 2), especially in relation to pedestrian fatalities in the Western Cape (and, therefore, in South Africa). Reported decreases will, therefore, have to be handled with caution.

The Provincial Government of the Western Cape (PGWC) collects its own crash data and has its own database system (iPas). Data in this database is supplied to the RTMC. Theoretically, the number of fatalities in the Western Cape should be equal to the RTMC system, as the base of the data is the same. However, an analysis of data in 2007 (the latest complete data in the iPas system), shows a significant difference (see Table 2).

Table 2: Fatality rates for different Western Cape databases

Year	iPas	RTMC
2007	1046	1645

Although capturing in the iPas system (PGWC) for 2007 is officially finalised, it seems that there is still a substantial amount of outstanding data. Given the additional data stream (reporting within 24 hours) to the RTMC, this data is assumed to be more complete. However, the PGWC often corrects data during capturing. The detailed data in the iPas system is, therefore, assumed more reliable.

3 GENDER AND ROAD FATALITIES

Besides outstanding records, as mentioned in Section 2, there are missing and unknown data fields in existing iPasdata records. It is assumed that the probability of missing data is equal for all attributes in the data base. Missing data is, therefore, excluded from the analysis. The totals in different sections of the paper can, therefore, vary.

The gender difference in fatal crashes is astonishing (see Table 3). Females are only involved in about 25% of fatal crashes. As drivers, they only account for less than 8% of fatal crashes. As pedestrians, they are involved in 25% of fatal crashes, and they are involved in 45% of fatal crashes as a passenger. The fatal crash risk for females clearly increases when they are dependent on the (driver) behaviour of others. In other words, women drive safer than men.

Table 3: Recorded fatal crashes in the Western Cape

All Fatal Crashes	Driver	Passenger	Pedestrian	Total
Female	21 (7.9%)	101 (45%)	55(24.8%)	177 (24.9%)
Male	244 (92.1%)	123 (55%)	167 (75.2%)	534 (75.1%)
Total	265 (100%)	224 (100%)	222 (100%)	711 (100%)

Data source: iPas, 2007

4 POPULATION GROUP AND ROAD FATALITIES

In 2001, the Coloured community made up more than 50% of the population in the Western Cape, followed by African Blacks, which made up more than 25% of the Western Cape population. The White community represented less than 20% of the Western Cape population and Asians made up 15% of the population (www.statssa.gov.za).

Analysing all crashes in the Western Cape, it appeared that the White and Coloured males were involved in the majority of crashes. In total, the White community represents over 43% of all crashes, while the Coloured community represents almost 40% of crashes (see Table 4).

Table 4: Recorded crashes per population group in the Western Cape

All Crashes	Asian	Black	Coloured	White	Other	Total
Female	253	2 295	8 692	18 222	63	29 525
Male	809	14 759	35 510	30 294	307	81 679
Total (%)	1 062 (1%)	17 054 (15.3%)	44 202 (39.7%)	48 516 (43.6%)	370 (0.4%)	111 204 (100%)

Data source: iPas, 2007

It is clear that the White community was involved in a larger portion of crashes, compared to their share of the overall Western Cape population. This could be explained by their economic activity and high car ownership rate (see Behrens, 2002 and DoT, 2005). In contrast, the proportion of crashes caused by Asians and their share in the population are equal, whereas the Black and Coloured community are involved in a lower crash ratio than their population portion. Less economic activity and lower car ownership (see Behrens, 2002 and DoT, 2005) are reasons for this statistic.

The next step in the analysis was to review the fatal crash record per population group. It appears that, although the White community is involved in 43% of crashes, they only make up 19% of fatalities. The Coloured community, however, which is involved in almost 40% of crashes, makes up more than 50% of the fatal crashes. Coloured males make up 51.3% of all male fatalities in the Western Cape (see Table 5).

Table 5: Fatal crash record per population group in the Western Cape

Fatal Crashes	Asian	Black	Coloured	White	Other	Total
Female	1	47	90	30	0	168
Male	2	144	258	97	2	503

Data source: iPas, 2007

Analysing the female driver crash records, per population group, it is clear that White females are involved in the majority of crashes, followed by Coloured females. For male drivers, the White and Coloured males are equally involved in the majority of crashes, with

around 40% each (see Table 4). Driver fatalities, however, show a different trend (see Table 6). Whereas females are involved in about 25% of the crashes, they are only account for 8% of driver fatalities. Coloured males make up the majority of driver fatalities with 45% of all males driver fatalities and over 40% of all driver fatalities. White males follow these percentages closely, making up 33% of all male driver fatalities and over 30% of all driver fatalities.

Table6: Driver fatality record per population group in the Western Cape

Driver Fatality	Asian	Black	Coloured	White	Other	Total
Female	0	1	5	14	0	20
Male	0	49	104	76	1	230

Data source: iPas, 2007

5 ACCIDENT TYPES

In the traditional reporting of contributing road safety factors, road factors always have the least contributing percentage. However, in many cases, infrastructure measures can be used to improve road safety. Traffic calming measures are an example of infrastructure measures that have been proven to make a huge reducing contribution in the European context. This section reports on various accident types.

An analysis of road types was carried out. It became clear that a significantly higher number of crashes occurred on 'Single Carriageways' (see Figure 3). The number of single carriageways in the Western Cape does, only partly, explain this finding. Further analysis revealed that a higher proportion of crashes happen when a barrier line is missing – in 40% of crashes. Unfortunately, it was not possible, in the time available for this study, to correlate all road characteristics with fatality rates. This is planned for the future.

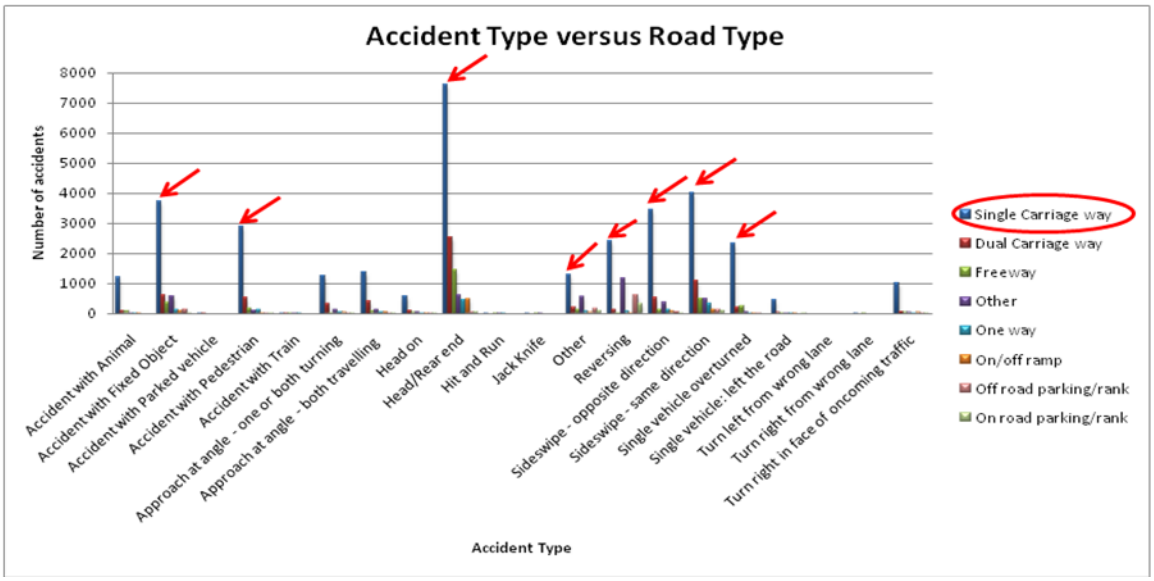

Figure 3: Accident type versus road type

Data source: iPas, 2007

6 DAY OF THE WEEK

Analysing the Western Cape data, it appeared that crash frequencies varied from day to day. Crashes were more or less evenly spread over the week (see Figure 4a). Fatal crashes, however, were concentrated on Fridays, Saturdays and Sundays (see Figure 4b).

As fatalities occur more on Fridays, Saturdays and Sundays, it is important to establish whether there are specific times of the day that have higher fatality rates. Figure 4.5 provides an overview of the fatality rates per hour of the day for Fridays, Saturdays and Sundays.

On Fridays, the fatality risk between 02h00 in the morning and 14h00 in the afternoon was less than 5 fatalities per hour. Between 15h00 and 18h00 the fatality rates were twice this amount (10 fatalities per hour). This high level remains for the remainder of the Friday night.

The fatality rates on Saturday show an exceptional result. Between 01h00 in the morning until 17h00 in the late afternoon, the rates vary between 5 and 10 fatalities. Between 18h00 and 22h00 the rate is significantly higher (up to over 20 fatalities).

Early Sunday morning the fatality rate was quite high - between 5 and 10 fatalities. Between 06h00 and 13h00 the fatality rate, on Sundays, dropped below 5 fatalities per hour. During the early afternoon (14h00), the fatality rate spiked to over 10 fatalities. Between 15h00 and 18h00 a significant drop was witnessed again (below 5 fatalities per hour). After 18h00 until midnight, the fatality rates increased to between 5 and 10 fatalities per hour again.

Time of day also influenced the type of crashes. More than 40% of the accidents with animals, for example, happened during the night on unlit roads. In 30% of the single vehicles overturning, night time was also a contributing factor. Furthermore, 53% of accidents, with fixed objects, happened at night under unlit circumstances. Only 36% of these crashes happen during the day.

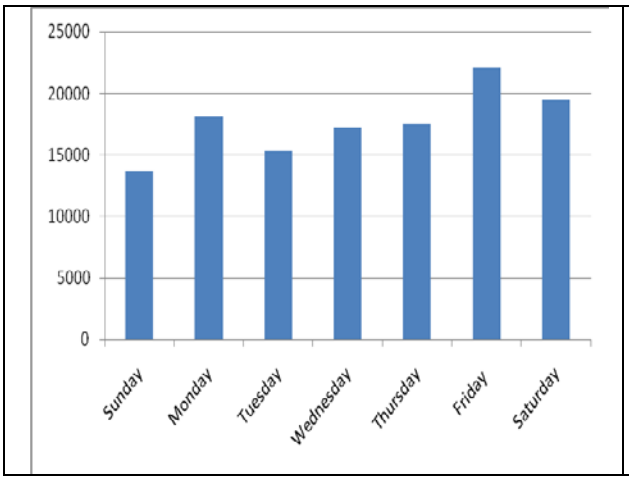

Figure 4a:Crashes per day of the week
Data source: iPas, 2007

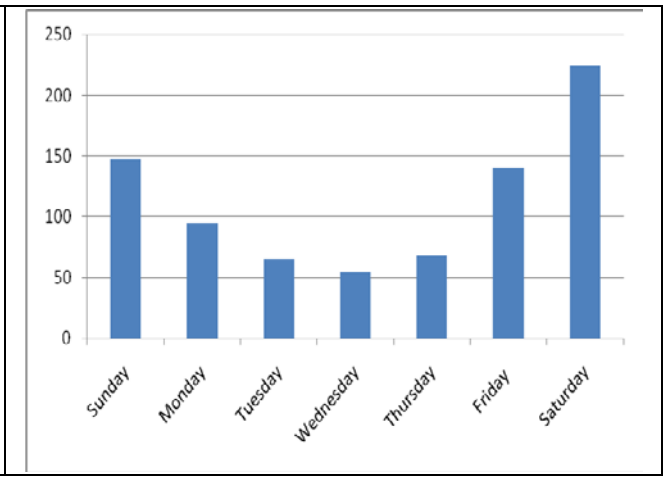

Figure 4b:Fatal crashes per day of the week
Data source: iPas, 2007

7 HAZARDOUS LOCATIONS

The aim of the PGWC is to reduce road fatalities by 50% between 2009 and 2014. One of the ways to identify where measures should have the largest benefits is to identify hazardous locations. Due to the limited space in this paper, only a selection of the findings is presented. The locations where fatal driver and pedestrian crashes happened, as well as single vehicles overturned, are analysed in this section. Unfortunately, the crashes in the City of Cape Town are not properly geo-coded. The diagrams, therefore, do not include the fatal crashes in Cape Town.

Figure 5 reveals many hazardous locations. Identified areas are (in no particular order): Vredendal, the N1, the R61, Oudtshoorn, Knysna/Plettenberg Bay, Mossel Bay, Robertson/Swellendam and Rawsonville.

Visual inspection of the N1 revealed that there is a lack of overtaking opportunities. Between Beaufort West and De Doorns, for example, there are no overtaking facilities for more than 300km. Given the substantial number of (slow) trucks, this appeared to provoke unsafe driver behaviour.

Analysing the hazardous pedestrian crash locations, it is clear that pedestrian movement in the Vredendal area, in the Winelands and in coastal towns, create the most hazardous locations. As pedestrians represent around 40% of all fatalities, a more detailed analysis was carried out (see Figure 6).

Vredendal is known to have low population densities. It is, therefore, surprising that 8% of fatal pedestrian crashes were recorded in this area. An investigation into the reasons revealed that many pedestrian crashes happened at night under unlit conditions (see Figure 7).

A visual road inspection in Vredendal revealed that speeding by local drivers and a non-changing high speed limit (100km/h even outside a pre-school) probably contribute to high fatality rates there.

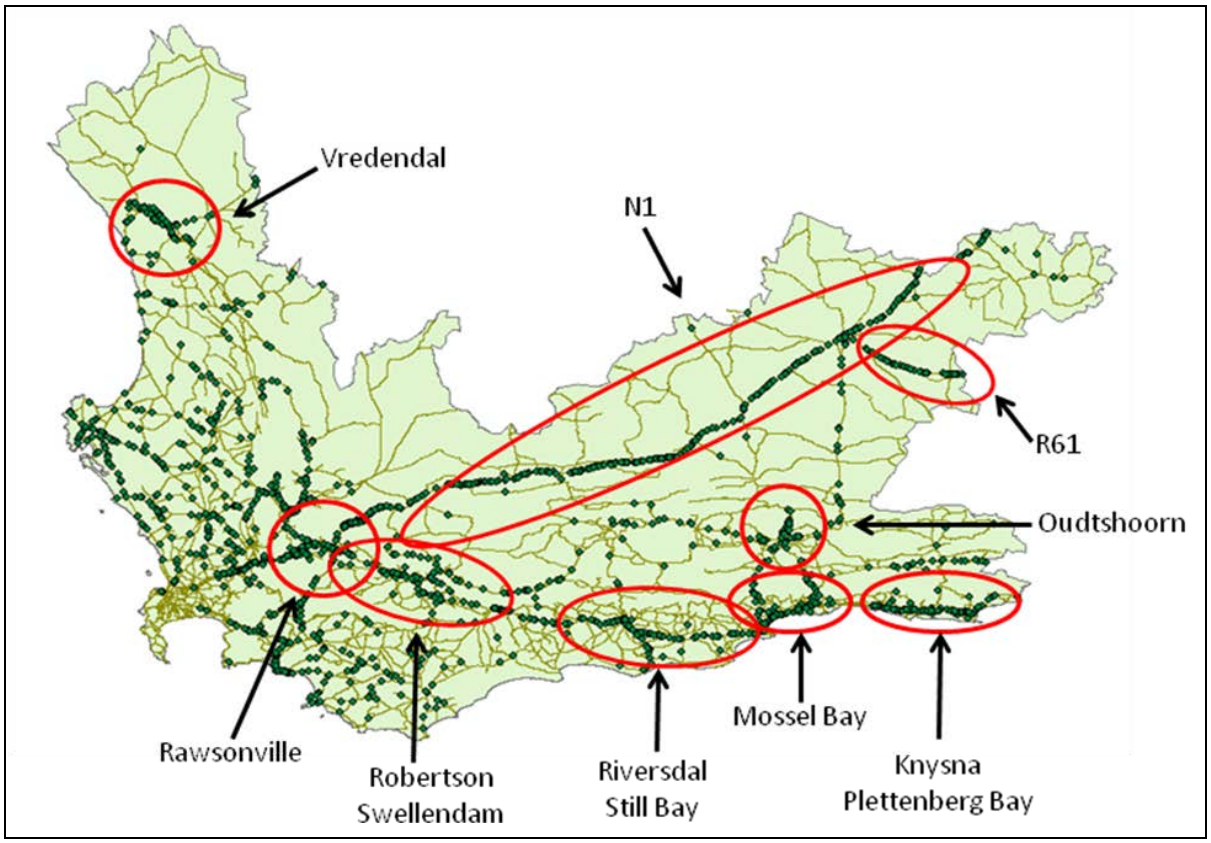

Figure 5:Fatal driver crash locations in the Western Cape
Data source: iPas, 2000 – 2008

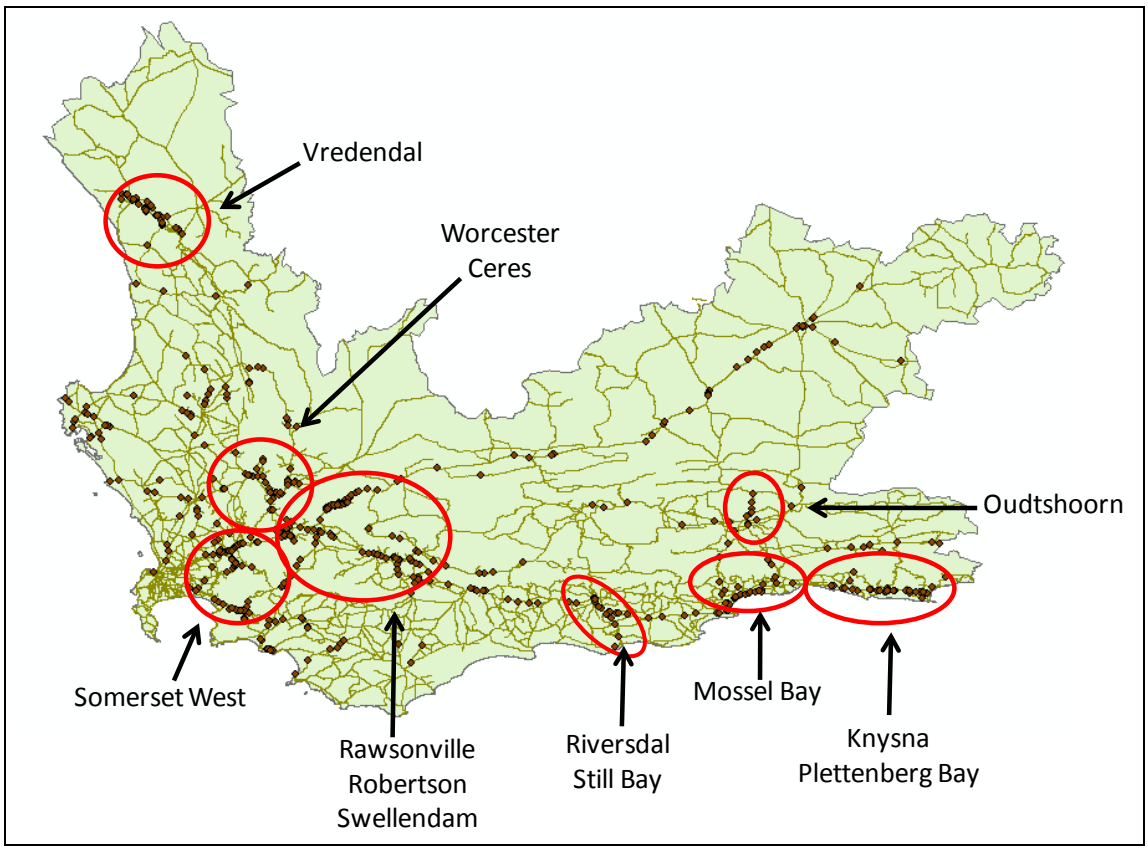

Figure 6:Fatal pedestrian crash locations in the Western Cape

Data source: iPas, 2000 – 2008

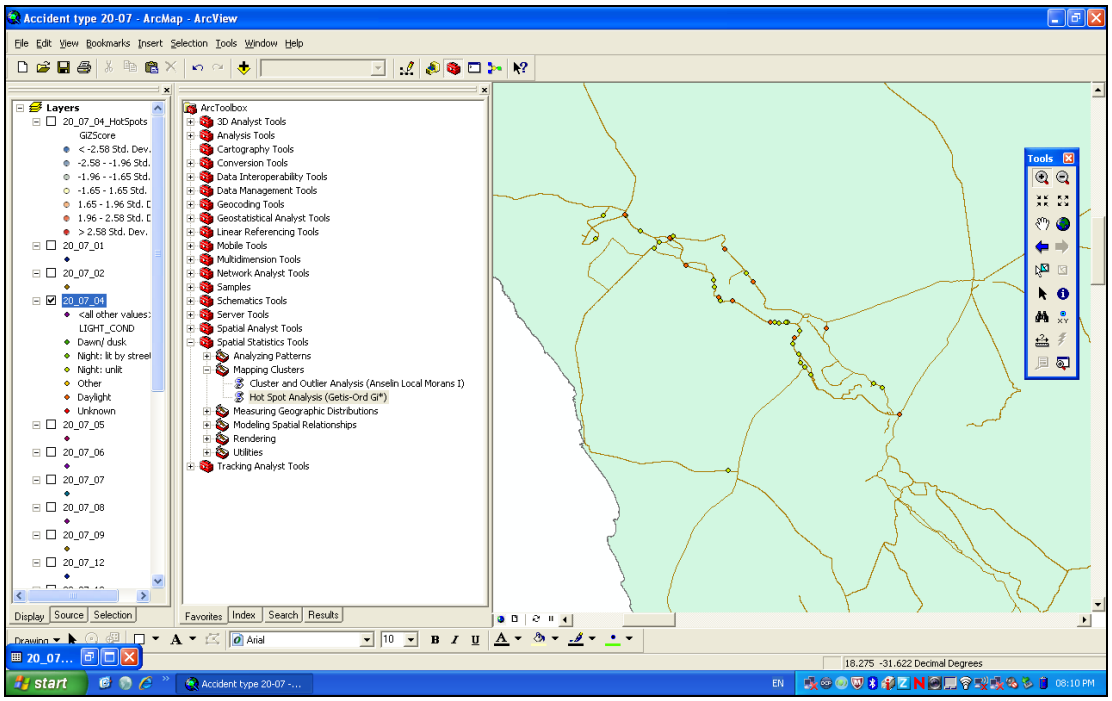

Figure 7:Light conditions for pedestrian crashes in the Vredendal area

Data source: iPas, 2000 – 2008

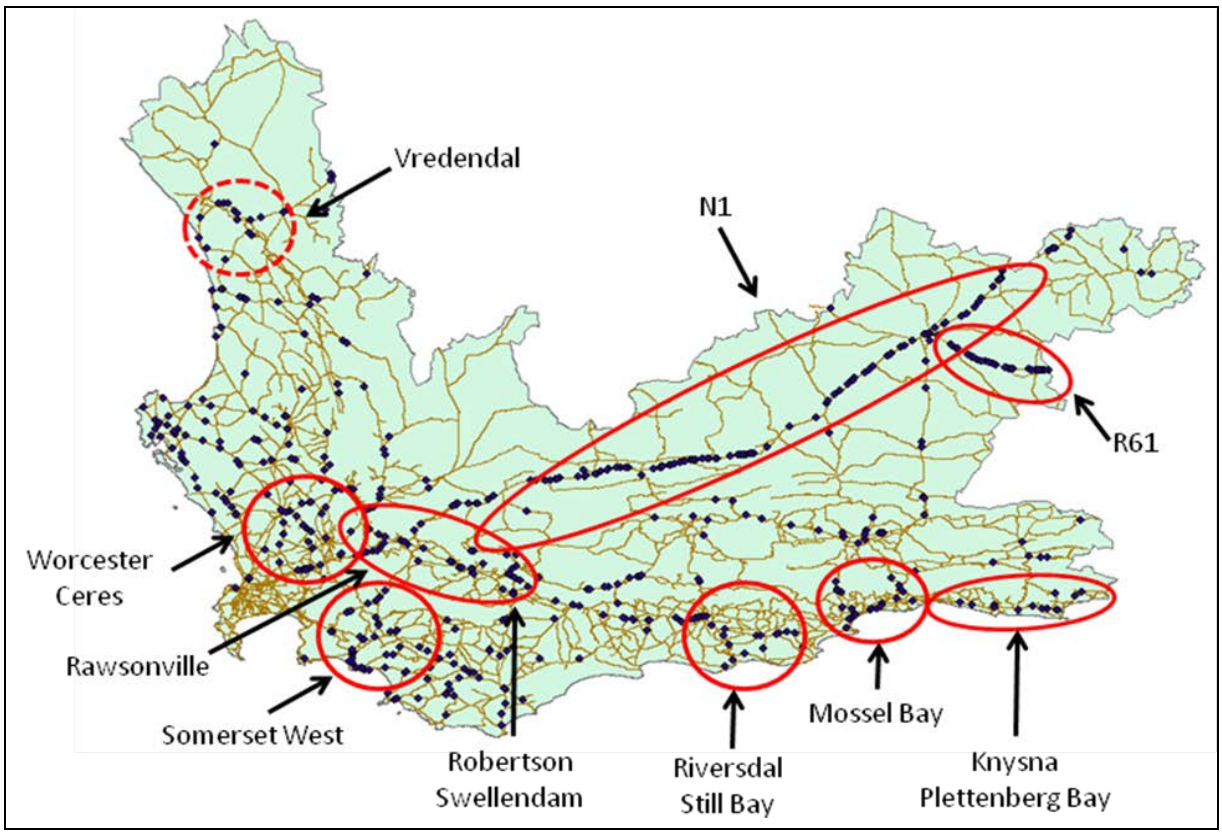

Figure 8:Location of single vehicles overturning in the Western Cape
Data source: iPas, 2000 – 2008

One of the accident types that stands out in the general analysis, as well as in the geographical analysis, is “single vehicle overturned”. Figure 8 provides an overview of the locations where these crashes happen. The N1 and R61 are clearly corridors where single vehicles overturn. Worcester, Rawsonville, Somerset West, Robinson, Riversdal, Mossel Bay, Knysna and, to a lesser extent, Vredendal are other areas where single vehicles overturn frequently.

Visual inspection of the R61 revealed that the top layer of the road shoulder is gravel. If a vehicle at high speed swerves into the shoulder, the risk of losing control is exceptionally high.

8 CONCLUSIONS AND RECOMMENDATIONS

The Baseline study carried out for the PGWC, as part of their SAFELY HOME initiative, revealed missing data records in the iPas system, as well as missing and unknown fields in existing records. Clearly, data collection and data processing needs to be improved. Detailed recommendations were made to the PGWC, so as to improve the **Evaluation** of data.

The ‘devil is in the detail‘. This slogan is particularly true for road safety data analysis. To be able to identify potential road safety measures, a large number of fields need to be analysed and understood.

Significant differences between male and female drivers have been identified. Female drivers are only involved in 25% of road crashes, which can partly be explained by the fact that less females drive cars. However, females are only accountable for 8% of road

fatalities. Clearly, females drive safer than males. It is, therefore, recommended to focus education and media campaigns on male drivers.

Population group also appeared to influence the involvement in crashes and fatalities. Coloured and White males are involved in over 80% of all crashes. Coloured males are almost 40% of all fatalities and 42% of all driver fatalities. Obviously, the fact that the Coloured community is the largest population group in the Western Cape influences this statistic. However, the figure is proportionally high. It was established that, besides differences in driver attitude, the quality of vehicles also influences the differences in fatality rates per population group.

The analysis, based on the geo-coded information, appeared to be extremely helpful in identifying potential measures. It appeared that measures included actions in various road safety fields: **Engineering, Education and Enforcement**. Together with the required improvement in Evaluation (see first conclusion), the PGWC needs to address at least four of the road safety E's identified in the literature (others are 'environment' and 'encouragement').

An analysis of engineering characteristics indicated that they pay a role in the road crash and road fatality rates. However, it was not possible, in the time available for this study, to correlate all road characteristics with fatality rates. This is planned for the future.

ACKNOWLEDGEMENT

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