A COMPARISON OF ROAD ACCIDENTS IN DEVELOPING COUNTRIES WITH SPECIAL REFERENCE TO JAMAICA

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May 1992

The University of Aston in Birmingham, A COMPARISON OF ROAD ACCIDENTS IN DEVELOPING COUNTRIES WITH SPECIAL REFERENCE TO JAMAICA, Regard Yakou, Doctor of Philosophy, 1990

Thesis Summary

This research was originally undertaken to aid the Jamaican government and the World Bank in making funding decisions relative to improvement of road systems and traffic control in Jamaica. An investigation of the frequency and causes of road accidents and an evaluation of their impact on the Jamaican economy were carried out, and a model system which might be applied was developed. It is believed that the importance of road accident economic and manpower losses to the survival of developing countries, such as Jamaica, cannot be overemphasized. It is suggested that the World Bank, in cooperation with national governments, has a role to play in alleviating this serious problem. Data was collected from such organizations as the Jamaica Ministry of Construction, Police Department, the World Bank, and the World Health Organization. A variety of methodologies were utilized to organize this data in useful and understandable forms. The most important conclusion of this research is that solvable problems in road systems and in traffic control result in the unnecessary loss of useful citizens, in both developed and developing countries. However, a lack of information and understanding regarding the impact of high rates of road accident death and injury on the national economy and stability of a country results in an apparent lack of concern. Having little internal expertise in the field of road accident prevention, developing countries usually hire consultants to help them address this problem. In the case of Jamaica, this practice has resulted in distrust and hard feelings between the Jamaican authorities and major organizations involved in the field. Jamaican officials have found confusing the recommendations of most experts contracted to study traffic safety. The attempts of foreign consultants to utilize a technological approach (the use of coding systems and computers), methods which do not appear cost-effective for Jamaica, have resulted in the expenditure of limited funds for studies which offer no feasible approach to the problem. This funding limitation, which hampers research and road improvement, could be alleviated by such organizations as the World Bank. The causes of high accident rates are many, it was found. Formulation of a plan to address this serious problem must take into account the current failure to appreciate the impact of a high level of road accidents on national economy and stability, inability to find a feasible approach to the problem, and inadequate funding. Such a plan is discussed in detail in the main text of this research.

Key words:

Road Accidents
Jamaica
Accident Location
Cost of Accidents
Developing Countries

ACKNOWLEDGEMENTS

The candidate wishes to express his deep appreciation to the people without whose help this project would never have gone anywhere.

Most sincere thanks to Dr. Jabbari, who helped with technical, as well as moral support toward the completion of this research. Also, all the faculty and staff of the Civil Engineering Department at Aston, especially Dr. Chidley, Mr. Foot, Dr. Collins and Dr. White have the candidate's gratitude.

In addition, the candidate wishes to express his deep appreciation to Mr. Jerry Cook and Mr. Iner Cook of Grundfos Pump Corporation, Clovis, California; the staff of the Ministry of Construction, the Police Department, and the Ministry of the Interior in Kingston and Montego Bay, Jamaica; the Transportation staff at the World Bank; the World Health Organization; Birmingham University; Aston University in Birmingham, England; and Transport Road Research Laboratory, London, England.

Special thanks to my wife, Teresa, and my family for their understanding and supportive attitude throughout the course of this study.

Last, but not least, I thank my typist, Ms. Mary Ann Myers, and her assistants, Ms. Kezia Daye Jones, Ms. Claudia

Strong, Ms. Susan McGlynn, and Mrs. Karrie Baker, for their help in preparing this manuscript.

It is my strong feeling that my relationship with God was crucial in the completion of this effort and that, without His help, I would never have been able to continue.

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Chapter 1

Introduction

1-1. Background of the Problem of Road Accidents

Since the invention of the motor vehicle, road traffic accidents have been an increasing problem for both developed and developing countries. Presently, it is likely that nearly every operator of a motor vehicle will have at least one road traffic accident during his or her driving life. Almost everyone knows of someone who has died or been seriously injured in a road accident (Ogren, 1979). Road traffic accidents now represent one of the most serious and intractable threats to the public health. For a variety of reasons, developing nations are particularly hard hit by this problem.

It is estimated that world annual road deaths approach 300,000 and total casualties are likely to number 15 million per year (Ross, 1991). Some recent statistics, by geographic regions, are provided in Table 1-1. These values, however, are underestimated, as only certain countries regularly furnish statistics and figures are not readily available from most of the larger countries (e.g., China, Egypt, India, and the U.S.S.R.)

Table 1-1

Annual Road Deaths by Geographical Region*

Geographical region	Total road deaths	Some examples within the region	
Europe	70,000	FDR	7,566
		France	10,340
		Italy	9,066
		G. Britain	5,399
The Americas	60,000	U.S.A.	47,000
		Canada	3,922
		Argentina	2,629
Africa	30,000	Nigeria	12,000
		South Africa	5,100
Asia	50,000	Japan	12,400
		Kuwait	343
Oceania	4,000	Australia	2,987

Source: World Health Organization, 1987

Although Britain reports nearly 320,000 people killed or injured on her highways annually (Dept. of Environment, 1989), it is commonly understood that non-serious injuries are typically underestimated by about 30 percent. About 1 1/2 million non-injury accidents are reported to insurance companies every year, and there is an unknown number of accidents which do not appear in any statistical accounting (Staughton & Stowie, 1977; The Swedish Traffic Safety Group, 1983; Ross, 1991).

There are many characteristics which differentiate the road traffic accident problem in developing countries from those in developed countries. For instance, though the levels of vehicle ownership in developing countries is still relatively low, the frequency and consequences of road traffic accidents are comparatively more severe. McKay (1979) proposed the following reasons for the difference:

1- In developing countries, a larger number of pedestrians, with little appreciation of the limitations of road vehicles' ability to stop and turn, share the roadway. This lack of education is compounded by the lack of physical barriers separating pedestrians from wheeled vehicles.

2- A proportionately larger number of older vehicles which are poorly maintained utilize the roadways of developing countries. Though vehicle ownership continues to increase exponentially, mechanical expertise remains in short supply and economic deprivation means that little can be spent on vehicle maintenance and repair. Thus, the proportion of accidents resulting from vehicle defects is very much higher than in industrialized countries.

3- Poor driving skills and frank incompetence are coupled with low driving licensing standards and many unlicensed drivers. Some developing countries do not even require driving aptitude testing to obtain a driver's license.

4- There are a large proportion of motorcycles on the road in developing countries with untrained, self-taught riders, because they are inexpensive and convenient. Representing a first step in powered transport, these machines, operated by vulnerable novice riders, add a negative factor to the mix of motorized traffic.

5- Overloaded buses and trucks in poor mechanical condition are a common sight in developing countries. Such vehicles often account for reports of single accidents involving fifty or more casualties. For example, in Colombia in 1977, one such accident resulted in 128 deaths.

6- Traffic regulations are frequently disregarded, especially in remote areas, in developing countries. The general populace are uneducated regarding the need for traffic laws and the enforcement effort is likely to be desultory.

7- In some developing countries, particularly those which are oil-rich, in adequate road systems are frequented by large numbers of new, high performance vehicles. Accidents result from this mismatch of technologies.

8- Unfortunately, it is those most important to the progress of developing nations who are most likely to be at risk. Vehicle occupants in emerging countries are more likely to be professionals, senior civil servants, and skilled technicians.

9- In Asian and South American countries, hybrid vehicles have emerged--the scooter-taxi and the bus-truck, respectively--which because of their wood-based, low technology construction are more vulnerable in collisions. A cheap and functional solution to transportation problems, they nevertheless place their occupants in a less survivable position in a road traffic accident.

10- Public and governmental information is lacking as to the level of the traffic accident problem. Rudimentary or nonexistent data collection systems leave both entities in the dark as to the scale and nature of this threat to public health. Though data collection systems may exist in theory, gross under reporting and inaccurate reporting frequently obviate their potential for shedding light on the issue.

11- As the road traffic accident problem is likely to constitute a new issue of governmental concern in many developing nations, local, regional and national authorities have neither the knowledge or resources to address it. Appropriate government agencies may not exist or may be recently formed, and with little understanding, lack the ability to apply remedial measures. Confusion may exist over with which existing agency (health, transport, police or the military) responsibility resides" (McKay, 1979).

The above factors, along with the fact that the real extent of the road traffic accident problem in Jamaica is not known, constitute the justification for this research. Because Jamaican officials do not understand the problem, its magnitude and impact on the health and economy of their country, they may be inclined to believe nothing can be done about it or are at a loss as to how to address the problem.

This study, in the context of a Ph.D. project, will utilize factual data, and discussions with officials and others concerned with road safety issues in exploring the problem in developing countries, with special attention to Jamaica. It will investigate approaches to road traffic safety utilized by other countries, and will include a site study of some "black spots" on a selected road in Jamaica. It is beyond the scope of this research to study the entire range of traffic problems in Jamaica; therefore, this effort will concentrate primarily on a rural road between Montego

Bay and Lucea (generally felt to be one of the most highly traveled roads in Jamaica). Finally, the budgetary process of estimating costs and directing investment for the purpose of instituting cost-effective improvements to successfully alleviate the problem of road traffic accidents in developing countries is addressed. A method is proposed for this purpose which does not rely on hard statistics, which are difficult if not impossible to come by in developing countries.

1-2. Objectives of Research

Utilizing a study of factors contributing to road traffic accidents in Jamaica as a vehicle for developing an approach to improvement of road safety in developing countries, the objectives of this research can be stated as follows:

1- To explore the extent and impact of the problem of road traffic accidents in developing nations, with some comparison of the problem in developed nations.

2- To generate a framework for investigating the problem of road traffic accidents which does not rely upon institutionalized statistical collection.

3- To prove or disprove whether the World Health Organization's published eleven (11) points apply to Jamaica.

4- To offer recommendations for remedying the causes of road traffic accidents in developing countries with emphasis on Jamaica.

1-3. Assumptions

Certain assumptions were necessary to facilitate the conduct of this research, as well as its report. These were:

1- Because of the different and unclear definitions given to the term "developing nation," it was necessary to determine which definition was most useful for the purposes of this research. Therefore, Jamaica is considered an underdeveloped nation, according to the definition that "any nations with a gross national product of $600 or less would be considered a developing nation," based on 1971 prices (Oxford Dictionary for Everyday Phrases, 12th Ed., 1981).

2- It was assumed at the beginning of this research that there are actually "black spots" on the road selected for study.

3- Because facilities were not available (time, financial resources, etc.) to enable the personal collection of data, it was assumed that data collected by the Jamaican police and other authorities is reliable.

1-4. Motivation for this Research

The author has always been interested in researching the problem of road accidents, as he is originally from a developing nation where road accidents have been personally devastating to him and his family. His interest in that direction was further developed when he became acquainted with Dr. Jabbari, then a Professor of Construction Management at the California State University in Fresno, California. Dr. Jabbari, having done his doctoral dissertation on a related subject at the University of Aston in Birmingham, inspired this research and has supported this effort as external supervisor.

As there was no opportunity to develop such research to an acceptable degree in Fresno, California, and, because, as the result of Dr. Jabbari's work there was a climate and substantial resources conducive to such research at Aston University in Birmingham, Dr. Jabbari suggested the author enter the external Ph.D. program at this institution. After much effort on the author's part, he was accepted into this program.

At this stage it was important to contact all prospective supporting organizations for such a project. Advice was duly solicited from the World Bank, the World Health Organization, Transport Road Research Laboratory (T.R.R.L.), and the University of Birmingham.

The original intention was to conduct road accident research in a middle eastern country. However, because of the turmoil that existed in the Middle East at the time this project began, an alternative had to be chosen. At the request of Dr. Jabbari, the World Bank was contacted for suggestions. After a short time, Dr. Jabbari and the author were invited by the World Bank's Executive Director of Transportation, Dr. Fosberg, to attend a meeting for further discussion of the project.

The World Bank had been interested for many years in allocating monies to projects towards the development of roads and the reduction of road traffic accidents in Jamaica. It was felt that the author's research would be likely to identify appropriate funding targets, and, thus, Jamaica was selected as the subject country by the World Bank staff. Unfortunately there were no World Bank funds available to support this research. Therefore, all monies spent on this project came from the author in the form of personal funds and financial help from family members who greatly believe in the importance of this research subject, and without whose assistance this project would never have been completed.

Time has been a major constraint as well. Since the author is a professional, working for a living, he could not dedicate all his time to the pursuit of this research. He had nevertheless to respond to time constraints imposed by the requirements of university policy and the World Bank's desire to have the research results rapidly available for developing funding guidelines.

Among the many problems to be overcome by this author from the very beginning of this project, travel between the United States, England and Jamaica was a necessity which proved to be very expensive, tiring and time consuming.

Had motivation been a problem for this author, there were sufficient obstacles and difficulties in the way of completing this effort to have terminated it long ago. However, in spite of it all, the author remained motivated, because he believes the results of this research may prove beneficial to many people in many countries around the world.

1-5. Definition of Terms

For the purpose of this study, the following definitions were used:

1- Developing Countries: Originally, a developing country was taken to be one with a vehicle ownership level of less than 1,000 vehicles per 10,000 population, but Cyprus, Kuwait, Singapore, and South Africa were later added to the list, which made the above definition obsolete. The distinction between developed and developing countries is by no means clear, and many different definitions have been used. In this study, countries similar to Jamaica are classed as developing, with a maximum gross national product of $600 per year 1971 base prices (Jacobs & Fouracre, 1977; B.C.E.O.M., 1979). (Also, see 1.3 above.)

2- A Fatal Road Traffic Accident: This is a road accident in which one or more vehicles either collide with each other, with an obstacle, a pedestrian or an animal, and as a result, one or more people loss their lives.

3- A Serious Injury Road Traffic Accident: This is a road accident in which one or more vehicles collide with each other, with an obstacle, a pedestrian or an animal, and as a result one or more people need hospital care.

4- A Slight Injury Road Traffic Accident: This is a road accident in which one or more vehicles collide with each other, with an obstacle, a pedestrian or an animal, and as a result one or more people suffer injuries which require first aid treatment only.

5- A Damage to Property Road Traffic Accident: This is a road accident in which one or more vehicles collide with each other, with an obstacle, a pedestrian or an animal, with resulting property damage which in Jamaica requires an expenditure of at least $10.0 for repair.

6- Fatalities: Care must be taken with this term, as definitions vary form country to country (See Table 2-7). Some countries consider that death occurred as the result of a road accident if the victim died on the spot (e.g., Belgium), some if the victim died within 24 hours (e.g., Spain), and some if the victim died within one year (e.g., U.S.A.). In this study, a fatality is considered to be death within one year and one day after the accident (Jamaican Traffic Police Department, 1985).

7- Personal Injury: Slight injury does not require hospitalization, but serious injury does require hospitalization.

8- Vehicles: Vehicles are defined, for the purpose of this study, as cars, trucks, minibuses, vans, motorcycles, and others (e.g., tractors, carriages pulled by animals, bicycles, etc.).

9- Slight Damage: Same as serious damage, but the cost of repairs would be less than $10.00 in Jamaica.

10- Traffic Flow: The number of vehicles using a certain junction or road within a specified time frame, e.g., 2,000 vehicles per day.

11- Black Spots: Defined as high accident rate locations, usually expressed in a ratio format. In this research, the term "black spots" is not expressed as a ratio, because there were no traffic flow statistics available for the road of study. The example below should help clarify the above statement:

> A junction or road that has 200 vehicles flowing through it every day, and has 10 accidents each day, is more dangerous than a junction that has 1,000 vehicles flowing through it daily and has 200 accidents occurring each day.

Therefore, when the term "high accident location" is used, the number of accidents in a specified time frame should be related to the number of vehicles using that particular location where the accident happened. Also, the improvements which prevent 10 accidents a day at a low traffic junction are likely to be relatively more expensive per accident prevented than will the same cost applied to a high traffic intersection reporting 20 accidents a day.

1-6. Methodology

Due to the complexity and the extent of the problem, several methodologies had to be developed in several stages in order to obtain the necessary information for subsequent analysis and recommendations.

Initially, a method had to be developed to identify the organizations involved in road safety in Jamaica. Although this was anticipated to be an easy stage, it turned out to be a rather difficult one. There is no one organization in Jamaica that deals only in roads and transportation.

The World Bank was first approached for some information relative to this aspect of the study. Unfortunately, they did not have any data directly related to Jamaica, but were able to supply some information useful in the initial literature review.

Finally, after lengthy discussions and research, it was found that what was called the Ministry of Construction Works and the Highway Police Department had some of the information needed for the completion of the research. Then a methodology for obtaining the necessary information from the correct organizations had to be developed.

For the literature review, a good deal of material was gathered from previously published research papers, books, and discussions. Unfortunately, none of it was directly helpful, nor could it be used without first sorting it out. Special techniques and methodologies discussed in the chapter on data collection were applied so that only relevant and reasonably reliable information would be presented to support the findings of this study.

The World Bank and the World Health Organization (W.H.O.) were first approached in an initial effort to gather specific data concerning the road accident problem in Jamaica. The data which they offered was inadequate for the purposes of this research. However, discussions with the World Bank and W.H.O. revealed that T.R.R.L. had actually conducted some research in Jamaica which produced those data subsequently provided to the World Bank and W.H.O. Therefore, T.R.R.L. in England was contacted and some information was acquired as a result.

The data received from T.R.R.L, nevertheless, presented problems similar to those found with the data offered by the World Bank and W.H.O. Therefore, it could be utilized only in a limited fashion within the review of literature. A great number of statistical formulae and derivations were presented in the T.R.R.L. material. It is felt that such formulae are not useful in research of this kind in developing countries, because there is simply not enough factual data to which to apply them. As the methods of data collection in these countries leave a great deal to be desired, such sophisticated formulae cannot be helpful in deriving reliable conclusions.

Finally, it was determined that the best methodology for collecting the most useful data for this research was to actually go to Jamaica. Therefore, the candidate and his advisor, Dr. Jabbari, each made a trip to Jamaica for this purpose. Due to limitations imposed by time and money, while in Jamaica, it was necessary to focus primarily on gathering as much available existing data as possible. Evaluation of the data collected in this fashion was postponed until return to the United States (methods of data collection are explained in Chapter 5). In general, however, even by this method, very little useful data were obtained.

Chapter 2

A Review of the Literature

2-1. Introduction

The problem of road traffic accidents is a new and not much understood issue in the developing nations. Until about the mid-seventies, there was little concern in these countries about how many people died as a result of road traffic accidents. Therefore, there was no effective attempt at any improvement in road conditions and very little research done on this problem.

Responsibility for road safety does not rest in any one academic field, but is spread over a truly multi-disciplinary area. Civil and highway engineers are responsible for the design and construction of the road system; mechanical engineers design, build, and maintain the vehicles using the road system; lighting engineers ensure that we are able to see at night by providing road and vehicle lighting; electronics engineers are responsible for many control systems on the road, and to an increasing extent in the vehicle. On the human side, psychologists study human behavior, ergonomists examine the immediate environment of vehicle operation; education services provide the population with road safety training. Support services are provided by the medical profession not only in the field of accident surgery, but also on the question of fitness to drive. Statisticians' experimental designs can give the information needed to evaluate changes in the system, and they provide, in cooperation with computer programmers, the tools to enable data storage and analysis.

However, these disciplines cannot work in isolation, as the findings of their research may affect other areas. Thus, the published work in this field is diversified in subject matter and, as the study of road safety expands due to social pressures created by the growth of the problem, it becomes more expensive.

The longer a subject is studied, the deeper and more specialized the research tends to become, but compared with the classical scientific disciplines, research into road safety is still moving from general topics into specific areas.

The effect of the many disciplines involved in gathering data which may ultimately be used in traffic accident countermeasures is that any review of the literature cannot hope to cover the entire field of traffic safety in depth.

This review will be no exception. Since the scope of this project is limited to the study of road traffic accidents in Jamaica and their prevention, all that will be attempted in this review will be a presentation of some of the work done to date on that subject matter.

2-2. Road Accidents as a Cause of Death in Developing and Developed Countries

To illustrate the extent of the road accident problem in developing countries, comparisons have been made between road accident fatalities and the number of deaths resulting from disease. The results have been shown by a World Health Organization (WHO) survey to be of particular concern to developing countries. Such an analysis was first carried out for the year 1968, and results were given in a paper presented at the Planning and Transport Research Cooperation (PTRC) Summer Meeting in 1975 (Jacobs & Hards, 1978). For the 10 countries for which data was available, it was found that road accidents ranked third as a cause of death, accounting for 13% of the total number of deaths studied. The analysis was repeated for the year 1975, using data from 15 countries:

1- Barbados
2- Cyprus
3- Hong Kong
4- India
5- Ivory Coast
6- Jamaica
7- Jordan
8- Kenya
9- Malawi
10- Malaysia
11- Mauritius
12- Singapore
13- Sri Lanka
14- Trinidad & Tobago
15- Zambia

In this later analysis (see Fig. 2-11), road accidents accounted for almost 17% of the total number of deaths studied, a value exceeded only by the number of deaths from enteritis (and other diarrheal diseases).

Although the countries for which data was available may not be representative of the entire Third World, it is clear

Fig. 2-1. Percentage of deaths by various causes in 15 developing countries (Jacob & Hards, 1978).

that road accidents in developing countries represent a growing social problem.

Road accident fatalities rank fourth as a cause of death in industrialized countries, after heart disease, neoplasms, and respiratory problems (MacKay, 1979).

Heart disease, cancer, stroke and accidents are the leading causes of death in the United States today. Figure 2-2 depicts the number of deaths attributed to these causes by single year ages in 1986.

Accidents were the leading cause of death of individuals from age 1 to 37 in 1986. The pattern of 1986 accident fatalities shows a substantial increase in fatalities occurred to persons between ages 14 and 21, rising from 699 for 14-year-olds to 2,336 for 21-year-olds. Persons age 21 suffered the greatest number of lives lost to accidents. Accident fatalities gradually decreased from age 21 to age 48, then remained relatively stable from age 48 to age 90 (National Safety Council, 1989).

Heart disease, the leading cause of death overall, was also the leading cause of death of persons age 63 and over in 1986. Heart disease fatalities peaked at 24,692 for persons 80 years of age (NSC, 1989).

Cancer, the second leading cause of death overall, was the leading cause of death of persons between ages 38 and 62 in 1986. Cancer deaths peaked at 15,390 for individuals age 72 (NSC, 1989).

Fig. 2-2 Accident Facts, 1989

(Source: National Safety Council tabulations of National Center for Health Statistics data. ICD codes are 390-398, 404-429 for heart disease; 140-208 for cancer; 430-438 for stroke; E800-E949 for accidents.)

The third leading cause of death in the United States in 1986 was stroke, which overtook accidents as the third leading cause of death of persons age 55 to 88 and overtook cancer as the second leading cause of death of persons age 89 and over. Stroke deaths peaked at 5,825 for persons age 83 (NSC, 1989).

Motor-vehicle accidents, falls, drownings, and fires and burns were the leading causes of accidental death in the United States in 1986. Figure 2-3 depicts the number of deaths attributed to these causes by single year ages in that year.

Motor-vehicle accidents were the leading cause of accidental death overall and the leading cause of accidental death of persons age 1 to 78 in 1986. The distribution of 1986 motor-vehicle fatalities shows a sharp increase for persons age 12 to 21, rising from 235 for 12-year-olds to 1,789 for 21-year-olds. The greatest number of motor-vehicle fatalities occurred to persons age 21 in 1986.

The second leading cause of accidental death overall in 1986 was falls. Falls were the leading cause of accidental death of individuals age 79 and over; falls deaths peaked at 398 for individuals age 86.

Drowning was the third leading cause of accidental death in the United States in 1986. Drowning fatalities reached a high of 241 for 1-year-olds; drowning was the second leading cause of accidental death for persons age 1, 2, and 6 to 41.

Fig. 2-3 Accident Facts, 1989

(Source: National Safety Council tabulations of National Center for Health Statistics data. ICD codes are E810-E825 for motor-vehicle; E880-E888 for falls; E830, E832, E910 for drowning; E890-E899 for fires.)

The fifth through ninth leading causes of accidental death in 1986 were poisoning by solids and liquids, suffocation by ingestion, medical misadventure, firearms, and poisoning by gases and vapors, respectively.

2-3. International Statistics on Traffic Accidents

In comparing international statistics on traffic accidents, a number of factors must be considered. Crude statistics, as in Tables 2-1 and 2-2, are not sufficient to evaluate comparative vehicle density, population density, annual vehicle kilometerage and road kilometerage. In addition, unquantifiable factors like the degree of urbanization and social characteristics must be considered relevant in any comparative analysis of road traffic accident problems. Although a general one exists, many countries use different definitions of traffic fatality. Wide variations range from the Belgian definition of a death occurring at the scene of the accident to the more frequent usage--death occurring with 30 days following involvement of the victim in a traffic accident (Department of Environment, 1989).

In Table 2-3, the international differences in car ownership rates, the fatality rates per million persons, and the vehicle density in terms of vehicles per road kilometer are presented. Exact comparisons of the relationship between vehicles and road kilometerage between different countries is frustrated by varying local definitions of what constitutes a

Table 2-1

International Comparisons of Road Deaths, and Rate for Different Road Users, by Selected Countries, 1987

(HMSO Statistics Report, 1989)

	Number of Road Deaths	Motor Vehicles per 1,000 Population	Road Deaths per 100,000 Population	Road Deaths per 10,000 Motor Vehicles	Car User Deaths per 100 million Car Kilometers	Pedestrian Deaths per 100,000 Population
England	4,340	411	9.2	2.2		3.0
Wales	220	386	7.8	2.0		2.4
Scotland	556	311	10.9	3.5		3.8
Great Britain	5,125	400	9.3	2.3	0.9	3.1
Northern Ireland	214	308	13.6	4.4		4.6
United Kingdom	5,339	398	9.4	2.4		3.1
Belgium	1,922 (c)	443	19.5	4.4	2.8	3.3
Denmark	698	400	13.6	3.4	1.2	2.7
Fed. Rep. of Germany	7,967	531	13.0	2.5	1.2	2.8
France	10,742 (d)	542	19.4	3.6	2.2	2.9
Greece	1,682	230	16.9	7.3		4.1
Irish Republic	461	253	13.0	5.2		4.0
Italy	7,108 (c)	525	12.4	2.5	1.7	2.2
Luxembourg	68	511	18.4	3.6		1.9
Netherlands	1,485	429	10.1	2.4	1.1	1.2
Portugal	3,100	271	31.5	11.2	3.0	8.5
Spain	7,615 (a)	383	19.6	5.1	6.4	3.6
Austria	1,469	522	19.4	3.6	2.8	3.3
Czechoslovakia	1,393	219	8.9	4.1		3.1
Finland	581	427	11.8	2.8	1.0	2.8
German Dem. Rep.	1,531	313	9.2	2.9		2.9
Hungary	1,571	214	14.8	6.9		5.2
Norway	398	499	9.5	1.9	1.0	1.9
Poland	4,625	176	12.2	7.0	5.5	5.5
Sweden	787	461	9.4	2.0	1.0	1.7
Switzerland	904	581	13.8	2.5	1.2	3.1
Yugoslavia	4,526	169	19.3	11.4	7.5	5.9
Australia	2,771	577	17.1	3.0		3.2
Canada	4,280 (b)	590	16.6	2.8		2.5
Japan	12,151	563	9.9	1.8	1.4	3.0
New Zealand	767	632	23.1	3.7		3.4
U.S.A.	46,386 (b)	784	19.5	2.5	1.0	3.4

(Source: Motor vehicle deaths, World Health Organization. Vehicle registrations, Motor Vehicle Manufacturers Association of the U.S., Inc., Motor Vehicle Facts and Figures, 1989 Edition.)

Death definition: In general, deaths are included if they occur within 30 days after the accident, but other time periods are as follows: (a) 24 hours, (b) one year, (c) at accident scene only, (d) three days.

road (National Safety Council, 1989). Nevertheless, Great Britain is shown to have comparatively low traffic accident

Table 2-2

Some International Vehicle Ownership and Road Accident Fatality Rates

(Jabbari, 1981)

Country	Year	Vehicle Rate (Vehicle/ Person	Road Accident Fatalities per 10 Persons	Road Vehicle per Kilometer of Road
U.S.A.	1979	0.43	278	16.9
N.Zealand	1980	0.31	194	10.8
Canada	1980	0.29	257	9.8
Australia	1980	0.29	281	4.7
Sweden	1980	0.29	159	13.2
France	1980	0.24	292	17.1
G.Britain	1980	0.21	139	37.2
W. Germany	1980	0.21	274	35.1
Belgium	1980	0.21	149	23.1
Switzerland	1980	0.20	248	24.2
The Netherlands	1980	0.20	256	35.2
Italy	1980	0.17	187	36.7
Japan	1980	0.08	171	16.5

fatalities per capita while reporting highest vehicles per mile figure. The U.S.A., in contrast, shows a high fatality rate with a relatively low vehicles per mile figure. But no true allowance for exposure is factored into these comparisons. The annual kilometerage maybe quite different for similar types of vehicles, for instance, and in the U.S.A. accident mean speed is likely to be higher than in Great Britain, thus the higher fatality rate.

Urban/rural population distribution and distance between population centers are elements which need to be factored into the equation. In 1988, 64.5% of fatal accidents in the U.S.A. occurred in rural areas (National Safety Council, 1989), while Great Britain's share of rural road fatalities was 48.8% (Department of Environment, 1988). A 1988 report noted that for the period studied, in the U.S.A., only 17.9% of road traffic accident deaths were pedestrian fatalities (National Safety Council, 1989), while Great Britain's figure in this category was 35% (Department of the Environment, 1988).

Demonstrating that population size (P) and the number of vehicles (V) can account for much of the variation in road deaths between different countries and at different times in the same country, Smeed (1949) offered the following formula:

$$\text{Annual road deaths} = 0.003\ (V.P^{2})^{1/3} = V/P$$

This widely applicable formula clarifies the relationship of the degree of motorization or vehicles per capita (V/P) to annual road deaths. Deaths per vehicle fall as V/P rises; road deaths rise less with increasing vehicle ownership than might be expected. It is reasonable to conclude that this relationship is an indicator of the many changes which follow upon increasing vehicle ownership per capita, e.g., improved roads, better vehicles, changes in driving behavior, and higher quality medical care for casualties (see Fig. 2-4).

These adaptations to increasingly technologically sophisticated means of road transport have been made over 70

Fig. 2-4. Typical relationship between fatalities per inhabitant and motor vehicles per 1,000 inhabitants*

(Source: Carlson and Hedman, 1989)

*This relationship would differ from country to country, because of the various definitions of "Fatal Accident." In general, the relationship will be the same with variations in the slopes of the lines (hence the rate of change).

These adaptations to increasingly technologically sophisticated means of road transport have been made over 70 years or more in the industrialized countries. Changes have been more rapid in many developing countries. Thus, for certain periods of time in these countries, Smeed's statistical relationship does not apply. In cases of very rapid modernization, the death rate per vehicle may rise with an increasing level of vehicle ownership.

Thus, in some developing countries, over a short period of time, the likelihood of being involved in a traffic accident may become so great that road deaths per capita exceed levels in industrialized countries, even though vehicle ownership numbers are still relatively low. Figure 2-5 demonstrates this relationship in the case of Zambia.

2-4. Road Accident Problems in Developing Countries

In developing countries, in 1974, there were over 100,00 people killed and over 1,500,000 seriously injured as a result of road traffic accidents (Jacobs & Hards, 1978), and the situation is getting worse. Up to 1972, very little research had been carried out on the problem of road accidents in developing countries. However, following requests for aid and guidance in this field, in 1972, a small team was formed within the Transport and Research Laboratory (T.R.R.L.) overseas unit to carry out some work on developing countries' road safety problems.

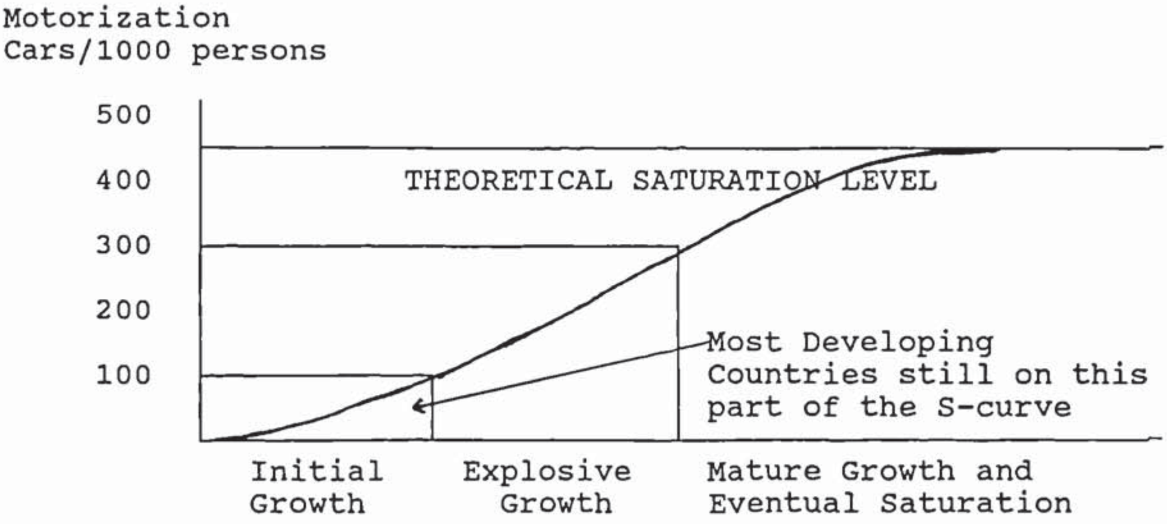
In those developing countries which are rich in oil, Nigeria, for instance, road casualties have increased spectacularly. Although gross under reporting probably occurs, road deaths have doubled in the past six years (MacKay 1979). But, in other developing countries without oil the increase has been less abrupt. In general, it is

Fig. 2-5. Fatalities per million population by year (Ogren, 1979; Jacobs & Fouracres, 1977).

likely that most of the developing countries are now entering a period of very rapid and sustained growth of vehicle ownership, and, hence, road accidents. The experience of the industrialized countries indicates that vehicle ownership, with time, follows a classical "S" curve (see fig 2-6). Although there is uncertainty over the final asymptotic level of stable ownership, it appears that many countries are reaching the point on the lower part of the "S: curve where the growth rates take off from very low levels and increase linearly for a number of years. Particularly, if oil is available, it is likely that the growth rates will be very much faster than has been the case in the industrialized world.

In order to investigate the changing pattern of fatality and injury rates over time, fatality and casualty rates per licensed vehicle were obtained for the years 1967 to 1977 (Table 2-3). It was found that there was a tendency for most of the rates related to licensed vehicles to decrease with time. Of the 21 countries studied, most showed a decrease with time, 15 showed a decrease in fatalities per vehicle, and 18 countries showed a decrease in injuries per vehicle. This analysis agreed with that carried out by Smeed in 1953 and again in 1968 (mainly in developed countries), which showed decreases in 15 out of 16 countries studied.

Zambia, Jamaica, and Kenya were among the countries which had considerable increases in the number of fatalities per licensed vehicle and, in such counties, unusual factors



1985 Car Ownership/1,000 Population

USA	540	Malaysia	91
Australia	426	Chile	53
Canada	443	Jordan	45
FDR	428	Turkey	24
France	382	Egypt	19[a]
Sweden	877	Thailand	10
Netherlands	338	Kenya	12[a]
UK	304	Pakistan	3
Japan	230	India	4[a]
Hungary	135	Ethiopia	1

[a] Private and commercial vehicles, but excluding motorcycles.

Fig. 2-6. Generalized vehicle ownership growth - S curve.

(Source: Ross, 1991)

may be operating. Thus, by examining trends over a period of time, it is possible to identify countries where the road accident situation is worsening. From the above analysis, Kenya, Malawi, Zambia, Botswana, Jamaica, and Nigeria fall into this category (Table 2-3).

Having studied changes in fatality rates over a 10-year period, the analysis was repeated for both longer and shorter time periods. The analysis was first repeated for as long a period as possible (up to 20 years), and then for the four year time period, 1974-1978. Results are given in Table 2-4. Over a longer period of time (mainly 1958-1978), the results are similar to those obtained in the earlier analysis of 22 countries over the 10-year period (1967-1977).

Thus, of the 26 countries for which data was available (15 developing Table 2-4, and 11 developed Table 2-5), 23 showed a decrease in fatality rates. Those showing an increase were all developing countries, namely: Kenya, Zambia, Jordan, and Sri-Lanka (Table 2-4). Similar results can be seen in developing countries in later periods (1971-80, 1980-84).

Over the four-year period, all 11 developed countries again showed a decrease in fatality rates. Of the 15 developing countries, eight showed an increase. Thus, over this shorter period, approximately two-thirds of the developing countries in the group of countries considered showed increase in fatality rates, indicating that the accident situation had worsened considerably over this short

Table 2-3

Percentage Change in Vehicle Ownership Fatality
and Injury Rates in Different Countries Over a 10-year Period
(1967 was used as the base year)

(Jacobs & Fouracre, 1977)

Country	Vehicles per Capita	Fatalities per Capita	Injuries per Capita	Fatalities per Licensed Vehicle	Injuries per Licensed Vehicle
Australia	+ 38	+ 18	+ 24	-15	-10
Botswana	+ 44	+ 69	+ 36	+16	- 7
Br. Honduras	+205	+ 95	+ 32	-37	-57
Ceylon	+ 36	+ 26	- 31	-10	-50
G. Britain	+ 41	+ 5	+105	-43	- 1
Guyana	+ 85	+ 74	+ 70	-26	-33
Hong Kong	+128	+ 42	+ 45	-40	-39
Jamaica	+ 26	+ 95	+ 16	+55	-33
Japan	+461	+ 14	+176	-80	-51
Kenya	+ 30	+123	+ 43	+78	+14
Malawai	+ 11	+ 37	+ 22	+22	+10
Malaya	+123	+ 70	+ 37	-24	-38
New Zealand	+ 48*	+ 13	+ 28	-24	-14
Nigeria	+ 33	+ 58	- 12	+27	-28
Singapore	+133	+ 41	+ 16	-34	-46
Sabah	+173	+103	+128	-28	-18
St. Lucia	+180	+165	- 21	- 4	-72
Tanzania	+ 50	+ 32	+ 23	- 2	-10
Turkey	+140	+ 59	+ 44	-28	-35
USA	+ 37	+ 29		- 6	
Zambia	+ 47	+125	+127	+52	+54

*1967 and 1977 figures not available, therefore 1965 and 1973 figures were used.

time. Over this period, although vehicle ownership had increased substantially (approximately 40% on average, it is possible that measures necessary to reduce accident rates, regulations and improvement in vehicle safety standards, had

Table 2-4

Percentage Change in Fatality Rate per 10,000 Vehicles in Different Developing Countries Over the Period 1974-1978, 1958-1978, 1970-1979 and 1979-1983

(Source: Jacobs & Hards, 1978)

Country	Changes in Fatality Rates 1974-1978 (%)	Changes in Fatality Rates 1958-1978 (%)
Barbados	- 4.6	-52.7
Cyprus	-26.6	-73.2
Hong Kong	-25.5	-62.7
India	-23.6	-22.8*
Ivory Coast	-23.7	-33.4
Jamaica	+ 8.8	- 3.7**
Jordan	+23.0	+ 9.6
Kenya	+30.8	+153.1
Malawi	+ 7.5	-24.5
Malaysia	+56.3	-24.7**
Mauritius	+29.2	-26.4
Singapore	- 4.2	-44.2
Sri-Lanka	+ 0.8	+47.4
Trinidad and Tobago	+ 2.7	-58.3
Zambia	- 4.9	+54.6
	1970-1979 (%)	1979-1983 (%)
Botswana	- 0.5	- 5.1
Chile	- 4.7	- 8.2
Ethiopia	+ 0.5	- 6.7
India	+ 2.0	- 5.7
Jordan	- 7.1	- 3.8
Kenya	+ 1.5	- 3.6
Malaysia	+ 3.3	-14.7
Morocco	- 2.7	- 5.8
Niger	- 3.6	-12.3
Pakistan	+ 4.1	- 5.4
Sri Lanka	- 2.2	- 0.4
Thailand	+ 4.7	- 6.0
Tunisia	+ 2.4	- 6.1
Turkey	- 7.1	- 7.7
Nigeria	- 1.9	- 4.9
Mauritius	- 5.9	- 5.5

* 10-year period

** 15-year period

Table 2-5

Percentage Change in Fatality Rate per 10,000 Vehicles in Different Developed Countries Over the Period 1974-1978, 1958-1978, 1979-1979 and 1979-1983

(Source: Jacobs & Hards, 1978)

Country	Changes in Fatality Rates 1974-1978 (%)	Changes in Fatality Rates 1958-1978 (%)
Australia	-17.4	-46.3
Canada	- 8.6	-34.1
Denmark	- 8.8	-66.3
France	- 1.2	- 8.7**
West Germany	-13.8	-87.2*
Great Britain	-81.8	-47.9
Italy	+17.5	-54.9**
Japan	-22.7	-92.2
Poland	- 8.1	-82.5*
Sweden	-26.1	-41.0**
Switzerland	- 7.3	-69.0
	1970-1979 (%)	1979-1983 (%)
Australia	- 4.0	- 8.0
Belgium	- 4.9	- 3.7
Denmark	- 4.4	- 0.6
Finland	- 8.0	- 3.6
Great Britain	- 4.3	- 2.3
Germany W	- 6.8	- 7.0
Ireland	- 3.8	- 1.1
Netherlands	- 5.1	- 5.7
N Zealand	- 4.4	0
Norway	- 6.4	- 1.1
Spain	- 5.3	- 3.5
Sweden	- 6.0	- 3.0
USA	- 3.9	- 4.8

* 10-year period

** 15-year period

not kept pace with the rise in vehicle ownership. Results of later studies (1979-1983) shows that rates of fatality accidents have actually been reduced. This fact is very encouraging and means that some of the developing countries are beginning to take note of their serious road accident problems.

2-5. Trends in Fatality Rates

Predicting trends in road accident fatality rates depends upon reliable analysis of past and current fatality rates. Smeed (1949) developed a formula for this purpose using 1938 road fatality data from 20 European countries, the U.S.A., Canada, Australia, and New Zealand. The relationship is expressed as follows:

$$F/V = 0.003\ (V/P)^{-2/3}$$

where F = road fatalities
V = number of vehicles
P = population

Smeed's method was again employed by Jacobs and Hutchinson (1979), and Jacobs and Fouracre (1977) in two studies analyzing developing countries' fatality rates over several years. Both studies produced a statistically significant relationship at the 1% level, shown in Figure 2-7. Figure 2-7 demonstrates that the fatality rate decreases as vehicle ownership increases. Thus, developing countries with fewer vehicle owners produce higher fatality rates (Jacobs & Fouracres, 1977), as shown in Table 2-6, with the exception of Zambia. Thus, vehicle

Table 2-6

Fatality and Vehicle Ownership Rates in Developing Countries

(Jacobs & Hards, 1978)

Country	Fatalities per 10,000 Vehicles	Vehicles Licensed per 10,000 persons
Angola	108.0	9.7
Botswana	43.2	278.0
Cameroon	18.2	748.2
Chile	21.1	519.0
Congo	56.9	150.7
Colombia	34.5	243.3
Ethiopia	206.1	15.5
Ivory Coast	42.3	109.6
Indonesia	35.9	83.3
Jordan	44.1	427.0
Kenya	65.4	166.3
Korea (S)	29.0	355.8
Liberia	62.0	134.3
Lesotho	111.2	88.6
Mauritius	340.2	22.9
Mexico	18.2	748.2
Malaysia (W)	16.21	196.0
Malawi	173.5	62.1
Morocco	46.6	278.0
Mali	21.3	127.3

Table 2-6 cont.

Fatality and Vehicle Ownership rates in <u>Developing</u> Countries

(Jacobs & Hards, 1978)

Country	Fatalities per 10,000 Vehicles	Vehicles Licensed per 10,000 persons
Niger	68.7	57.0
Nigeria	234.8	48.7
Panama	29.7	511.1
Pakistan	53.2	93.3
Peru	611.4	17.0
Sierra Leone	44.2	114.0
Sri-Lanka	48.2	131.2
Senegal	34.8	142.5
Swaziland	88.9	310.0
Taiwan	17.7	1295.3
Thailand	26.8	3340.0
Togo	56.7	147.3
Tunisia	39.8	364.4
Turkey	53.3	364.4

* 10-year period.

** 15-year period.

Fig. 2-7. Relationships between fatality rates and levels of vehicle ownership (Jacobs & Hards, 1982).

ownership doubled from 1967-1974 with a concomitant increase in fatalities of 181% per vehicle (Emanlo, Puustelli, Ciampi, Joshi, 1977).

2-6. Factors Affecting Accident Fatality Rates

As vehicle ownership increases, it would be expected that vehicle-vehicle and vehicle-pedestrian accidents will increase. It might also seem logical to assume that as the number of vehicles owned in a country increases, rates of vehicle accident injury and fatality would increase. Jacobs and Hards (1982), however, demonstrated that the rates of vehicle accident fatalities and injuries fall with increasing vehicle ownership. This relationship is shown in Figure 2-7. In analyzing this trend, Garwood and Munden (1968), in a study of Great Britain, demonstrated that, while the total number of casualties per vehicle mile traveled fell over time, the rate per vehicle mile for drivers of cars, other four-wheeled vehicles, motorcyclists and pedal cyclists rose. The following explanations were put forward:

1- Over time, riders and passengers of two-wheeled vehicles, who show the highest casualty rates per mile traveled, decrease in their proportion of total traffic.

2- Not included in these statistics are pedal cyclists and pedestrians, however, casualties in this group do not show as fast a rate of increase as the total casualties.

3- Pedestrian casualties per motor vehicle mile are falling for the deferent classes of vehicle.

Garwood and Munden's findings suggested that, perhaps, the fact that vehicles with the highest accident rates are decreasing in numbers accounts for the decreased rates per vehicle over time in most countries. Further, the increasing construction of shopping malls, pedestrianization of central shopping areas, and improved pedestrian crossing facilities may have contributed to the decline in pedestrian accident rates per vehicle. These effects were confirmed in a study of developed countries by Smeed (1968) as having a significant impact on dampening motor vehicle casualty and fatality rates over time.

In contrast to the downward trend exhibited by most other developed and developing countries, however, as demonstrated in Table 2-3 above, Kenya, Jamaica, Zambia and Nigeria showed an upward trend in fatality rates per vehicle over time.

Garwood and Munden's work suggests that such aberrant trends may be due to a rapid increase in vehicle ownership or the failure to improve pedestrian facilities, thus deceasing pedestrian/motor vehicle conflicts.

2-7. Measurement of Exposure

For comparison of traffic hazards in different areas, or at different times, or to different classes of road users it is important to take exposure to the hazard into account. A number of different measures of exposure are currently used and are described by the Institute of Traffic Engineers

(1965), Department of Scientific Research (1963), and Johanson and Garwood (1972). The rates most commonly used are:

1- Casualties or accidents per capita.

2- Casualties or accidents per mile (or kilometer) of road.

3- Casualties or accidents per vehicle mile (or vehicle kilometer).

4- Casualties per vehicle accident.

The amount of exposure differs for each measure mentioned above. Casualties per capita is the measure usually used to describe pedestrian casualty rates, although it does not take into account possible differences in the number of kilometers (miles) driven per vehicle (Hayes, 1983).

A measure of casualties or accidents per unit of road length is only valid for comparative purposes when traffic flows on the lengths being compared are similar. The most widely used basis for comparison is the rate per vehicle kilometer. Accidents or casualties per vehicle kilometer takes into account traffic volume and the kilometers driven. This measure is used for comparison of different road types and vehicle classes, and for comparisons between countries, although caution is needed when making such comparisons. At intersections, it is meaningless to consider accidents per vehicle kilometer, since the distance over which such a rate is being calculated is virtually zero. Thus, a better description of the accident rate is obtained simply by accidents per vehicle entering the junction. Accepting these current measures of exposure, Hadden (1964) pointed out two important aspects of their use. First, the kilometers driven by each class of vehicle are calculated from fuel usage, and the average consumption rate by the different types of vehicle. It is thus inappropriate to apply rates calculated on such a gross scale to local conditions where the quality of the exposure may differ considerably from the average. Second, vehicle occupancy rates differ for different types of road, at different times of day, and for different classes of vehicle. These variations make casualty rate comparisons more liable to error.

A serious difficulty encountered in making comparisons between countries arises from the employment of different definitions of traffic accident fatality. Table 2-7 shows some definitions used.

Using the data in Table 2-7, it can be seen that the definition of a traffic accident fatality used in the U.S.A. is death within one year of the accident, while in Belgium it is defined as death at the scene of the accident. Therefore, comparison of traffic accident fatality rates of these two countries is difficult.

Jamaica defines a traffic accident fatality as death occurring 24 hours after occurrence of an accident (Traffic Police Department, 1985). Therefore, it is difficult to compare Jamaica with the U.S.A., U.K. or Australia.

Table 2-7

Traffic Accident Fatality Definitions for Various Countries
(World Health Organization 1990)

Country	Definition of a Fatality Death Occurring
Austria	Within 3 days of the accident
Belgium	At the scene or immediately afterwards
Canada	One year of accident
Denmark	Within 30 days of the accident
Finland	Within 30 days of the accident
France	Within 3 days of the accident
Great Britain	Within 30 days of the accident
Hungary	Within 48 hours of the accident
Ireland (Eire)	Within 30 days of the accident
Italy	At the scene of the accident
Netherlands	Within 30 days of the accident
Norway	Within 30 days of the accident
Poland	Within 48 hours of the accident
Portugal	Within 30 days of the accident
Spain	Within 24 hours of the accident
Sweden	Within 30 days of the accident
Switzerland	Within 30 days of the accident
U.S.A.	Within 1 year of the accident
West Germany	Within 30 days of the accident
Yugoslavia	Within 30 days of the accident

2-8. Cost of Road Accidents

Before studying any road accident costs in Jamaica, let us look at some work that has been carried out in developed countries. In 1988, in the U.S.A., the estimated cost of motor vehicle accidents was or \$7.0 x 10^{10} (National Safety Council, 1989) and in 1988, in the U.K., was over 5.5 pounds x 10^{8} (DOE 1990). In the calculations of accident costs, there are a number of aspects which must be considered, including:

1- cost of permanent disability,

2- cost of medical treatment,

3- cost of vehicle and property damage,

4- administrative costs

5- subjective costs -- pain and suffering, and

6- cost of productive time lost as the result of an accident.

To date, there has been almost no cost analysis of Jamaican accident data, but, in the U.K., four studies have been made to calculate the cost of road accidents. The earliest was by Jones (1946), using data for 1938. This was followed by Reynolds (1956) and by Damson (1967, 1970). The absolute cost of accidents calculated by different authors is of little interest since comparisons are made difficult by the conversions needed due to price and wage increases. It is methodologies used in arriving at these cost figures which are more useful.

Jones (1946) did not break his calculations down into the sections listed above, but considered only compensation for injury were based upon court awards. The effect of this method is to consider only the more serious injuries and then to use a nonrepresentative value for these, since court awards tend to be skewed in their distribution. Jones tried not to include any contribution for pain and suffering, as this can be difficult.

Reynolds (1956) used basically the same system as that of the government (explained above), but used 1952 costs. Dawson (1967) was the first of the British authors to make any allowance for the non-pecuniary losses resulting from an accident. Thedie and Abraham (1961), in a French study, included about $5,000 per fatality for effective losses, including pain and suffering compensation ad other factors. Dawson added (in 1963 values) $12,000 per fatality and $500 per serious injury accident.

Thorpe (1963) reports that, based on insurance claims and on minor accidents not involving claims, the costs of accidents in the state of Victoria, Australia, was about $60 x 10. The true cost would be considerably higher if subjective costs were included.

More recent work, published in 1980, was carried out on the costs of road accidents in Great Britain for the year 1977 by Barbara E. Savey and H. Taylor. They found that, in Great Britain in 1977, there were 6,000 deaths, 81,700 serious injuries (usually requiring hospitalization), and

259,770 lesser injuries reported in the police statistics. It is known that injuries are underestimated by probably 30%. In addition, it is estimated that at lease another 1½ million non-injury accidents were reported to insurance companies and an unknown number of accidents do not appear in any statistics. The costs of these accidents to the community have been fairly reliably assessed at $1.8 billion in resource costs, damage to vehicles and property (over half the total), and costs of police and administration of accident insurance (see Table 2-8). For 1988 see Table 2-9.

Over and above these costs are the costs of pain, grief and suffering to the involved person, relatives and friends. These are very real costs to the society, but are by their nature not directly quantifiable in monetary terms. In recognition of the relevance of these losses, current practice in Great Britain is to include what can only be regarded as a national minimum allowance for subjective costs, which totals $680 million, and averages $50,660 per fatal accident. However, a recent appraisal of these figures (Sabey, 1980) suggests that they are not in line with general principles of cost benefit analysis. A survey of studies where researchers have attempted to evaluate how an individual values risk has revealed figures for value of life between 2 ½ and 10 times this average. It is also true that the U.K. accident values are consistently lower than those of other countries.

Furthermore, it is difficult to calculate the lost output of persons in developed countries, because of the way computers and robots are doing people's work in different industries. In some respects, it is possibly less costly for' some developed countries to lose these people--unemployment is high, so these deaths allow other people to take the vacated places--it means the state has one less person to support.

Table 2-8

Costs of Road Accidents in Great Britain in 1977

(Sabey, 1980)

	Total Stg Pnds Million	Stg Pnds per Accident		
		Fatal	Serious Injury	Slight Injury
Lost Output	560	75,000	1,400	40
Police and Administration	150	300	200	180
Medical and Ambulance	88	60	1,010	60
Damage to Property	1,080	1,620	1,290	880
Subtotal	1,878	77,520	3,900	1,160
Pain, Grief and Suffering	680	50,660	4,850	100
Total	1,558	128,180	8,750	1,260

Table 2-9

Average Cost per Casualty and per Accident
Great Britain, 1990

(DOE, 1990)

Casualties		
Fatal	551,600	610,320
Serious	16,720	21,410
Slight	340	2,010
Average All Severities	12,210	17,670
Damage		770

2-9. Road Accidents as a Cause of Death in Jamaica

The size of the current problem in Jamaica is demonstrated in Table 2-10, which shows the accident statistics by results for several years. The table shows a total of 5,106 accidents took place in 1981 alone. The above figure may not appear large, but for a country as small as Jamaica (population 2,200,000 1982 Census), it should be considered disastrous. A brief comparison between the number of fatal average between Jamaica and Great Britain, taking into consideration the population, shows that Jamaica's fatality/population is 68% higher than that in Great Britain.

2-10. Jamaica's Statistics on Traffic Accidents

In general, basic traffic accident statistics in Jamaica are fragmentary, and, unlike most developed countries, there is no central organization which records all the accident statistics for the whole country. The urban traffic police, a division of the national police, collect and record urban road traffic accident data and the highway police, who are also part of the national police, collect and record rural road traffic accidents.

In 1981, there were 5,106 serious damage accidents reported on rural roads in Jamaica, involving 8,301 light and heavy vehicles (Traffic Police Department, 1985). However, many accidents are not reported to the police, because of the legal procedures involved for drivers. This is especially true for the guilty drivers, because the parties have to spend a lot of time in legal processing. Usually, the parties agree to sort the matter out between themselves, unless one of the parties requires police attendance. An informal estimate from the Jamaican road police places the number of road accidents at 10 times the reported figure (Bendley, Keith, 1985). This is especially true in cases where a road goes through a populated area.

Using the data in Tables 2-10 and 2-11, it can be shown that the number of fatalities and serious injury accidents were less in 1974 than in any other year, although the number of vehicles licensed had approximately doubled. This was due to the oil shortage, which was a result of the Oil Producing Economic Community (OPEC) oil embargo.

2-11. Number of Vehicles in Jamaica

There are no official sources in Jamaica that could provide the number of vehicles in use in the country. The only official source which could give the actual number of vehicles registered in the country for different years is the Department of the Collector General. The figures are shown in Table 2-11.

However, in most towns, vehicle number plates are issued by the Police Department. The police know, of course, exactly how many vehicles are given plates, but when a vehicle is scrapped, they are rarely informed. Therefore, there is no reliable data showing the size, age, and composition of vehicles.

Vehicle ownership rates in Jamaica are rising rapidly, often tripling in a 10-year period (see Table 2-11 for 1967/68-1979/80). A concomitant increase in road traffic accidents in Jamaica has resulted in their constituting a major national health and economic problem, with some distinct differences from accidents in developed countries. Nevertheless, in spite of the relatively large toll in human lives, causing grief and hardship to thousands of Jamaican citizens, wives and children, the response has been inadequate. Road traffic accidents, therefore, constitute an issue of serious concern to Jamaican society--remedial measures are demanded.

Table 2-10

Road Traffic Accidents in Jamaica by Results, 1967-1981

(Department of the Collector General, 1985)

Year	Total	Accidents Involving Deaths	Serious Personal Injury	Slight Personal Injury	Damage to Vehicle Only
1967	9,944	264	977	2,914	5,789
1968	9,964	305	928	2,732	5,999
1969	8,925	311	886	2,448	5,240
1970	8,315	328	1,023	2,342	4,622
1971	8,001	364	997	2,115	4,525
1972	8,485	381	1,063	1,993	5,048
1973	8,264	405	1,027	1,792	5,036
1974	7,365	368	944	1,677	4,376
1975	8,443	414	1,223	1,836	4,970
1976	7,339	399	1,076	1,466	4,398
1977	7,432	357	1,269	1,426	4,380
1978	6,674	323	1,348	1,128	3,875
1979	5,813	287	1,047	1,019	3,460
1980	4,838	264	782	750	3,042
1981	5,106	247	782	805	3,262

(Source: Police Traffic Department)

Table 2-11

Road Motor Vehicles Licensed in Jamaica, 1967/68-1979/80

(Department of the Collector General)

Period	Cars**	Trucks Tractors & Buses	Motor-cycles	Trailers
1967-1968	60,428	17,472	8,383	3,126
1968-1969	68,996	19,872	10,525	3,351
1969-1970	72,244	21,129	11,191	4,195
1970-1971	93,425	21,720	11,191	3,203
1971-1972	86,373	21,862	7,328	3,583
1972-1973	32,749(a)	11,676(b)	7,852	3,597
1973-1974	109,628	28,609	9,084	4,265
1974-1975	70,491	18,852	11,565	3,356
1975-1976	58,671	12,569	11,958	832
1976-1977	55,969	12,430	10,510	1,074
1977-1978	48,101	13,946	9,263	862
1978-1979	39,446	12,336	7,578	882
1979-1980	142,421	35,407	18,316	3,809

* April 1st - March 31st

** Includes PMC; PPV; CMC

(a) This figure is very incomplete as it does not include returns for major towns including Kingston, Spanish Town and Mandeville.

(b) Buses not included.

2-12. The Cost of Road Accidents in Jamaica

The cost of road accidents in Jamaica is extremely high, because the majority of people at risk as car occupants in Jamaica are the very people most valuable to the community. Such casualties include professionals, senior civil servants, doctors and technicians--those people most useful to the economic development of the country.

The author has been unable to find any research that has been carried out to estimate the cost due to road traffic accidents in Jamaica up to the present time. But a consultant (Dr. Collins, Aston University, Birmingham, U.K., personal interview, 1984) suggested that the cost is so large that road safety expenditures would be one of the most profitable investments the Ministry of Construction (Works) of Jamaica could make.

A good example is provided by the U.S., where between 1968 and 1973 almost 1,500 safety improvement projects, at total cost of $53 million, were completed. Studies indicated that these improvements resulted in reductions by 5,000 accidents, 19.000 injuries and 210 fatalities annually (Anderson, 1976). This was estimated to be a $5 savings for each dollar spent. However, to put a meaningful cost on a road accident is a difficult procedures. Some of the constituent costs of each accident can be calculated, such as repair bills, running costs of emergency services, legal fees, etc., but there are other, intangible items such as traffic delay, most production and, in particular, pain, suffering, and grief, upon which it is difficult to place a sensible cost.

Dawson (1967-1971) has developed costs for road accidents, upon which the official figures for the United Kingdom are based. Using his figures, the total economic cost of accidents, in 1970, was $680 million. In a later paper, Dawson changed his methods of calculating the effective loss of output of those killed in accidents, so that their future consumption was no longer deducted from their future output, thus considerably increasing the cost of a fatality from $30,000 to $40,000.

The author's deductions suggest that the cost to Jamaica of road accidents its extremely high, and one of the justifications for this research is to quantify this loss and suggest ways in which this cost to Jamaica can be reduced by reducing the number of road accidents.

A more detailed discussion and calculations will be attempted in Chapter 3 of this study.

2-13. Factors Contributing to Road Accidents in Developing Nations and Some Researched Solutions

Lately, research has been carried out by certain organizations and consultants (McDonald, T.R.R.L.) on behalf of some developing countries. Few of these countries have finally realized the severe effects of road accidents on their citizens and economies. This cry for help, however, is a great step in the right direction. Unfortunately, many more countries are still occupied with local and regional disputes and have no time or resources to invest in improving their accident rates.

In order for a solution to be devised, it is necessary to know the causes of these accidents. Should they be blamed on the driver, the road conditions, the weather, pedestrians, or, perhaps, substance abuse? Unfortunately, in most cases it is a combination of many of these factors that contributes to a road accident. That is why this phenomenon is one of the most difficult to successfully address.

Recent studies done by T.R.R.L. have produced interesting results, some of which will be discussed in this section. Their findings can be very useful in comparison studies and studies like this one where data has been very limited and fragmentary.

As alluded to above, accidents can be caused by the following factors:

1. Human (driver or pedestrian)
2. Mechanical (vehicle)
3. Road and environment.

Table 2-12 shows some factors causing road accidents in some developing nations. These statistics were compiled by each country's road police. In most developing countries, police reports on accidents are the only records available. Unfortunately, police officers tend to single out the human factor in road accidents because they are not usually

Table 2-12

Causes of Road Accidents As Determined by the Police in Developing Countries

Country	Main Cause of Accident (%)			
	Road-user error	Vehicle defect	Adverse Road conditions or environment	Other
Afghanistan 1984	74	17	9	-
Botswana 1982	94	2	1	3
Cyprus 1982	94	1	5	-
Ethiopia 1982	81	5	-	14
India 1980	80	7	1	12
Iran 1984	64	16	20	-
Pakistan 1984	91	4	5	-
Philippines 1984	85	8	7	-
Malaysia 1985	87	2	4	7
Zimbabwe 1979	89	5	1	5
T.R.R.L. On-the-Spot Study 1975*	95	8	28	

* In about 30% of accidents, multiple factors were identified.

(Source: A. J. Downing, C. J. Baguley & B. L. Hills, 1991, <u>Road Safety in Developing Countries: An Overview</u>.)

trained, as highway engineers are, to recognize flows in highway design.

In the United Kingdom a more reliable approach was instituted in the early 1970's. This is "On the Spot" investigation carried out in England by a research team for T.R.R.L. (Sabey & Staughton, 1975). Their research demonstrated the importance of the road-user factor, which contributed to 95% of road accidents, and the strong link between road-user error and deficiencies in the road environment, together contributing to over 25% of road accidents (see Table 2-12). In general, Table 2-12 shows that the data emphasize the importance of road-user error in road accidents in developing nations, but gives little indication of road environment factors, other than for Iran. It is obvious from the data in Table 2-12 that the road environment factor has been considerable underestimated by the police in compiling their statistics. The condition of main roads is poorer in developing countries than in developed countries (Hammel & Faiz, 1988), and the pace of engineering improvements to reduce road accidents is considerably slower in the third world.

2-13-1. Pedestrian Accident

There are some accident characteristics which are common to a number of developing countries and yet are somewhat different from those in developed countries (see Figure 2-8 and Table 2-13), e.g., in developing countries a relative

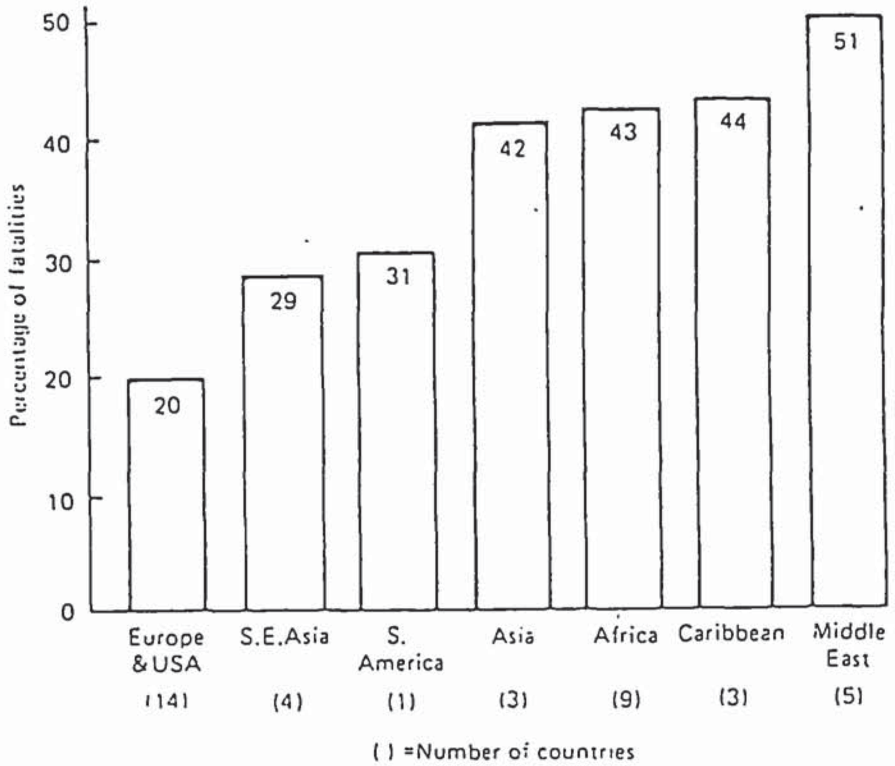


Fig. 2-8. Pedestrian fatalities as a percentage of all road accident fatalities.

high proportion of road accident fatalities are pedestrians, with a large percentage being children aged under 16 years (Downing, 1991).

In many cases, these higher percentages are an obvious consequence of the differences between the traffic and population characteristics of developed and developing countries. For example, in a sample of 16 developing countries, the average percentage of the population aged 5 to 14 years was 28 percent compared with 15 percent for nine developed countries (Downing & Sayer, 1982).

Table 2-13

Characteristics of Fatal Accidents

Country		Percentage of fatalities which: were children under 16 years	Percentage of fatalities which: involved trucks and buses
Botswana	(1988)	16	25
Egypt	(1984)	12	37
Ghana	(1989)	28	50
Pakistan (Karachi)	(1988)	14	44
Papua New Guinea	(1987)	20	37
Zimbabwe	(1988)	11	45
United Kingdom	(1988)	9	21

A good example for the purpose of this research is the case of Papua New Guinea (PNG). The population of PNG is virtually the same as Jamaica, the terrain is similar and, finally, the accident data is very similar. Research done in 1988 by the Royal Papua New Guinea Constabulary and the U.K.

department of Transport shows that "crossing the road" in PNG is the biggest single hazard for pedestrians, contributing to 46 percent of all casualties. In PNG, "walking along the edge of the road" produces the highest number of fatalities (38%). This 1988 study revealed that the combined activities of walking along the road, along the edge of the road, or on the pavement resulted in 46 percent of all pedestrian casualties, demonstrating that these activities are just as dangerous in PNG as crossing the road.

Fig. 2-9. 1988 accident statistics, Papua New Guinea
(Source: RPNGC/Department of Transport)

2-13-2. Alcohol and Drugs

Drugs and alcohol constitute an area of great concern in some, but not all, developing countries. Certain studies (summarized in Table 2-14) show that the blood alcohol levels found in connection with accident fatalities in Trinidad (Simmons, 1990) and Zimbabwe (Sandwith;, 1980) were considerably higher than those found in Great Britain (T.R.R.L., 1990). Also, looking at recent roadside alcohol surveys conducted in PNG on weekends between 10 p.m. and 2 a.m., it is found that 24 percent of drivers were over 80 mg/100 ml (the UK legal limit). This is much higher than the figures of 2 percent found in similar surveys in the UK (Everest, 1991).

Table 2-14

Blood Alcohol Levels in Road Accident Fatalities

Country	Road-user type	Percentage with BAC exceeding (mg/100 ml)	
		0	80
Trinidad (1988)	driver	-	41
	pedestrian	-	41
Zimbabwe (1979)	driver	56	-
	pedestrian	72	-
Great Britain (1988)	driver	31*	20
	pedestrian	37*	28

* = Over 9 mg/100 ml

Examining the statistics derived by T.R.R.L. in PNG (tables 2-15 and 2-16), we see that almost half of the fatalities in 1988 were suspected of having some percentage of alcohol or drugs in their systems at the time the accident occurred. This statistic, by itself, is rather frightening. It is very important to realize this problem does not only apply to drivers, but also to pedestrians. Pedestrians who are under the influence of alcohol or drugs are often as dangerous to themselves and others as drivers who are under the influence.

Table 2-15

All Recorded Road Accidents in Papua New Guinea, 1981-1988

Year	Total Accidents	Fatal Accidents	Injury Accidents	Liquor Suspected	Fatalities	Injuries	Vehicles Involved
1981	6862	252	1621	961	295	3072	11191
1982	6058	215	1532	1000	253	2894	9845
1983	5781	222	1471	830	264	2720	9268
1984	5731	236	1565	891	274	3042	9072
1985	5763	236	1523	865	277	2952	9090
1986	5419	242	1541	-	274	3081	8539
1987	5046	263	1495	730	316	2958	7911
1988	5046	274	1569	863	347	3175	7861

(Source: RPNGC/Department of Transport)

2-13-3. Data Collection

Good data is probably the single most important factor in carrying forward a successful accident investigation. This is true in almost every scientific field. All the

Table 2-16

Injury Severity by Province, Papua New Guinea, 1988

(All Casualties in "Alcohol Suspected" Accident)

	Acci-dents	Vehicles Involved	Number of Casualties			
			Fatal	Hospital	Non-Hospital	Total
Western	24	29	0	3	13	15
Gulf	3	4	1	0	2	3
Central	29	38	4	15	29	48
Milne Bay	10	11	3	4	2	9
Northern	8	8	0	12	11	23
S-Highlands	7	10	1	1	5	7
E-Highlands	54	76	10	56	36	102
Chimbu	25	29	10	21	17	48
W-Highlands	61	88	16	43	38	97
W-Sepik	1	1	0	0	1	1
E-Sepik	24	33	2	9	10	21
Madang	31	29	8	28	14	50
Morobe	99	146	6	37	39	82
WNBritain	24	33	2	12	13	27
ENBritain	95	144	9	33	27	69
New Ireland	14	14	2	7	4	13
N-Solomons	49	63	5	21	27	53
Manus	4	5	1	8	0	9
NCD	277	445	14	41	79	134
Enga	24	29	7	28	20	55
Total	863	1245	101	378	387	866

(Source: Papua New Guinea Department of Transport)

stages of obtaining reliable data are important, from the collection of all relevant facts to the compiling of such data into easily accessible and understood forms. Because the whole process starts with the Police Report, this is usually considered the most important source of data for accident investigations.

In the early 1970s, a survey of road accident information systems in use in developing nations (Jacobs, et al., 1975) indicated that only 15 percent of the countries studied had adequate accident report forms and none had computer analysis facilities. Even though utilizing computer technology is important in developing and maintaining a good data base, most of the programs designed for developed nations are too complicated for developing countries. Therefore, officials in developing countries are likely to become very hostile when the use of computerized data bases is proposed in addressing their highway safety concerns. Thanks to T.R.R.L., however, this problem has been solved. To help developing countries improve their accident investigation and research capabilities, the Overseas Unit of T.R.R.L. has developed, initially in cooperation with the Traffic Police of Egypt (Hills & Elliott, 1986), its Microcomputer Accident Analysis Package (MAAP), which is now in use in over 12 countries.

2-13-4. Road Conditions

Though it seems that human error is the chief causal factor in most road accidents, there should be little doubt that improvement of road conditions and initial correct design of roads can affect road-user behavior in such a way that errors are less likely to occur, or when they do occur the environment can be made more forgiving. Engineering and planning can have a positive effect on road safety in two ways:

1. Accident prevention, resulting from good standards of design and planning of new road schemes.

2. Accident reduction, resulting from remedial measures applied to problems identified in the existing road network.

2-13-4-1. Accident Prevention

Very little research has been done in developing nations into the relationship between highway design and accident rates. This is mainly due to the lack of understanding of the problem and its effects, and lack of the resources and expertise necessary to carry out such an investigation. Therefore, many of the developing countries try to utilize standards used in developed countries, or try to modify these standards to suit their particular needs (at least that is what they believe they are doing). This kind of approach will not work in developing countries, because often the traffic mix and road usage are very different from those encountered in more industrialized nations. In addition, there is usually a great need to minimize costs. The trick is to devise an appropriate solution, while maintaining an acceptable standard of safety.

In 1984, Hills, et al., suggested a completely new approach to the geometric design of highways for developing nations, especially on low volume roads. Hills' methods were based on studies done by Jacobs in 1975, in Kenya and Jamaica, linking geometric design to road accidents. Also used in this new model were results from studies done in India and Chile, indicating that number of junctions per kilometer was the most significant factor related to road traffic accidents, followed by horizontal and vertical curvatures.

Another very important study was done in Cyprus in 1984, which showed that accident rates can be reduced by improving highway design standards. The number of fatal accidents per annum went from 63 to 54 following such improvement.

In recognition of these findings, T.R.R.L.'s new project in Papua New Guinea is also aimed at examining the relationship between highway design and improvement of accident rates.

2-13-4-2. Accident Reduction

In the case of accident reduction, some of the approaches designed in developing countries can work very well in developing ones. Especially effective are approaches that concentrate on low-cost improvement schemes at hazardous locations. These schemes must be easy to implement. For example, in 1986, 13 low-cost engineering measures were carried out in Summerset County in the U.K. by the D.O.T. At a cost of 5,500 pounds sterling, 63 accidents and 422,000 pounds sterling were saved in a three-year period, accounting for a first year return of 2530%.

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A few developing countries have begun to introduce such schemes on a trial basis and the Overseas Unit of T.R.R.L. is currently carrying out joint research to evaluate their effectiveness in Egypt, Ghana, Indonesia, Malaysia, Pakistan, and Papua New Guinea (Downing, Baugley & Hills, 1991). Preliminary findings suggest that countries which have relatively low levels of road-user discipline are less likely to have success with low-cost measures, such as road signs and markings. For example, a study of the effects of introducing stop lines and lane lines at junctions in Pakistan (Downing, 1985) indicated no improvement in driver behavior, apart from a small reduction in overtaking violations from 19 to 14. On the other hand, preliminary results form Papua New Guinea indicate that the introduction of roundabouts at uncontrolled major/minor junctions has halved the average injury accident rate (Hills, et. al., 1990).

2-14. Conclusions

This review of the literature has shown how serious the road accident problem is in both developing and developed nations. However, the situation seems to be improving in most developed countries (see Fig. 2-10). Unfortunately, this is not the case in developing countries where the number of fatalities per 10,000 vehicles can reach 100 and in certain countries even double that number (Jacobs & Hutchinson 1973, Jacobs & Forance, 1977; Jacobs 1982). This

Fig. 2-10. Percentage change in road accident fatalities

(Source: B. L. Hills, (1991), Road Safety in Developing Countries: An Overview, T.R.R.L.)

fact looks frightening when compared to the same numbers in developed counties which may reach 5 fatalities per 10,000 vehicles.

The economic drain on developing countries caused by road accidents is also a very serious problem. Since most ofthe people injured or killed in road accidents in developing countries are in the economically active age group of 5-44 years. The cost of accidents to developing countries is often between 1-2% of their GNP, and in many cases reach 4-5% of the GNP. Most of these costs are incurred as foreign exchange since most spare parts for damaged vehicles, drugs and medicines for those injured have to be imported.

Road accidents can never be completely eliminated, but action can be taken to minimize the likelihood of their occurrence. Which will in effect help those developing countries save a lot of their much needed resources for the development of their countries.

The conclusion and recommendations ~~above~~ are based on information obtained from Jamaica compiled with statistics from other researchers, such as T.R.R.L. (see Section 2-13).

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Chapter 3

Description of the Philosophy of the Modeling Approach

3-1. Introduction

In order for an effective accident investigation to take place, accurate data is needed. In most developing countries one would be lucky to find data relating to road accidents that are in any accurate or understandable form. Therefore, methods have to be developed for the generation of some of these data.

As mentioned earlier, one of the aims of this study is to develop a model which will provide a framework or skeleton on which miscellaneous pieces of information can be hung, to permit the observation of the various relationships between these miscellaneous elements.

3-2. Parameters of the Model; Conditions of the Model

The model will have to be set up in such a way that all of its elements are capable of being projected into the future. This is necessary in order to study future trends and enable cost-benefit studies to be done.

The model will have to be as general as possible, in order that it be applicable to different countries with slightly different conditions. Subsequent international comparisons can be made to see how the model functions under these differing conditions.

One of the most important decisions to be made by officials in organizations like the World Bank is how much to allocate where. This model should be able to provide a tool for the purpose of comparative investment analysis between countries.

For example, once a certain country is selected by the World Bank, the officials responsible for the allocation of funds to that country will have to determine where to use those funds. This model will provide tools for the allocation of funds to alleviate dangerous conditions of the most hazardous locations on roads in the country selected. Officials in the country concerned will also find this model useful in determining where they should concentrate their limited resources, as they frequently must make such decisions without hard facts.

In many cases data used for the purpose of completing the model will not be accurate and in many cases it will be deficient. Therefore, the model will have to provide a tool to highlight data deficiencies and provide interim means for estimating missing data and parameters.

As some of the data used in the model remain stable over a certain period of time (e.g., period of study, section lengths, etc.), the model will have to be designed in a way that will make it possible to change certain data and parameters within its framework without affecting the original, more stable data used in the model, as more accurate data is obtained.

Road traffic accidents should be seen, not only in the context of loss of life, but also as a vital factor in a country's material economy and material welfare. This crucial point does not seem to be recognized in many nations, especially in developing countries. Therefore, any model for dealing with road traffic accidents would be incomplete if it did not provide for ways of estimating the cost of accidents in their various types.

The model should also be aimed towards prevention of accidents by suggesting places for investment in preventive measures and studies focused on that goal (e.g., actual and potential high accident spots).

It is essential that the work on the model is done from a central headquarters location or by qualified external consultants. Thus, very little local knowledge is required by the police or by the citizens involved in this procedure, though some general knowledge of the model is essential on the part of the local authorities involved in the various stages of road safety. Local understanding of the need for the model can contribute to calibrations to improve the relationships between its actual parameters.

3-3. Conclusion

It is important to understand that it is a modeling approach that is being introduced in this research. The construction and application of an actual model is suggested as a subject for further research. Chapter 4 describes a set of models which perform many of the requirements identified in this chapter. They are not necessarily the only or preferred models available, but they do form a complete set. Chapter 5 considers how the outputs of these models can be used to improve rational estimates of accident costs and possible benefits from investment in accident prevention measures.

Chapter 4

Methods of Identifying Hazardous Locations

4-1. Using Computer Programs for the Generation of Otherwise Unavailable Data for the Road of Study

Computer programs are becoming more and more useful in studying road safety problems. In developing nations, for example, data (accurate data) are very hard to come by, if at all. Therefore, one has to look at alternative ways of obtaining these data. One way that comes to mind immediately is to spend many years in the field actually collecting data. This, of course, would be ideal, if one had all the necessary resources required to carry out such an elaborate investigation.

The second best alternative is to "guesstimate" the needed data using computer programming and some basic data that almost every country that can call itself a country should have. Such basic information would include population distribution, types of roads existing in the country, division of the different regions of the country into zones, etc.

Using the above-mentioned information, and the help of some good transportation programs, one can derive much useful data for analysis. One of the programs that was introduced to the author by Dr. T.R.E. Chidley (Internal Supervisor) of the University of Aston in Birmingham (MVA SYSTIMATICA), can generate data from a trip generator model to calculate the actual flows on each intersection and strip of road studied.

This kind of computer programming, then, can save a researcher an enormous amount of time and other resources. Of course, these data will not be one hundred percent exact, but it will be close. These results can give a clear idea of what is really going on and will facilitate decision-making regarding where, when and how to carry on the improvement process.

In the author's opinion, though, there are some drawbacks to using this kind of programming in developing nations. Considering its severity in developing countries, officials are usually looking for short-term, quick, cheap, and easily understandable solutions to the road accident problem. Once one mentions computer programming, such officials tend to become very wary of the situation. This is so, first, because they probably have never encountered any real training on this kind of computer software; second, they may feel that one is trying to sell them something for a high price that they may not be able to use. This fear has not come out of the blue. Many developing countries, like Jamaica, have spent a lot of money and time on computer programs that were introduced to them by some western agencies and have not benefitted from this investment.

The other drawback is that these programs were not originally created for use in developing nations. As was mentioned earlier and will be mentioned again, the problem in developing countries is considerably different from the one in developed countries. Many factors have to be considered when dealing with developing countries that would not have a major role to play in developed countries. For example, in relation to religion, as mentioned earlier, many countries consider a road accident an act of God. Many other sociological factors must be considered, as well, when analyzing developing countries' problems.

Also, not all developing countries are the same; some are more developed than others, and they all have different social values and religions beliefs. Therefore, when using this type of programming, one is really generalizing to a great extent. Hence, the results obtained will not be accurate.

When the above-mentioned program was first introduced to the author, no one at the university had operated it to its fullest extent. Therefore, there were many hurdles that the author had to negotiate before any real results could be obtained from the program. Many weeks of reading manuals, and trial and error experience with the expert help of Dr. Chidley, resulted in the final understanding and operation of the program. Appendix E shows the results obtained using this program and, also, the data necessary to start the program. Data that has to be identified is called "input data" and is formatted into "input files." Data obtained as a result of using this program is called "output data" and is formatted into "output files."

4-2. Identifying Hazardous Locations (Accident Method)

The whole idea of road safety improvement is to reduce the number and severity of accidents. An effective safety program should involve these basic steps:

1 - identifying hazardous locations,

2 - evaluating and making improvements, and

3 - evaluating completed improvements.

This chapter will deal with the first step.

Identifying hazardous locations is necessary in the process of learning how to analyze accident information. It is the first step in making up a list of locations where some kind of improvement would really pay off. What it boils down to is finding locations that have unusually high accident rates.

The two most widely used and accepted methods for this process rely on accident data. These two methods are by no means the only ones that can be used to identify hazardous locations, however.

A new method has evolved, where the identification of problem areas can occur before accidents happen. This approach is called <u>non-accident analysis</u> (Institute of Transportation Engineers). The idea is to collect data to identify potential hazards and use this information as the basis for making improvements, instead of waiting until a sufficient number of accidents have happened. It is a good idea, but unfortunately, non-accident methods of analysis have not been perfected. Until that happens, a good study must rely on methods that include accident data.

Some countries lack the kind of defined data needed for the computations involved with the more sophisticated methods. Until such data is available, hazardous locations may need to be identified by a "seat of the pants" method. This approach is likely to be acceptable only for a competent engineer or technician who really knows the territory and has a lot of experience with hazard identification.

4-2-1. Method #1, the Number of Accidents Method

As mentioned earlier in this chapter, the purpose of identifying hazardous locations is to find locations where there are unusually high numbers of accidents. This can be either very simple or very complicated, depending on the method of analysis used. Because safety budgets are limited, a process of elimination is really necessary. One cannot just attempt to address and improve safety factors at every location where there are accidents. Some methods use very detailed data and fairly sophisticated calculations; others require only basic information and have somewhat limited applications. The number-of-accidents method falls into the second category. It does not require much data.

The only data required for this method is:

1- A time period. This is the specific time period for the study. It could be for a month, but usually it will be at least three months or longer.

2- Accident locations. One needs to know the exact locations of all reported accidents in the area of study.

To identify hazardous locations using this method, all accidents that occur during the study period are recorded on a map of the study area using pins or dots.

The final step in this method is to list the locations identified as accident clusters on the map. Locations showing the most accidents are placed highest on the list. This, then, becomes the list of hazardous locations.

The spot map provides a good visual summary of some accident information. It makes it easy to identify accident clusters. The cost of the materials involved is low and it takes very little time to keep the map updated.

The number-of-accidents method is effective for street systems in small towns, sections of streets in large metropolitan areas, or country roads with low traffic volume. However, this method has serious limitations when it is used in areas with more vehicle exposure. To see why, the fictional example below was created for the purpose of illustrating these limitations (see Fig. 4-1).

At first glance, one might be tempted to think that the two accident clusters on the fictional example are equally hazardous. This would be a good guess, unless one knew more

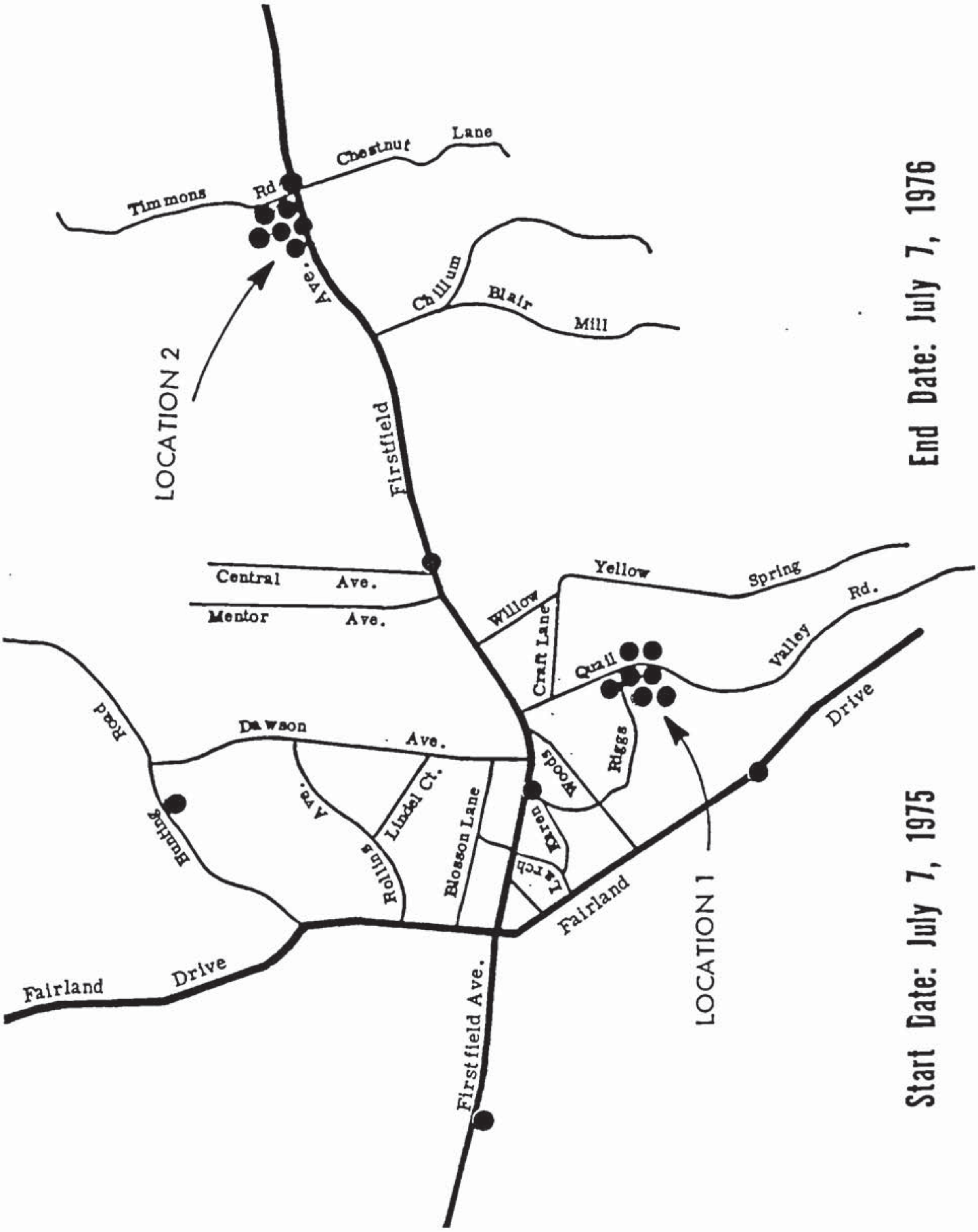


Fig. 4-1. Fictional map demonstrating accident location plotting.

about the locations. Location 1 is the junction of two roadsin a residential area. Location 2 is an intersection next to a suburban shipping center.

Looking again at the illustration, although more factors might be examined, it would probably be safe to say that Location 1 is more hazardous. Since Location 2 is near a busy shipping center, the exposure of the intersection to traffic is much higher. Thus, one would expect more accidents to happen there. But at a residential intersection where there probably are not many vehicles passing through, such a high rate may be abnormal and leads to the suspicion that this is a very hazardous location. More investigation would have to be done to come to a reliable conclusion, but obviously the pins are not telling the whole story.

4-2-2. Method #2, the Accident Rate Method

The accident rate method should be used in cases where large variations in traffic volume exist. This method takes traffic volume into consideration by comparing the actual accident rate for a location with a systematic average. The idea here is to use systemwide averages to find out if the accident rate at a particular location is really unusual. If the actual rate turns out to be higher than the systemwide average, the location is considered hazardous and is recorded on the hazardous location map and list.

The data that must be available for this method to work is shown below:

Time: Number of days in the study period.

Accident Location: Where the accident happened in relation to established spots, intersections and sections of highways.

Section Length: The lengths of all sections in the road system.

Traffic Volumes: The average daily traffic (ADT) at each location. At intersections, vehicles are counted only as they enter the intersection in order to eliminate the problem of counting vehicles twice.

Average Accident Rate: The average rate of accidents per million vehicles (MV) or per million vehicle miles (MVM) for all kinds of roads in the system.

Number of Accidents: The actual number of accidents that happen at each location.

Once these data have been collected, the analysis can begin. Since this method is basically a comparison between the rate of the actual number of accidents with the systemwide rate, the two figures would have to be calculated. This can be simply done using Steps 1 through 6, shown below:

1- Record the locations of all accidents during the study period. A spot map can be used.

2- Record the number of accidents at all locations, breaking them into two categories. The number of accidents for intersections and established spots must be placed under one heading and the numbers for sections must be grouped separately.

3- Calculate an actual accident rate for each location where there were accidents, using the formula below:

For sections:

$$\text{Rate/MVM} = \frac{(\text{Number of Accidents on Section})\ (10^6)}{(\text{ADT})\ (\text{Number of Days})\ (\text{Section Length})}$$

For Spots and Intersections:

$$\text{Rate/MV} = \frac{(\text{Number of Accidents at Intersection or Spot})\ (10^6)}{(\text{ADT})\ (\text{Number of Days})}$$

4- Calculate the systematic average and rate for sections using total numbers for the number of average and ADT. Total for sections should include all sections -- even those without accidents.

A systemwide average for established spots and intersections must be calculated. Here, interest must be focused on the locations where there were clusters of accidents. For the purpose of this research, a "cluster" is defined as a location where there were two or more accidents within 0.01 miles. The reason for using clusters is simple. Typically, spots and intersections are grouped together for calculation purposes. Although we can identify and read data on all intersections, we cannot on spots. After all, the only reason a particular spot is noticed is because it is a location that experiences accidents. Therefore, it would be impossible to read the number of spots where there were no accidents.

To solve this problem, spots and intersections are grouped together and data are collected only on cluster locations. This means that the average obtained is not a true systemwide average. It is an average for locations where there are clusters. One should also note that the definition of "cluster" is somewhat arbitrary. Whether two or more accidents within 0.01 miles is used is a decision that has to be made by the researcher.

The formulae used for the calculation of systemwide averages are:

Systemwide Rate for Section:

$$\text{Accident/MVM} = \frac{(\Sigma \text{ of Accidents of All Sections})\ (10^6)}{\Sigma\ [(\text{Section of ADT})\ (\text{Number of Days})\ (\text{Section Length})]}$$

Systemwide Rate for Spots and Intersections:

$$\text{Accident/MV} = \frac{(\Sigma \text{ Number of Accidents})\ (10^6)}{(\text{ADT at All Spots and Intersections})\ (\text{Number of Days})}$$

Steps 3 and 4 will give two numbers to use as a basis for comparison. One will be an actual average rate. The other will be the systemwide average rate.

5- Determine an accident rate cutoff point. Going through the above four steps could produce a very lengthy list of locations along with their accident rates, expressed in either rate/MVM or rate/MV. The purpose of this step is to make the list shorter by establishing a cutoff point. This will give the most hazardous locations on the list. One way of getting a cutoff point is to multiply the systemwide rate by two and compare it to the list of actual accident rates for all locations.

6- The final step in this method is to link the locations whose average rates exceed the cutoff point. The locations on this final list would be the hazardous areas that need more study.

4-2-3. Method #3, the Number-Rate Method

This method shows a third way of developing a list of hazardous locations. This method can be used for any system regardless of size or differences in traffic volumes. The main difference between this method and the previous two is that it analyzes more detailed information about each location.

First, it breaks roads into more categories than just sections, spots and intersections. Hence, there is a separate category for urban and rural roads, and for each of these there are several categories. The chart below shows typical categories for sections. Spots and intersections are divided the same way.

For each of these general categories, the Number-Rate Method has to develop a <u>systematic average</u> that can be compared to <u>actual</u> rates of the same category. In other words, the <u>actual</u> accident rate on a particular section of an urban 4-lane divided highway is compared to a <u>systemwide average</u> for all sections of urban 4-lane divided highways.

Urban Sections	Rural Sections
2-lane	2-lane
4 or more lanes - undivided	4 or more lanes - undivided
4 or more lanes - divided	4 or more lanes - divided
Freeway	Freeway

Fig. 4-2. Location categories used in Number-Rate Road Accident analysis Method

The second difference is that a location is not considered hazardous unless both the number of accidents and the accident rates are higher than the established systemwide average for that particular category of highway.

Data needed for this method are listed below. (Some of the data have already been designated in the previous method description.)

Time Period

Accident Location

Section Length

Average Daily Traffic (ADT)

Categories of Highways: A listing of all roads in the system, broken into categories. A typical breakdown is shown below:

Urban Sections	Urban Spots and Intersections
2-lane	2-lane
4 or more lanes - undivided	4 or more lanes - undivided
4 or more lanes - divided	4 or more lanes - divided
Freeway	Freeway
Rural Sections	**Rural Spots and Intersections**
2-lane	2-lane
4 or more lanes - undivided	4 or more lanes - undivided
4 or more lanes - divided	4 or more lanes - divided
Freeway	Freeway

Fig. 4-3. Categories of highways used in Number-Rate Road Accident Analysis Method

<u>Number of Accidents</u>: typical categories of highways.

<u>Rate/MV</u>: Number of accidents per million vehicles passing through a spot or intersection. Rate/MV always refers to a measurement for spots or intersections.

<u>Rate/MVM</u>: Number of accidents per million vehicle miles. It is always used in connection with sections of highways.

The following steps are used to calculate the Number-Rate Method:

1- For sections, the <u>average</u> number of accidents per mile and per million vehicle miles for each category of highway must be calculated. This step gives systemwide average rates. This must also include locations where there were no accidents. The formulae that must be used are:

$$\text{Average Accidents per Mile} = \frac{\Sigma\ \text{Number of Accidents}}{\Sigma\ \text{Length of Highway Category}}$$

$$\text{Average Accident per MVM} = \frac{(\Sigma\ \text{Number of Accidents})\ (10^6)}{\Sigma\ [(\text{Section ADT})\ (\text{Number of Days})(\ \text{Section Length})]}$$

2- For spots and intersections, calculate the <u>average</u> number of accidents per million vehicles for each category of highway. This step also gives a systemwide average. It is an average of those locations where there are clusters. The formulae are:

$$\text{Average Accidents/Location} = \frac{\Sigma\ \text{Number of Accidents}}{\Sigma\ \text{Number of Locations}}$$

$$\text{Average Accidents/MV} = \frac{\Sigma\ (\text{Number of Accidents})\ (10^6)}{\Sigma\ (\text{ADT})\ (\text{Number of Days})}$$

3- For each highway section, <u>actual</u> accident per mile and <u>actual</u> average per MVM must be calculated as follows:

$$\text{Actual Accidents/Mile} = \frac{\text{Number of Accidents on Section}}{\text{Section Length}}$$

$$\text{Rate/MVM} = \frac{(\text{Number of Accidents on Section})\ (10^6)}{(\text{ADT})\ (\text{Number of Days})\ (\text{Section Length})}$$

4- Calculate actual number for spots and intersections. Also, the number of accidents that happened at each intersection and spot, for each category of highway where there were clusters of accidents, must be known.

The number of accidents is then simply equal to the sum of all accidents that happened at spots or intersections where there were clusters of accidents. This would be repeated for each category:

$$\text{Rate/MV} = \frac{(\text{Number of Accidents at Spots or Intersections})\ (10^6)}{(\text{ADT})\ (\text{Number of Days})}$$

The above steps will give the actual numbers and the systemwide numbers for each spot and section of the study road or area.

5- Now, a cutoff point for the systemwide averages has to be established. This, as mentioned before, would give us a shorter list to consider. To calculate a cutoff point for all systemwide averages, simply multiply each systemwide average rate (for each category) by a predetermined number. In this study, the number 2 will be used. Therefore, for sections, the calculations would be:

Average Number of Accidents/Mile X 2 = Cutoff Point

Average Accident per MVM X 2 = Cutoff Point

The same thing is done for systemwide averages for spots and intersections.

Average Number of Accidents/Location X 2 = Cutoff Point

Average Number of Accidents/MV X 2 = Cutoff Point

It must be noted that, with this method, average numbers for each category of highway are obtained--one for the accident and one for average accidents.

6- A list of hazardous locations can be derived now by comparing the values of both cutoff points to the numbers of accidents and the accident rate for each location. If both the accident rate and the numbers of accidents are higher than the cutoff points, then the location is placed on the hazardous location list.

4-2-4. Method #4, the Rate-Quality Control Method

Compared with the three methods mentioned earlier, this method is the most accurate. It can be used by any system regardless of size or variation in traffic volumes. Because of its complexity, the use of a computer is advised, especially when evaluating a large area.

The Rate-Quality Control Method also develops systemwide averages like the Number/Rate Method. But the Rate-Quality Control Method uses the systemwide figures in a statistical test that is applied to each location being studied. This test assures "quality control" by making sure that the accident rate at a particular location is really unusual.

The statistical test is actually a mathematical formula that determines a critical rate of accidents for each location where there were accidents. And, it is this initial accident rate that is compared to the actual rate for a location. Locations with actual rates higher than the initial rate are placed on the hazardous location list.

In summary, the critical rate and actual accident rate are determined for each location where there are clusters of accidents and not only for categories of highways.

The data required for this method are exactly the same as that used in the Number/Rate Method:

Time Period

Accident Location

Section Length

Number of Accidents

Rate/MV

Rate/MVM

Average Daily Traffic (ADT)

Categories of Highways

Also, the same typical categories of highways are used in this method as in the previous one.

The work steps for the Rate-Quality Control Method are as follows:

1- For sections, calculate the systemwide average number of accidents per MVM for each category of highway.

$$\text{Average Accidents/MVM} = \frac{(\Sigma \text{ Number of Accidents})\ (10^6)}{\Sigma\ [(\text{Section ADT})\ (\text{Number of Days})\ (\text{Section Length})]}$$

2- For intersections and spots where there are clusters; the systemwide average number of accidents/MV for each category of highway is:

$$\text{Average Accidents/MV} = \frac{(\Sigma\ \text{Number of Accidents})\ (10^6)}{\Sigma\ (\text{ADT})\ (\text{Number of Days})}$$

3- For each location, a determination of the vehicle exposure must be made during the study period. This tells how much a location is exposed to traffic. For sections:

$$\text{Vehicle Exposure (MVM)} = \frac{(\text{Section ADT})\ (\text{Number of Days})\ (\text{Section Length})}{10^6}$$

4- A calculation for the critical accident rate (R_c) for each location where there were clusters of accidents during the study period is:

$$\text{Critical Accident Rate} =$$

$$\text{Systemwide} + \text{Constant} \quad \frac{\text{Systemwide Average}}{\text{Vehicle Exposure (MV or MVM)}} - \frac{.5}{\text{Vehicle Exposure}}$$

Abbreviated:

$$R_c = R_a + K \quad \frac{R_a}{m} - \frac{.5}{m}$$

K = Constant

This number has the same effect as the cutoff point. It serves to limit the length of the hazardous location list.

5- The computation of actual accident rates for each location where there were clusters of accidents during the study period must be carried out. This is accidents per MVM for sections and accidents per MV for spots and intersections. The figures obtained in this calculation are the ones that must be compared with the critical rate of each location. Sections:

$$\text{Rate/MVM} = \frac{(\text{Number of Accidents on Section})\ (10^6)}{(\text{ADT})\ (\text{Number of Days})\ (\text{Section Length})}$$

Intersections and Spots:

$$\text{Rate/MV} = \frac{(\text{Number of Accidents at Spots or Intersections})\ (10^6)}{(\text{ADT})\ (\text{Number of Days})}$$

6- This is the final step in this method. It compares the actual accident rate to the critical rate for each location being studied. Locations are placed on the hazardous location list if the actual rate is greater than the critical rate for that location.

Chapter 5

Selecting and Making Highway Safety Improvements

5-1. Introduction

Making highway safety improvements involves several tasks, and probably the most difficult one is deciding which improvement or combination of improvements will solve a particular problem. It is even more difficult because it is not an exact science. Other decisions have to be made using judgement, experience and common sense.

This chapter will discuss one method of deciding which improvement to implement to make safer a hazardous location. This method is by no means the only one available, and can be adjusted to respond to the particular needs of an agency of government.

The method selected by the author is derived by combining several methods and ideas developed by CalTrans of California, U.S.A.; the Institute of Transportation Engineers, U.S.A.; the College of Engineering, University of Illinois; the Highway Traffic Safety Center, Washington, D. C., U.S.A., etc. Of course, these methods could not all have been used at the same time in this chapter. Therefore, the author chose to utilize the 171 best features of each one, combining them to fit this research and the data available, using the newest method for the purpose of this research.

This method for selecting improvements relies on economics. All alternative improvements were analyzed to determine which would return the most benefit for each dollar spent. There are two major steps in an economic analysis. In the first, the reduction in accidents that can be expected from each improvement is estimated and a value is assigned to the accident reduction that is termed the "benefit." Also, the cost of each improvement is estimated. The second major step is to adjust the calculated benefits and costs to account for the effect that interest has on investments. Then, a comparison of the benefits and costs should be made to determine which improvement is the most cost-effective.

5-2. Calculating Initial Benefits and Costs

Accidents cost money; safety improvements do to. If there are several possible ways to solve a safety problem, one should choose the best investment, the one that will really "pay off" in terms of reduced fatalities, injuries, property damage, and so on.

Perhaps the best way of demonstrating this concept is by means of an example. Let us assume that we have analyzed a location and have found that there are two alternative solutions to the safety problems, but we can only choose one, not both of them. Alternative A will cost $5,000 and Alternative B, $10,000. Should Alternative A be chosen? Not necessarily. If we look more closely, we may find that Alternative A will reduce accidents by 20% and Alternative B by 35%. If Alternative A will save $60,000 in accident costs over the next 10 years, and Alternative B $100,000, the choice is much easier to make. Alternative B is the best buy.

A fictional example is provided below for the purpose of illustrating this technique. The circumstances in this example have been made as simple as possible to avoid complications. Also, the assumption has been made that all the data necessary are readily available. In a real-life situation, most data will have to be gathered by the researcher. For example, an attempt to carry out this method in Jamaica failed because one of the most important datum needed to make an accurate evaluation of the situation (type of accident) is not recorded in the Jamaican accident reports. Therefore, the investigation into why these accidents took place was stymied at the outset, for it is not possible to find a solution to a problem without a cause. Fictional accident data provided for this illustration are:

<u>Location</u>: Aston Street and Park Lane

<u>Traffic control in place</u>: Stop sign on Park Lane

<u>Study period</u>: One year

Accident pattern: 9 right-angle collisions during daylight hours, 3 at night:

Fatalities = 0

Injuries = 3

Property damage only (PDO) = 9

Possible Improvements Identified:

Restrict parking near corners, or remove any other sight obstructions.

Install warning signs

Install flashing beacons

Install traffic signals

Install street lights

Channelize intersection

There are nine basic steps in selecting improvements:

1- Analyze the collision diagrams to see what types of accidents are happening, and relate the accident problem to the physical definitions at the site.

2- List all possible solutions.

3- Estimate accident reduction.

4- Assign value to accident reduction.

5- Estimate secondary benefits.

6- Estimate improvement costs.

7- Calculate equivalent uniform annual benefit and costs.

8- Calculate benefit-to-cost ratio.

9- Calculate net annual benefit.

Step 1 was covered in the previous chapter. Step 2 is a very important step and would greatly depend on the experience and knowledge of the engineer or researcher.

5-3. Estimate Accident Reduction

Estimating how a certain improvement will affect accidents is a more difficult task. Installing traffic signals at one location may reduce accidents by 50%, while signals at another location may actually increase accidents. Things would be a lot more simple if we could say with absolute certainly that installing stop signs will always reduce accidents by 50%, and that installing signals will always reduce accident by 30%, and so on. Unfortunately, that is not the way it works. Results are different from region to region and form city to city. Each country or agency should develop their own set of data. This can only be done by making the improvements and comparing before and after statistics.

For the purpose of this research, two sets of data will be used. The first was developed by the California Department of Transportation (CalTrans) and the other was published by the Missouri State Highway Commission in their "Manual on Identification, Analysis and Correction of High Accident Locations" (see Appendix F).

Using these tables, it is possible to assign accident reduction factors to the improvement possibilities for Aston

Street and Park Lane. Using Missouri's table, we find the following outcomes:

Table 5-1

Traffic Safety Improvements
and Corresponding Accident Reduction Factors

Improvement	Reduction Factor
Restrict parking near corners	32%
Install warning signs	29%
Install traffic signals	80%
Install flashing beacons	50%
Install street lighting	75% (night accidents)
Channelize intersections	19%

(Source: "Manual on Identification, Analysis and Correction of High Accident Locations," Missouri State Highway Commission, U.S.A.)

As a result of field observations, it has been determined that parking is already restricted, the warning signs in place are adequate, lighting is already in use, and channelization is not practical, because both streets are two-lane roads. That leaves us with two alternatives:

Improvement	Reduction Factor
Install flashing beacons	50%
Install traffic signals	80%

Still, there are other questions to answer, such as: Are these traffic controls warranted by the Manual of Uniform

Traffic Control Devices (MUTCD)? This would be the situation in the United States at least. Many other counties would probably not even have a standard, as such.

To apply the reduction factors for each improvement, multiply the number of accidents in each severity class by the reduction factor for each improvement, for example:

9 x .80 = 7.20; 3 x .50 = 1.50.

To get a better picture of the number by which accidents have been reduced, one should analyze two things; the traffic volume in the future and the service life of each improvement. As volumes go up, the number of accidents reduced will go up and, obviously, an improvement will last only so long. Sooner or later, it will have to be replaced. For the purpose of this research, a 2% increase in volume projections every year will be used. This, of course, will differ from country to country and area to area. Below are some estimates of the service life of different highway improvements developed by CalTrans.

Improvement	Service Life
Signals	15 years
Safety lighting	15 years
Median barriers	15 years
Flashing beacons	10 years
Guard rails	10 years
Pavement grooving	10 years
Signing (major)	10 years
Signing (minor)	5 years
Delineators	5 years
Partial stripes	2 years

Accident savings can now be computed using the following formula:

$$\text{Accidents Saved} = N \times P \ \frac{\text{ADT Future Year}}{\text{ADT Study Year}}$$

Where N = Number of accidents in study period

P = % reduction in decimal

ADT = Average daily traffic

Assume ADT at example intersections is 5,000 and the increase in volume is 2% every year. Calculations for the PDO accident reduction for Alternative One are provided in Table 5-2 below.

Table 5-2

PDO Accident Reduction Calculations for Alternative One

Service Year	N	x	P	x	ADT Future	÷	ADT Study	=	Accident Reduction
1	9		.5		5,100		5,000		4.59
2	9		.5		5,202		5,000		4.68
3	9		.5		5,306		5,000		4.78
4	9		.5		5,412		5,000		4.87
5	9		.5		5,520		5,000		4.97
6	9		.5		5,630		5,000		5.07
7	9		.5		5,743		5,000		5.17
8	9		.5		5,859		5,000		5.27
9	9		.5		5,974		5,000		5.38
10	9		.5		6,094		5,000		5.48

Table 5-3

PDO Accident Reduction Calculations for Alternative Two

Service Year	N	x	P	x	ADT Future	÷	ADT Study	=	Accident Reduction
1	9		.8		5,100		8,000		7.34
2	9		.8		5,202		8,000		7.49
3	9		.8		5,306		8,000		7.64
4	9		.8		5,412		8,000		7.79
5	9		.8		5,520		8,000		7.95
6	9		.8		5,630		8,000		8.11
7	9		.8		5,743		8,000		8.27
8	9		.8		5,859		8,000		8.43
9	9		.8		5,974		8,000		8.60
10	9		.8		6,094		8,000		8.78
11	9		.8		6,216		8,000		8.95
12	9		.8		6,340		8,000		9.13
13	9		.8		6,467		8,000		9.31
14	9		.8		6,728		8,000		9.50
15	9		.8		6,094		5,000		9.69

The calculations for injury are done in the same way. Results are shown below.

Table 5-4

PDO Injury Improvement Calculations for Alternatives One and Two

Service Year	Improvement One (Beacon)		Improvement Two (Signals)	
	PDO	Injury	PDO	Injury
1	4.59	1.53	7.34	2.45
2	4.68	1.56	7.49	2.49
3	4.78	1.59	7.64	2.55
4	4.87	1.62	7.79	2.60
5	4.97	1.66	7.95	2.65
6	5.07	1.69	8.11	2.70
7	5.17	1.72	8.27	2.76
8	5.27	1.76	8.43	2.81
9	5.38	1.79	8.60	2.87
10	5.48	1.83	8.78	2.93
11			8.95	2.98
12			9.13	3.04
13			9.31	3.10
14			9.50	3.17
15			9.69	3.23

The above table denotes the number of accidents one would expect to avoid by installing flashing beacons or traffic signals.

5-4. Assign Values to Accident Reductions

Looking at the results obtained above, it seems that Alternative Two (traffic signals) would be the best alternative. But it is also the most expensive of the two alternatives examined. A judgement, in this case, cannot be made just by looking at accident reduction. Therefore, we must assign a dollar value to the accident reductions; then we can compare the benefits to the costs and determine which alternative is the "best buy."

The method that will be used in this research, for the purpose of assigning a value to the accident reduction, is the same method used by CalTrans in California, U.S.A. This is not the only method available, but from the author's point of view it is the most realistic one, and is known as "costing by accident severity."

As has been mentioned earlier in the context of this work, it is very difficult to assign a monetary value to life, pain and suffering, and so on. But, in order to compare cost benefits, we must include the costs that we can calculate, such as medical costs, legal fees, lost wages, etc. The National Highway Traffic Safety Administration (NHTSA) publishes a list of estimates, updated periodically, which can be used in benefit computations. Other U.S. agencies, like the National Safety Council, also publish cost estimates different from those of NHTSA. A comparison of these figures is provided below:

NHTSA		NSC	
Average Fatal Accident	$287,175	Fatal	$125,000
Average Injury Nonfatal Disabling Accident	3,185	Injury	4,700
Average PDO Accident	520	PDO (including minor injuries)	670

For the calculation below, we will be using the NHTSA figures.

Table 5-5

Alternative One Savings (Beacons)

Service Year	Accidents Saved	x Cost Est. =	$ Saved	Accidents Saved	x Cost Est. =	$ Saved	Total
	PDO			INJURY			
1	4.59	$520	$2,387	1.53	$3,185	$4,873	$7,260
2	4.68	520	2,434	1.56	3,185	4,969	7,403
3	4.78	520	2,486	1.59	3,185	5,064	7,550
4	4.87	520	2,530	1.62	3,185	5,160	7,692
5	4.97	520	2,584	1.66	3,185	5,287	7,871
6	5.07	520	2,636	1.69	3,185	5,383	8,109
7	5.17	520	2,688	1.72	3,105	5,478	8,166
8	5.27	520	2,746	1.76	3,185	5,606	8,352
9	5.38	520	2,798	1.79	3,185	5,701	8,499
10	5.48	520	2,850	1.83	3,185	5,829	8,679

The calculations for Alternative Two operate in the same fashion.

Table 5-6

Comparison of Alternative One and Alternative Two
Accident Savings in U.S. Dollars

Alternative One (Beacons) (Signals)				Alternative Two		
Service Year	PDO	Injury	Total	PDO	Injury	Total
1	$2,387	$4,783	$7,260	$3,817	$ 7,803	$11,600
2	2,434	4,969	7,403	3,895	7,931	11,826
3	2,486	4,969	7,550	3,973	8,122	12,095
4	2,532	5,160	7,692	4,051	8,281	12,332
5	2,584	5,287	7,871	4,134	8,440	12,817
6	2,636	5,383	8,019	4,217	8,600	12,817
7	2,688	5,478	8,166	4,300	8,791	13,091
8	2,746	5,606	8,352	4,384	8,950	13,334
9	2,978	5,701	8,499	4,472	9,141	13,613
10	2,850	5,829	8,679	4,566	9,332	13,898
11				4,654	9,491	14,145
12				4,748	9,682	14,330
13				4,841	9,874	14,715
14				4,940	10,096	15,036
15				5,039	10,288	15,327

5-5. Estimating Secondary Benefits

Obviously, the major thing to expect from a highway safety improvement is a reduction in accidents and related costs. But sometimes, improvements affect other things. For example, installing street lights may reduce both accidents and street crimes. Providing signal progressions, on the other hand, not only helps reduce rear-end collisions, but saves gasoline and reduces delays and pollution.

However, not all secondary benefits are positive. For example, choosing to place a median opening in front of a department store can reduce accidents, but cut retail sales. Restricting left turns can cause a traffic problem, but it will usually increase gasoline usage, pollution and travel time.

Some secondary benefits are easy to put a value on, but others, like reducing pollution, are nearly impossible to evaluate.

5-6. Estimated Improvement Costs

The benefit of each alternative has been estimated; now we must estimate the costs. In order to estimate the total cost of improvement, the following figures will be needed:

1- initial cost, including materials, equipment and installation;

2- annual cost of operation and maintenance;

3- service life of the improvement; and

4- terminal value (salvage value).

The total cost of an improvement is:

Initial cost + Annual Cost During Service Life - Terminal Value. Below are some estimates made by the author for this research. (These values vary from country to country; therefore, one should obtain exact figures and estimates from manufacturers in each particular area of the world.)

Table 5-7

Cost Comparisons for Alternative One and Alternative Two

Cost Factors	Alternative One (Beacons)	Alternative Two (Signals)
Initial Cost	$2,500	$20,000
Annual Cost	500	1,250
Terminal Value	200	500
Service Life	10 years	15 years

Total Cost for Alternative One =

$2,500 + [10($500)] - $200 = $7,300

Total Cost for Alternative Two =

$20,000 + [15(1,250)] - $500 = $38,250

Is it possible to make a good decision now? Unfortunately, NO.

If it were not for interest rates, terminal values, annual costs, and so on, one could use the "raw" benefits and cost values to evaluate alternatives and select the best investment. One could average all costs and benefits to arrive at annual figures for each. But, because of the effects of interest, it is necessary to convert future dollars into base-year dollars. By considering interest, one can convert any future year's benefits and costs into uniform annual benefits and costs equivalent to present-year dollars.

5-7. Definition of New Terms

Capital Recovery Factor: is used to convert an investment (or benefits) to an annual payment (or return) at a given interest rate. For example, it would be the principal plus interest payment for each year on a loss or an investment.

The Present Worth Factor: is the multiplier that is used to convert costs (or benefits) for some future year to present value, considering interest earning power.

An interest rate will have to be selected for the calculations. For the purpose of this research, a 10% interest rate is chosen. Different situations and currencies may require the use of different interest rates. Multiplier figures for different interest rates are available in most economics textbooks.

Now that the figures above are provided, one can calculate the Equivalent Uniform Annual Benefits (EUAB). To do so, one must follow the steps below:

1- Multiply each year's total benefits by the Present Worth Factor for that year to adjust the benefits to present-day dollars.

2- Add up all of the adjusted benefits.

3- Multiply the total by the Capital Recovery Factor for last year of the Improvements Service Life. Or,

$$EUAB = CRF \quad (B)(PW)$$

Where, CRF = Capital Recovery Factor

B = Each Year's Benefits

PW = Present Worth Factor for Each Year

Table 5-8

Multipliers for a 10% Compound Interest Rate on Capital Revenue and Present Worth Factors for a 10-Year Period

	10% Compound Interest Factor	
n	Capital Revenues Factor	Present Worth Factor
1	1.10000	0.9091
2	0.57619	0.8264
3	0.40211	0.7513
4	0.31547	0.6830
5	0.26380	0.6209
6	0.22961	0.5645
7	0.20651	0.5132
8	0.18744	0.4665
9	0.17364	0.4241
10	0.16275	0.3855
11	0.15396	0.3505
12	0.14676	0.3186
13	0.14078	0.2897
14	0.13575	0.2633
15	0.13147	0.2394
16	0.12782	0.2176
17	0.12466	0.1978
18	0.12193	0.1799
19	0.11955	0.1635
20	0.11746	0.1486

For Alternative One (beacons), the "raw" benefits are:

Service Year	Annual Benefits
1	$7,260
2	7,403
3	7,550
4	7,692
5	7,871
6	8,019
7	8,166
8	8,352
9	8,499
10	8,679

Using the formula:

Service Life	Annual Benefits (B) x	PW =	Adjusted Benefits
1	$7,260	.9091	$ 6,600
2	7,403	.8264	6,118
3	7,550	.7513	5,672
4	7,692	.6830	5,254
5	7,871	.6209	4,887
6	8,019	.5645	4,527
7	8,166	.5132	4,191
8	8,352	.4665	3,896
9	8,499	.4241	3,604
10	8,679	.3855	3,346
		(B)(PW) =	$48,095

To get EUB, multiply (B)(PW) by the Capital Recovery Factor for a 10-year service life:

EUB = (CRF($48,095)

= (.16275)($48,095)

= $7,827

Therefore, with installation of beacons at the intersection of Aston Street and Park Lane, we get $7,287 per year of savings in percent-day dollars.

The figures for installing signals are:

Service Life	Annual Benefits (B)	x PW =	Adjusted Benefits
1	$11,620	.9091	$10,564
2	11,826	.8264	9,773
3	12,095	.7513	9,097
4	12,332	.6830	8,423
5	12,574	.6209	7,807
6	12,817	.5645	7,235
7	13,091	.5132	6,718
8	13,334	.4665	6,220
9	13,613	.4241	5,773
10	13,898	.3855	5,358
11	14,145	.3505	4,958
12	14,430	.3186	4,597
13	14,715	.2897	4,263
14	15,036	.2633	3,959
15	15,329	.2394	3,669
		(B)(PW) =	$98,414

Again, to EUAB, multiply (B)(PW) by the Capital Recovery Factor for a 10-year service life:

EUB = (CRF)($98,414)

= (.13147)($98,414)

= $12,938

Therefore, Annual Benefits are:

Alternative One (Beacons) = $7,827

Alternative Two (Signals) = $12,938

Now, one must calculate the annual costs (EUAC). The formula below is used for this calculation:

EUAC = CRF [I = Ca(PN) - T(PW)]

where,

CRF = Capital Recovery Factor for Last Year of the Improvement Service Life

I = Initial Investment

Ca = Annual Costs

PW = Present Worth Factor

T = Terminal Value

The raw cost data are again shown below:

Cost Factors	Alternative One (Beacons)	Alternative Two (Signals)
Initial Cost	$2,500	$20,000
Annual Cost	500	1,250
Terminal Value	200	500
Service Life	10 years	15 years

and,

Service Life	Annual Costs	x	PW	=	Adjusted Annual Cost
1	$500		.9091		$ 455
2	500		.8264		413
3	500		.7513		376
4	500		.6830		342
5	500		.6209		310
6	500		.5645		282
7	500		.5132		257
8	500		.4665		233
9	500		.4241		212
10	500		.3855		193
				Ca(PW) =	$3,072

Ca(PW) = 3,073

+2,500

5,573

200 (.3855) = - 77

4,496

x .16275

Alternative One EUAC = $ 894 Annual Cost

For Alterative Two,

Service Life	Annual Costs	x	PW	=	Adjusted Annual Cost
1	$1,250		.9091		$1,136
2	1,250		.8264		1,033
3	1,250		.7513		939
4	1,250		.6830		854
5	1,250		.6209		776
6	1,250		.5645		706
7	1,250		.5132		642
8	1,250		.4665		583
9	1,250		.4241		530
10	1,250		.3855		482
11	1,250		.3505		438
12	1,250		.3136		398
13	1,250		.2897		362
14	1,250		.2633		329
15	1,250		.2394		299
					Ca(PW) = $9,507

EUAC for Alternative Two =

[9,407 + 20,000 - (500 x .2394)] .13147

= (29,507 - 119.7) .13147

= $3,864

Other costs may be involved, e.g., relamping street lighting every two years, cost of energy, etc. One has to account for these costs as well.

Comparisons between EUAB and EUAC must be done now. For each alternative, one must obtain two figures:

1- the Benefit/Cost Ratio, and

2- the Net Annual Benefits.

	EUAB	EUAC
Alternative One	$ 7,827	$ 894
Alternative Two	12,938	3,864

To get the Benefit/Cost Ratio:

Alternative One B/C = 7,827 ÷ 894 = 8.76

Alternative Two B/C = 12,938 ÷ 3,864 = 3.35

Looking at the above two figures, one would think that Alternative One returns a lot more per year than Alternative Two. But that is not yet a reliable assumption, because we have not compared the Net Annual Benefit for each.

	EUAB	-	EUAC	=	Net Annual Benefits
Alternative One =	$ 7,827	-	$ 894	=	$6,933
Alternative Two =	12,938	-	3,864	=	9,079

Basically, any improvement over 1.0 with a B/C ratio is worth the investment.

If we were just to look at the B/C ratio, we would probably choose Alternative One over Alternative Two. but looking at the NAB for each alternative, Alternative Two returns about $2,000 more every year.

In order to make a sound judgment on which one of the alternatives to choose, one would have to have more information, such as:

1- What kind of budget is available?

2- Is this the only location needing improvement or do we have 20 more?

3- Does the Manual on Uniform Traffic Control Devices allow either of the alternatives (this is usually done at the beginning, when choosing alternatives)?

4- Are there any political issues involved?

It is always best to choose the alternative with the highest Annual Benefit, but good engineering judgment is irreplaceable in alternative selection.

Chapter 6

Selection and Description of Study Road

6-1. Summary

This chapter explains briefly why and how the study road was chosen. It identifies organizations involved in the selection, and provides a general description and brief history of the road.

6-2. Introduction

For a clear understanding of the rural accident problem in Jamaica, a typical rural Jamaican road was needed on which to carry out a detailed investigation of accidents and high accident locations. The selection of such a road had to be approved by various authorities (see below).

Unfortunately, confusion and a lack of understanding of the problem of road accidents among top officials caused a delay in the selection of the study road and, therefore, the completion of the research.

6-3. The Process of the Selection of the Road of Study

Because one of the primary objectives of this research was to develop a model upon which future research regarding the problem of road accidents in developing countries could be based, a typical Jamaican road had to be chosen for this study. The road had to have an impact on the overall economy of the country, and had to incorporate varying densities of population along its route.

For the World Bank (the originator of this research), the choice was fairly obvious. The road that would fit all of these criteria was identified as the Montego Bay to Lucea Road (Map 6-1). The officials of the Jamaica Ministry of Construction did not, however, share this view. The assumption that the Jamaican officials would agree with World Bank recommendations, as the latter is the source of funds for any road improvement in Jamaica, proved to be very inaccurate. The Jamaican officials were not convinced that this road was representative of the roads in Jamaica. After about two visits to the suggested roadways and many discussions with Mr. Kirkpatrick, the permanent secretary of the Ministry of Construction, he agreed that a study conducted on the Montego Bay to Lucea Road would be most beneficial to the Ministry and, hence, to the country.

6-4. Description and Location of the Study Road

On investigation, it was apparent that very little information about the Montego Bay to Lucea Road existed anywhere in Jamaica. There are no written records of the history of the road. Most of the information presented here, therefore, is based on personal observation of the road and lengthy discussions with officials of longstanding with the Police Department and the Ministry of Construction.

This road is 28 miles long and linked two major cities in Jamaica, Montego Bay and Lucea (see Fig. 6-1), located in the northwestern part of the country. In between the two major cities and falling on the same road, there are many small villages. The northern area, which it traverses, is probably the most beautiful section of Jamaica, and attracts about 60% of the tourists visiting the country. It is the location of the second largest airport in Jamaica, after the Kingston International Airport. Montego Bay is also one of the largest ports in Jamaica.

The Montego Bay to Lucea Road goes through all kinds of natural terrain, from mountains to valleys and beachfronts. It is a winding road, consisting of a single carriageway of approximately 15 feet in width (width varies from location to location on the road).

The road was designed by British students as a project for a British university, and was built (about nine years ago) as a joint venture of a British company and an American company. Since then, little maintenance has taken place (most of it improperly done)(Ministry of Construction, 1985). The road has several bridges. The main bridge had collapsed a week before the candidate's visit to Jamaica (see Photograph 6-1). The condition of the pavement is very poor at the present time and signage is poorly positioned and very

Map 6-1. Showing Road of Study between Montego Bay and Lucea, Jamaica.

unclear--road markings are virtually nonexistent (see photographs 6-2 through 6-5).

Photograph 6-1. Condition of the Road of Study, 1985.

Photograph 6-2. Condition of the Road of Study, 1985.

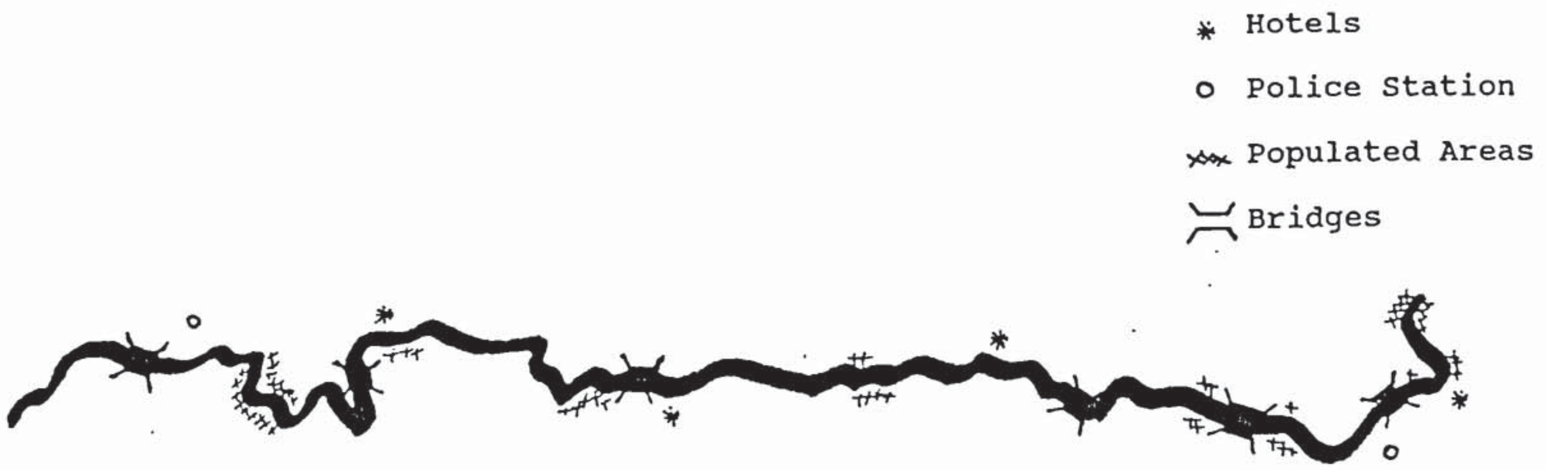


Fig. 6-1 Features of the Road of Study, between Montego Bay and Lucea, Jamaica


Photograph 6-3. Condition of the Road of Study, 1985.


Photograph 6-4. Condition of the Road of Study, 1985.

Photograph 6-5. Condition of the Road of Study, 1985.

Chapter 7

Accident Data Collection and Analysis of the Road of Study

7-1. Introduction

As mentioned in Chapter 1, the process of collecting data was not an easy one. Because of the nature of the study, and because the subject of the study was so far away from the candidate's residence, much information had to be gathered during trips the candidate was able to make to Jamaica. Even though much of the information gathered was not directly useful for the purposes of this project, it was considered an acceptable risk that the data collected in Jamaica might be found insufficient for the completion of the study.

The initial and most difficult task was location of the existing data. Upon collection, it was then necessary to carefully evaluate the data and separate out the useful material. None of the organizations involved in this project (Aston University in Birmingham, the World Bank, and the Jamaican government) were able to provide the author with any assistance at this stage of the research.

A great many unanticipated problems arose in the process of on-site research in Jamaica. Flights to Montego Bay, Jamaica (where the research was carried out), from the candidate's city of origin were difficult to find. As there was considerable uncertainty surrounding the granting of a visa to the candidate by Jamaican authorities, no advance airline booking was possible. Availability of hotel reservations in Jamaica was another problem. In Jamaica, there is no off-season for tourists and good hotels are very scarce, especially in the Kingston area. Prices in an acceptable hotel may range from $90 to $150 U.S. for a single room, depending on the location.

Transportation to and from various government offices and to and from the study road was a problem. There were, as well, many difficulties in finding the way to many locations in Jamaican cities, because of inadequate urban street mapping. Natives were, of necessity, hired as guides.

All of the above and some of the commentary in Chapter 1, indicate the difficult circumstances under which this study was conducted, and should serve to alert future researchers to the problems inherent in carrying out research in developing countries.

7-2. Sources of Accident Data

Reliable data is required in order to gain an accurate picture of the situation. There are different sources of accident data for different types of studies, but there are four main sources upon which this research relies:

1- Road Traffic Police (highway police)

2- Insurance companies

In Jamaica, many people drive uninsured, even though insurance is compulsory, so information here is underestimated (Ministry of Construction, 1984). Also, one would have to collect information from all the insurance companies serving accident victims in Jamaica, which would be prohibitively time consuming.

3- Emergency hospitals

Again, each hospital keeps its own records, so to obtain any accurate data on accident casualties and injuries would be extremely difficult and beyond the limitations of this study.

4- Garages

There are so many private and company garages that it is not feasible to collect information from this source. (There is no centralized accident information resource in Jamaica.)

In some countries, the records are held by the Ministry Statistical Bureau. For example, in Great Britain, all the official road traffic accident statistics are compiled from information collected by the road police and forwarded to the Department of Works (STATS 19 form). Only accidents involving injuries are collected, as the law requires drivers to report only these accidents. Thus, in great Britain, large scale data collection is carried out automatically, using this system.

In Great Britain, to obtain any property damage accident information,, one must look into insurance company files. In Jamaica, the most reliable sources of information are records of the urban traffic police, or the highway police, depending on the type of data required.

In order to obtain any accident data from the police in Jamaica, it is necessary to have the request processed through many channels. Much detail and explanation are required to support the request at each level of approval before data are released. Most of the data then available is in crude and unorganized form. There is no centralized collection agency or any similar agency to which to turn for the purpose of obtaining reliable and organized traffic data.

7-3. Accident Data Collection

Using the diagram labeled Figure 7-1, it can be seen that road accidents are complex phenomena, and to identify the causes of any one accident many experts from different academic fields, much time, and extensive facilities are needed. The highway police and the highway authorities are likely to have differing attitudes toward road accidents, as the police are oriented toward isolating the human elements. Yet, the human element is only one factor, and passing a deterrent sentence on one driver does not take into account all the facets of the problem. It seems necessary to take the driver as he is, not as society would like him to be. The driver is a single element of many which must be considered when evaluating road accident problems. He is full of physical, emotional and moral limitations and imperfections, and it is necessary to weed out those drivers

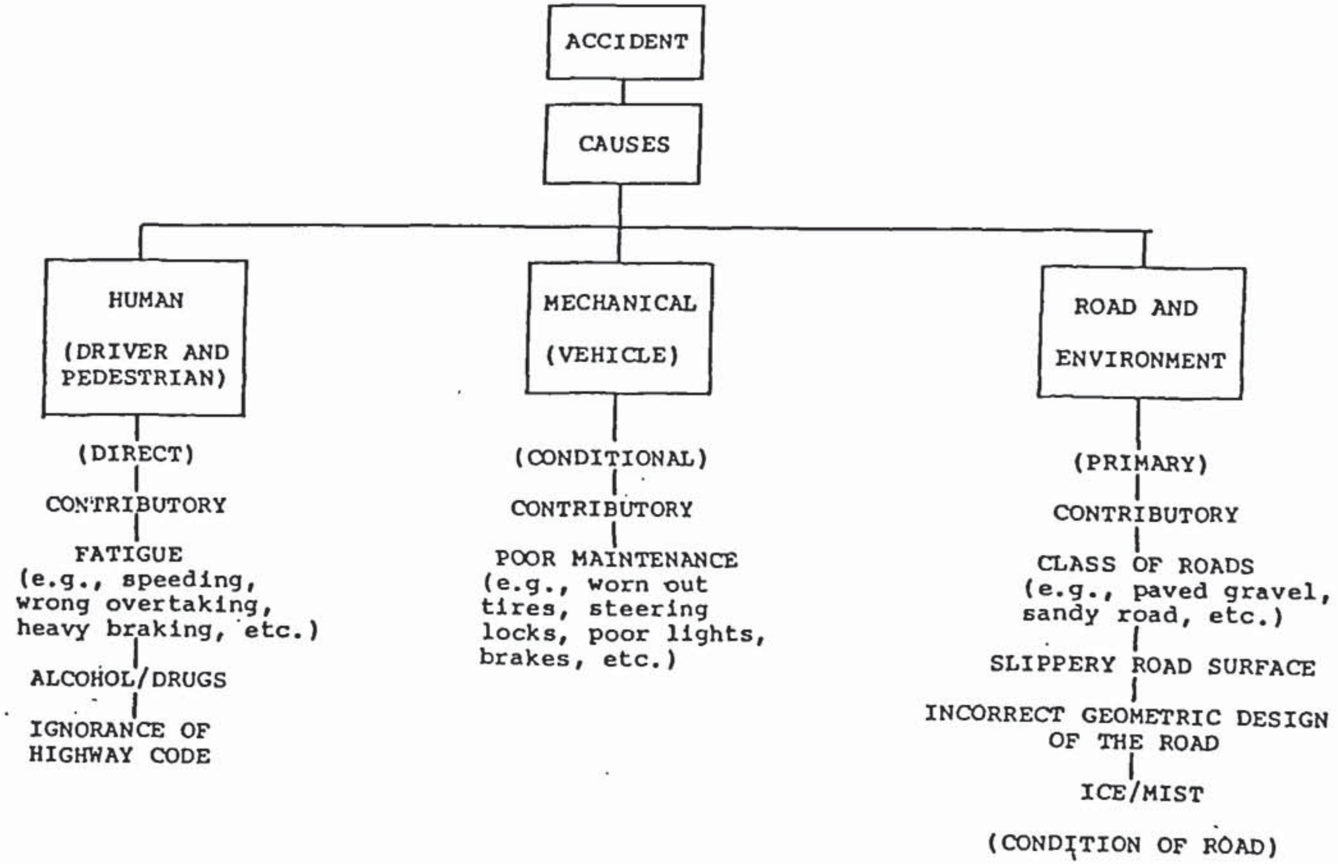


Fig. 7-1. The three contributory causes of road accidents.

whose ability to drive in a proper and safe manner is not up to standard.

The highway authorities, in contrast, usually try to isolate the road element of the road accident problem. There is no such thing as an absolutely safe highway, any more than there is an absolutely safe vehicle, or entirely safe human behavior. Reduction of accident losses must be sought, therefore, in modifications to the environment, to the vehicle, and to human behavior.

However, in most developed countries, information collected by the road police takes the form below (see figures 7-2A, B & C for more detailed information):

1- Time and date of accident

2- Environmental situation, such as lightness, darkness, road surface condition, etc.

3- Types of collision:

  a- Vehicle/vehicle

  b- Vehicle/pedestrian

  c- Multi-vehicle

  d- Vehicle/stationary object.

4- Casualties of road traffic accidents:

  a- Number

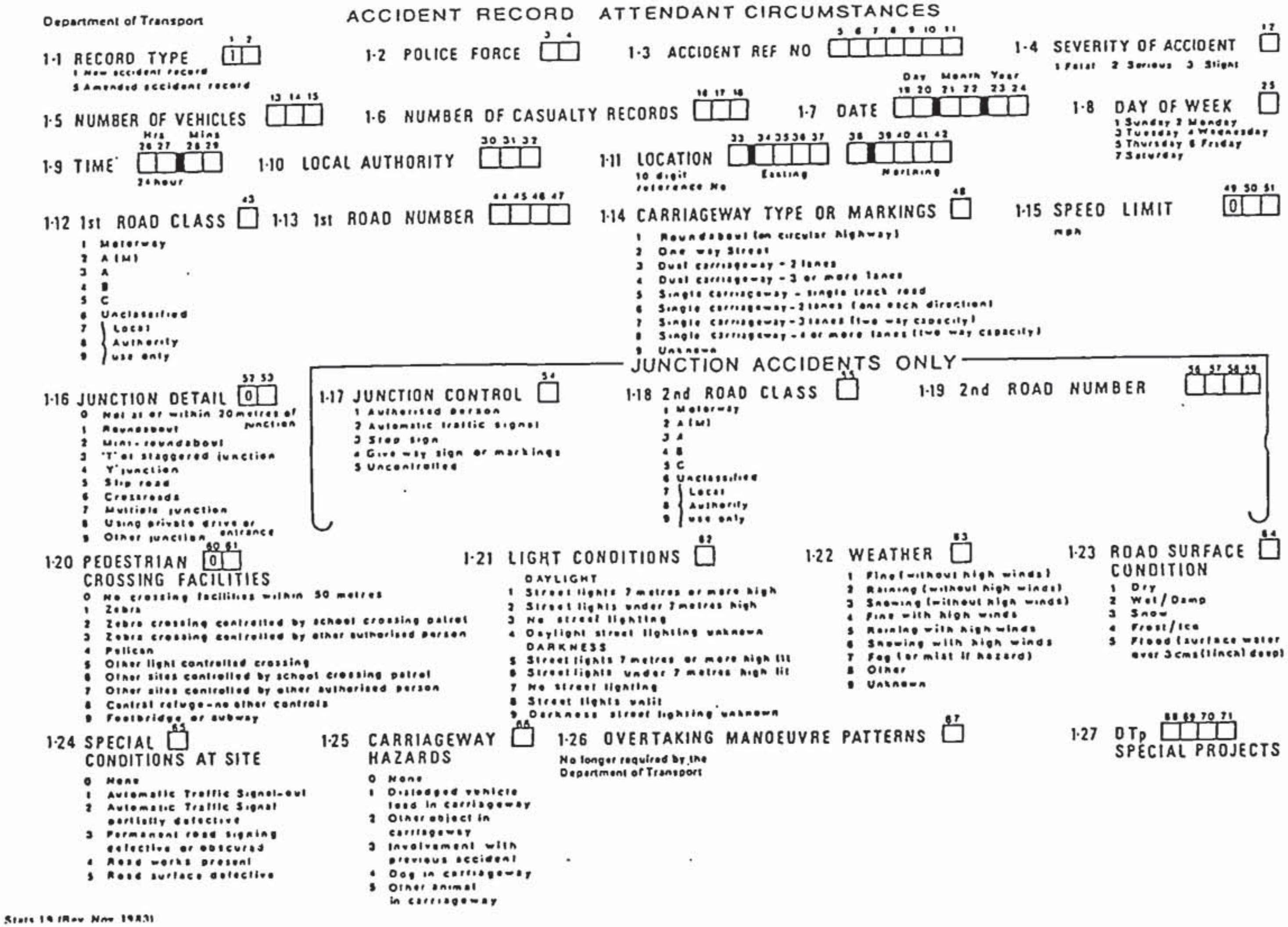
  b- Sex

  c- Severity of injury

  d- Age

5- Road conditions:

  a- Road marking and signage



Department of Transport

ACCIDENT RECORD ATTENDANT CIRCUMSTANCES

1·1 RECORD TYPE 1 2 [1] ☐
1 New accident record
5 Amended accident record

1·2 POLICE FORCE 3 4 ☐☐

1·3 ACCIDENT REF NO 5 6 7 8 9 10 11 ☐☐☐☐☐☐☐

1·4 SEVERITY OF ACCIDENT 17 ☐
1 Fatal 2 Serious 3 Slight

1·5 NUMBER OF VEHICLES 13 14 15 ☐☐☐

1·6 NUMBER OF CASUALTY RECORDS 16 17 18 ☐☐☐

1·7 DATE Day Month Year 19 20 21 22 23 24 ☐☐ ☐☐ ☐☐

1·8 DAY OF WEEK 25 ☐
1 Sunday 2 Monday
3 Tuesday 4 Wednesday
5 Thursday 6 Friday
7 Saturday

1·9 TIME Hrs Mins 26 27 28 29 ☐☐ ☐☐
24 hour

1·10 LOCAL AUTHORITY 30 31 32 ☐☐☐

1·11 LOCATION 33 34 35 36 37 ☐ ☐☐☐☐ 38 39 40 41 42 ☐ ☐☐☐☐
10 digit reference No Easting Northing

1·12 1st ROAD CLASS 43 ☐
1 Motorway
2 A (M)
3 A
4 B
5 C
6 Unclassified
7 Local
8 Authority
9 use only

1·13 1st ROAD NUMBER 44 45 46 47 ☐☐☐☐

1·14 CARRIAGEWAY TYPE OR MARKINGS 48 ☐
1 Roundabout (on circular highway)
2 One way Street
3 Dual carriageway - 2 lanes
4 Dual carriageway - 3 or more lanes
5 Single carriageway - single track road
6 Single carriageway - 2 lanes (one each direction)
7 Single carriageway - 3 lanes (two way capacity)
8 Single carriageway - 4 or more lanes (two way capacity)
9 Unknown

1·15 SPEED LIMIT 49 50 51 [0] ☐☐
mph

1·16 JUNCTION DETAIL 52 53 [0] ☐
0 Not at or within 20 metres of junction
1 Roundabout
2 Mini-roundabout
3 'T' or staggered junction
4 'Y' junction
5 Slip road
6 Crossroads
7 Multiple junction
8 Using private drive or entrance
9 Other junction

JUNCTION ACCIDENTS ONLY

1·17 JUNCTION CONTROL 54 ☐
1 Authorised person
2 Automatic traffic signal
3 Stop sign
4 Give way sign or markings
5 Uncontrolled

1·18 2nd ROAD CLASS 55 ☐
1 Motorway
2 A (M)
3 A
4 B
5 C
6 Unclassified
7 Local
8 Authority
9 use only

1·19 2nd ROAD NUMBER 56 57 58 59 ☐☐☐☐

1·20 PEDESTRIAN CROSSING FACILITIES 60 61 [0] ☐
0 No crossing facilities within 50 metres
1 Zebra
2 Zebra crossing controlled by school crossing patrol
3 Zebra crossing controlled by other authorised person
4 Pelican
5 Other light controlled crossing
6 Other sites controlled by school crossing patrol
7 Other sites controlled by other authorised person
8 Central refuge - no other controls
9 Footbridge or subway

1·21 LIGHT CONDITIONS 62 ☐
DAYLIGHT
1 Street lights 7 metres or more high
2 Street lights under 7 metres high
3 No street lighting
4 Daylight street lighting unknown
DARKNESS
5 Street lights 7 metres or more high lit
6 Street lights under 7 metres high lit
7 No street lighting
8 Street lights unlit
9 Darkness street lighting unknown

1·22 WEATHER 63 ☐
1 Fine (without high winds)
2 Raining (without high winds)
3 Snowing (without high winds)
4 Fine with high winds
5 Raining with high winds
6 Snowing with high winds
7 Fog (or mist if hazard)
8 Other
9 Unknown

1·23 ROAD SURFACE CONDITION 64 ☐
1 Dry
2 Wet / Damp
3 Snow
4 Frost / Ice
5 Flood (surface water over 3cms (1inch) deep)

1·24 SPECIAL CONDITIONS AT SITE 65 ☐
0 None
1 Automatic Traffic Signal-out
2 Automatic Traffic Signal partially defective
3 Permanent road signing defective or obscured
4 Road works present
5 Road surface defective

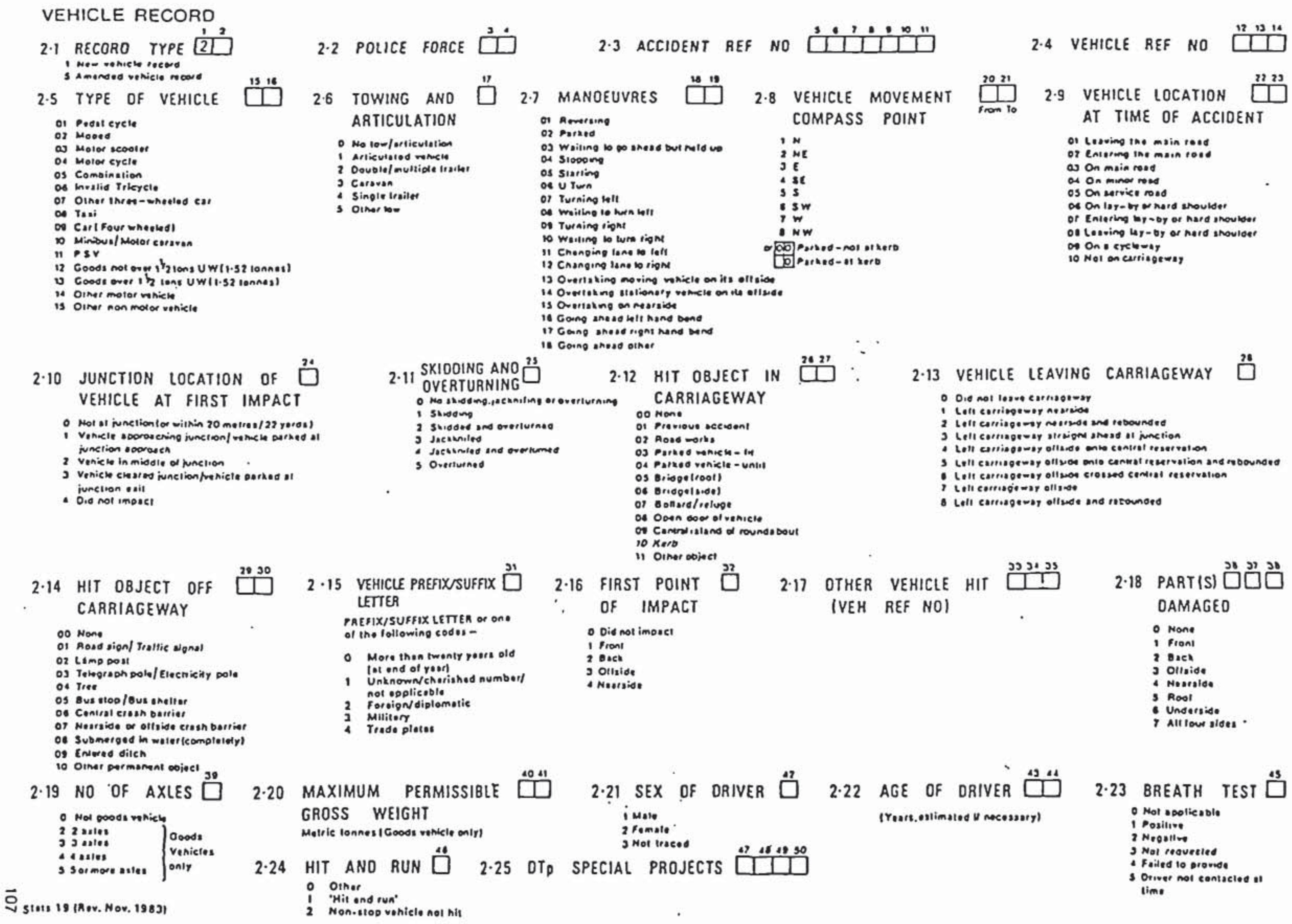
1·25 CARRIAGEWAY HAZARDS 66 ☐
0 None
1 Dislodged vehicle load in carriageway
2 Other object in carriageway
3 Involvement with previous accident
4 Dog in carriageway
5 Other animal in carriageway

1·26 OVERTAKING MANOEUVRE PATTERNS 67 ☐
No longer required by the Department of Transport

1·27 DTp SPECIAL PROJECTS 68 69 70 71 ☐☐☐☐

Stats 19 (Rev Nov 1983)

Fig. 7-2A. Stats 19 Form



VEHICLE RECORD

2·1 RECORD TYPE 1 2 [2]☐
1 New vehicle record
5 Amended vehicle record

2·2 POLICE FORCE 3 4 ☐☐

2·3 ACCIDENT REF NO 5 6 7 8 9 10 11 ☐☐☐☐☐☐☐

2·4 VEHICLE REF NO 12 13 14 ☐☐☐

2·5 TYPE OF VEHICLE 15 16 ☐☐
01 Pedal cycle
02 Moped
03 Motor scooter
04 Motor cycle
05 Combination
06 Invalid Tricycle
07 Other three-wheeled car
08 Taxi
09 Car (Four wheeled)
10 Minibus/Motor caravan
11 PSV
12 Goods not over 1½ tons UW (1·52 tonnes)
13 Goods over 1½ tons UW (1·52 tonnes)
14 Other motor vehicle
15 Other non motor vehicle

2·6 TOWING AND ARTICULATION 17 ☐
0 No tow/articulation
1 Articulated vehicle
2 Double/multiple trailer
3 Caravan
4 Single trailer
5 Other tow

2·7 MANOEUVRES 18 19 ☐☐
01 Reversing
02 Parked
03 Waiting to go ahead but held up
04 Stopping
05 Starting
06 U Turn
07 Turning left
08 Waiting to turn left
09 Turning right
10 Waiting to turn right
11 Changing lane to left
12 Changing lane to right
13 Overtaking moving vehicle on its offside
14 Overtaking stationary vehicle on its offside
15 Overtaking on nearside
16 Going ahead left hand bend
17 Going ahead right hand bend
18 Going ahead other

2·8 VEHICLE MOVEMENT COMPASS POINT 20 21 ☐☐ From To
1 N
2 NE
3 E
4 SE
5 S
6 SW
7 W
8 NW
or [0|0] Parked - not at kerb
[|0] Parked - at kerb

2·9 VEHICLE LOCATION AT TIME OF ACCIDENT 22 23 ☐☐
01 Leaving the main road
02 Entering the main road
03 On main road
04 On minor road
05 On service road
06 On lay-by or hard shoulder
07 Entering lay-by or hard shoulder
08 Leaving lay-by or hard shoulder
09 On a cycleway
10 Not on carriageway

2·10 JUNCTION LOCATION OF VEHICLE AT FIRST IMPACT 24 ☐
0 Not at junction (or within 20 metres/22 yards)
1 Vehicle approaching junction/vehicle parked at junction approach
2 Vehicle in middle of junction
3 Vehicle cleared junction/vehicle parked at junction exit
4 Did not impact

2·11 SKIDDING AND OVERTURNING 25 ☐
0 No skidding, jack-knifing or overturning
1 Skidding
2 Skidded and overturned
3 Jackknifed
4 Jackknifed and overturned
5 Overturned

2·12 HIT OBJECT IN CARRIAGEWAY 26 27 ☐☐
00 None
01 Previous accident
02 Road works
03 Parked vehicle - lit
04 Parked vehicle - unlit
05 Bridge (roof)
06 Bridge (side)
07 Bollard/refuge
08 Open door of vehicle
09 Central island of roundabout
10 Kerb
11 Other object

2·13 VEHICLE LEAVING CARRIAGEWAY 28 ☐
0 Did not leave carriageway
1 Left carriageway nearside
2 Left carriageway nearside and rebounded
3 Left carriageway straight ahead at junction
4 Left carriageway offside onto central reservation
5 Left carriageway offside onto central reservation and rebounded
6 Left carriageway offside crossed central reservation
7 Left carriageway offside
8 Left carriageway offside and rebounded

2·14 HIT OBJECT OFF CARRIAGEWAY 29 30 ☐☐
00 None
01 Road sign/Traffic signal
02 Lamp post
03 Telegraph pole/Electricity pole
04 Tree
05 Bus stop/Bus shelter
06 Central crash barrier
07 Nearside or offside crash barrier
08 Submerged in water (completely)
09 Entered ditch
10 Other permanent object

2·15 VEHICLE PREFIX/SUFFIX LETTER 31 ☐
PREFIX/SUFFIX LETTER or one of the following codes –
0 More than twenty years old (at end of year)
1 Unknown/cherished number/not applicable
2 Foreign/diplomatic
3 Military
4 Trade plates

2·16 FIRST POINT OF IMPACT 32 ☐
0 Did not impact
1 Front
2 Back
3 Offside
4 Nearside

2·17 OTHER VEHICLE HIT (VEH REF NO) 33 34 35 ☐☐☐

2·18 PART(S) DAMAGED 36 37 38 ☐☐☐
0 None
1 Front
2 Back
3 Offside
4 Nearside
5 Roof
6 Underside
7 All four sides

2·19 NO OF AXLES 39 ☐
0 Not goods vehicle
2 2 axles
3 3 axles
4 4 axles
5 5 or more axles
} Goods Vehicles only

2·20 MAXIMUM PERMISSIBLE GROSS WEIGHT 40 41 ☐☐
Metric tonnes (Goods vehicle only)

2·21 SEX OF DRIVER 42 ☐
1 Male
2 Female
3 Not traced

2·22 AGE OF DRIVER 43 44 ☐☐
(Years, estimated if necessary)

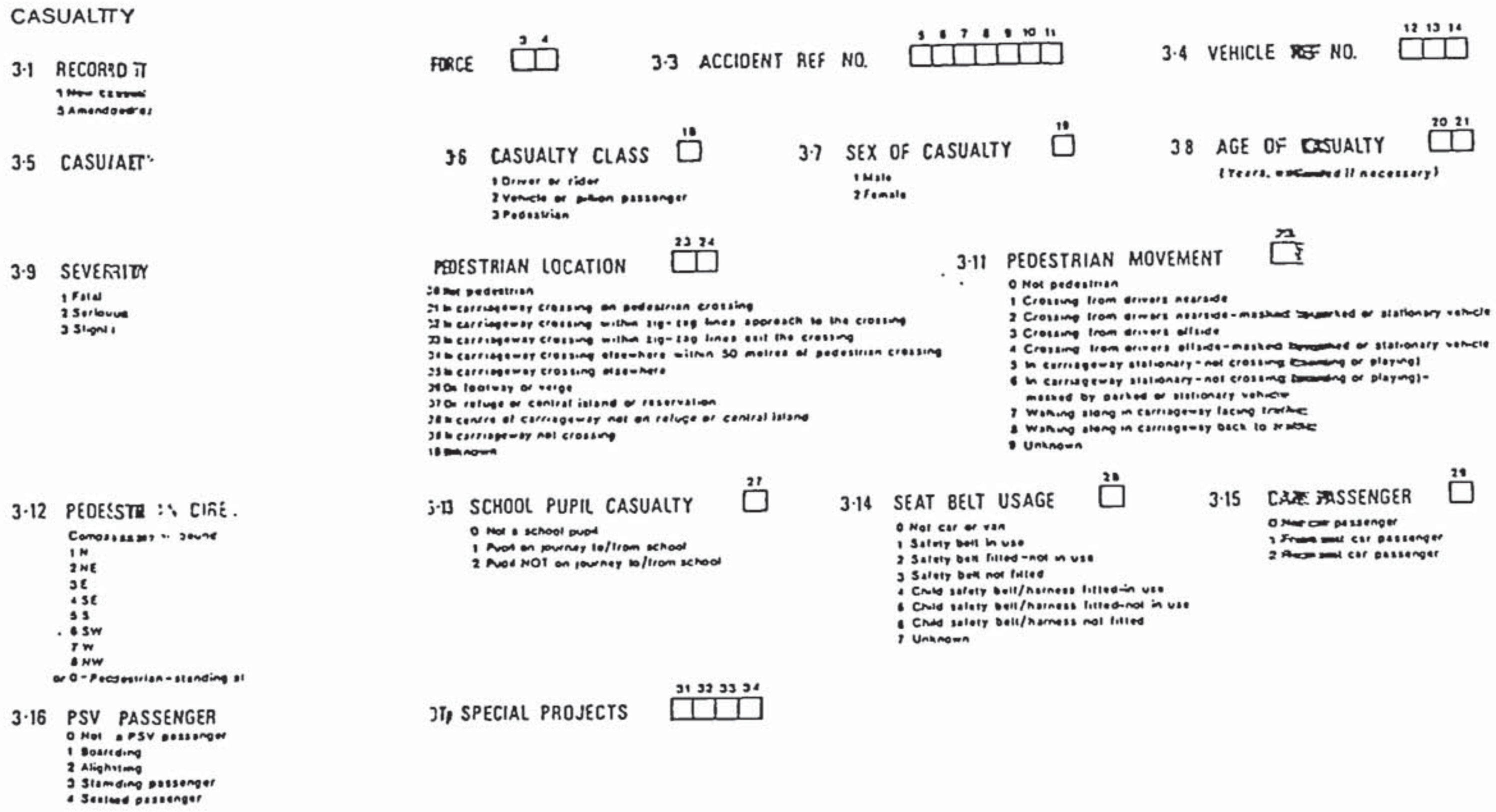
2·23 BREATH TEST 45 ☐
0 Not applicable
1 Positive
2 Negative
3 Not requested
4 Failed to provide
5 Driver not contacted at time

2·24 HIT AND RUN 46 ☐
0 Other
1 'Hit and run'
2 Non-stop vehicle not hit

2·25 DTp SPECIAL PROJECTS 47 48 49 50 ☐☐☐☐

107 Stats 19 (Rev. Nov. 1983)

Fig. 7-2B. Stats 19 Form



CASUALTY

3·1 RECORD T
1 New casualty
3 Amendment

FORCE ☐☐ (3 4)

3·3 ACCIDENT REF NO. ☐☐☐☐☐☐☐ (5 6 7 8 9 10 11)

3·4 VEHICLE REF NO. ☐☐☐ (12 13 14)

3·5 CASUALTY

3·6 CASUALTY CLASS ☐ (18)
1 Driver or rider
2 Vehicle or pillion passenger
3 Pedestrian

3·7 SEX OF CASUALTY ☐ (19)
1 Male
2 Female

3·8 AGE OF CASUALTY ☐☐ (20 21)
(Years, estimated if necessary)

3·9 SEVERITY
1 Fatal
2 Serious
3 Slight

PEDESTRIAN LOCATION ☐☐ (23 24)
20 Not pedestrian
21 In carriageway crossing on pedestrian crossing
22 In carriageway crossing within zig-zag lines approach to the crossing
23 In carriageway crossing within zig-zag lines exit the crossing
24 In carriageway crossing elsewhere within 50 metres of pedestrian crossing
25 In carriageway crossing elsewhere
26 On footway or verge
27 On refuge or central island or reservation
28 In centre of carriageway not on refuge or central island
29 In carriageway not crossing
10 Unknown

3·11 PEDESTRIAN MOVEMENT ☐ (25)
0 Not pedestrian
1 Crossing from drivers nearside
2 Crossing from drivers nearside-masked by parked or stationary vehicle
3 Crossing from drivers offside
4 Crossing from drivers offside-masked by parked or stationary vehicle
5 In carriageway stationary - not crossing (standing or playing)
6 In carriageway stationary - not crossing (standing or playing) - masked by parked or stationary vehicle
7 Walking along in carriageway facing traffic
8 Walking along in carriageway back to traffic
9 Unknown

3·12 PEDESTRIAN DIRECTION
Compass point bound
1 N
2 NE
3 E
4 SE
5 S
6 SW
7 W
8 NW
or 0 - Pedestrian - standing st

3·13 SCHOOL PUPIL CASUALTY ☐ (27)
0 Not a school pupil
1 Pupil on journey to/from school
2 Pupil NOT on journey to/from school

3·14 SEAT BELT USAGE ☐ (28)
0 Not car or van
1 Safety belt in use
2 Safety belt fitted - not in use
3 Safety belt not fitted
4 Child safety belt/harness fitted-in use
5 Child safety belt/harness fitted-not in use
6 Child safety belt/harness not fitted
7 Unknown

3·15 CAR PASSENGER ☐ (29)
0 Not car passenger
1 Front seat car passenger
2 Rear seat car passenger

3·16 PSV PASSENGER
0 Not a PSV passenger
1 Boarding
2 Alighting
3 Standing passenger
4 Seated passenger

3·17 SPECIAL PROJECTS ☐☐☐☐ (31 32 33 34)

Fig. 7-2C. Stats 19 Form

b- Geometric design of the road--junction, main road, dual carriageway; condition of pavement and roadside facilities.

In Jamaica, the booklet shown in Appendix A is the standard booklet used by the highway police for accident reporting. Information from such booklets was collected and is presented in the form of the tables in Appendix B; the acquisition of this information was a major product of the candidate's trip to Jamaica.

As one compares the methodology employed in accident data collection by the Jamaican police with data collection in most developed countries, it is possible to identify many areas in need of improvement. For example, the type of accident is not recorded in any of the data collected by Jamaican police, nor are road conditions at the time of the accident noted. These two pieces of information are crucial to any successful accident investigation, as well as to research aimed at attacking the problem of road accidents.

Therefore, it seems that the biggest problem that an accident investigator faces in Jamaica is the lack of reliable information and data. Limited resources prevented the candidate from collecting accident data over time at the site of the Road of Study, the most acceptable and reliable way to provide an accurate data base for any study.

A special methodology, therefore, had to be utilized in this research to identify accident concentrations and types in the clearest way possible. The "histogram" model selected helps to identify where so-called "black spots" (high accident frequency locations) occur on the Road of Study. Utilizing squares with different shading techniques (Figs. 7-3 through 7-11) assist in delineating different types of accidents common to different sections of the study road. This method was utilized as the best for illustrating the percentages on the histogram. Percentages of each type of accident occurring on identified sections of the Road of Study were graphed on the histogram. This method was found to be the best for data analysis.

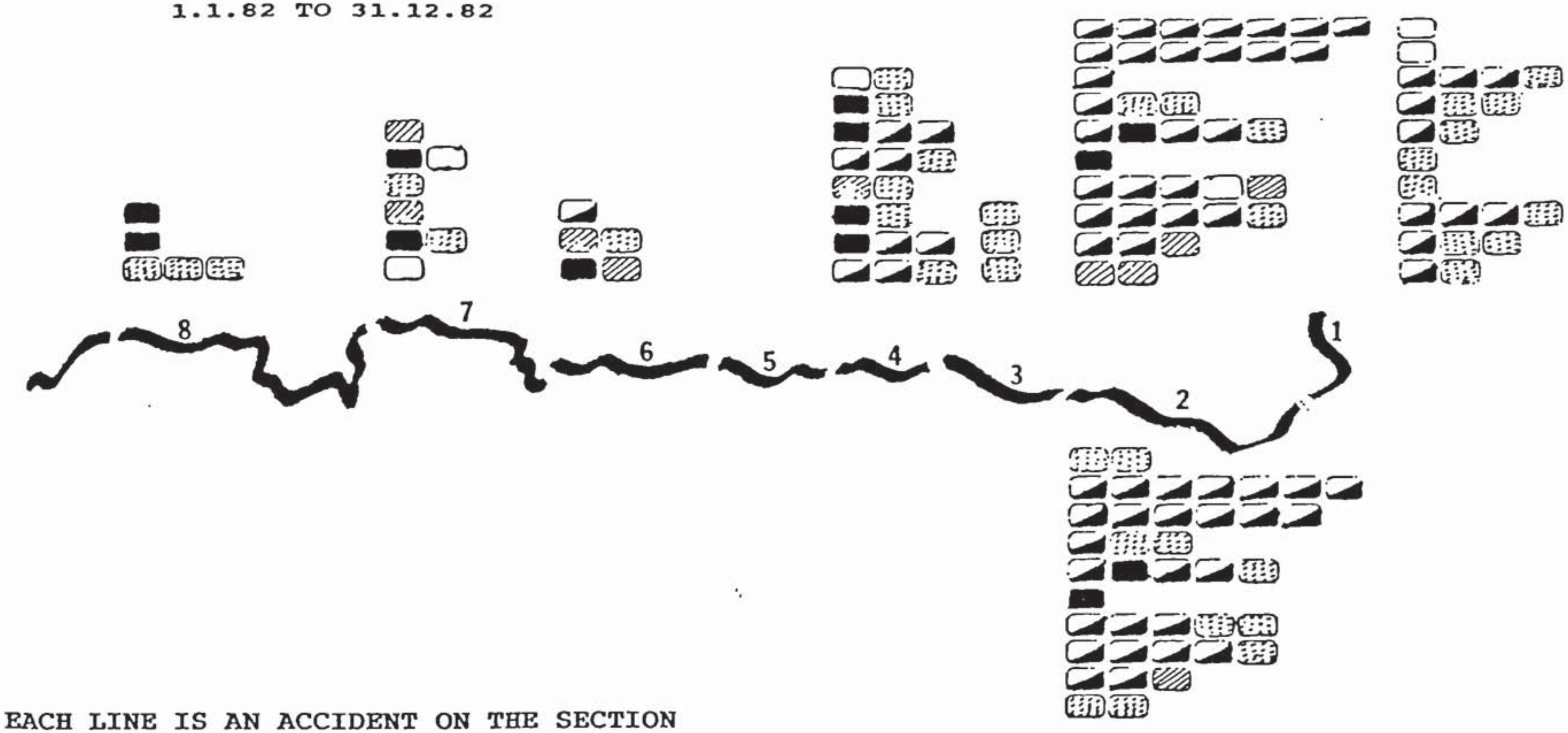
Accident data shown is limited to three years (1982, 1983 and 1984), because these were the only data available in Jamaican records. The methodology selected assisted, as well, in a comparison of accident types, location, frequency and outcomes among these three years. Only fatal and serious accidents are shown on the colored histograms, because the study is limited to these two outcomes.

7-4. Data Analysis

The data obtained was sorted and organized in a format most useful for data analysis. It was then analyzed by year, the years 1982, 1983 and 1984 being the only years available for analysis. Fortunately, these three years did provide a clear picture of the accidents which occurred on the road of study and where they took place.

In 1982, it can be seen that most of these accidents were concentrated in sections 1 and 2 (Reading and Barnet,

1.1.82 TO 31.12.82



EACH LINE IS AN ACCIDENT ON THE SECTION

KEY 2

SECTION 1 - READING & BARNET
SECTION 2 - BOGUE RD.; SECTION 3 - ROUND HILL RD.
SECTION 4 - ORCHARD RD.; SECTION 5 - HOPEWELL RD.
SECTION 6 - SANDY BAY RD.; SECTION 7 - JOHNSON RD.
SECTION 8 - LUCEA RD.

KEY 1

INJURY ACC.		DAMAGE ACC.	
■	FATAL	⣿	OVER $10
◪	SERIOUS	☐	UNDER $10
▨	SLIGHT		

Fig. 7-3. Accident distribution on the Montego Bay to Lucea Road for 1982.

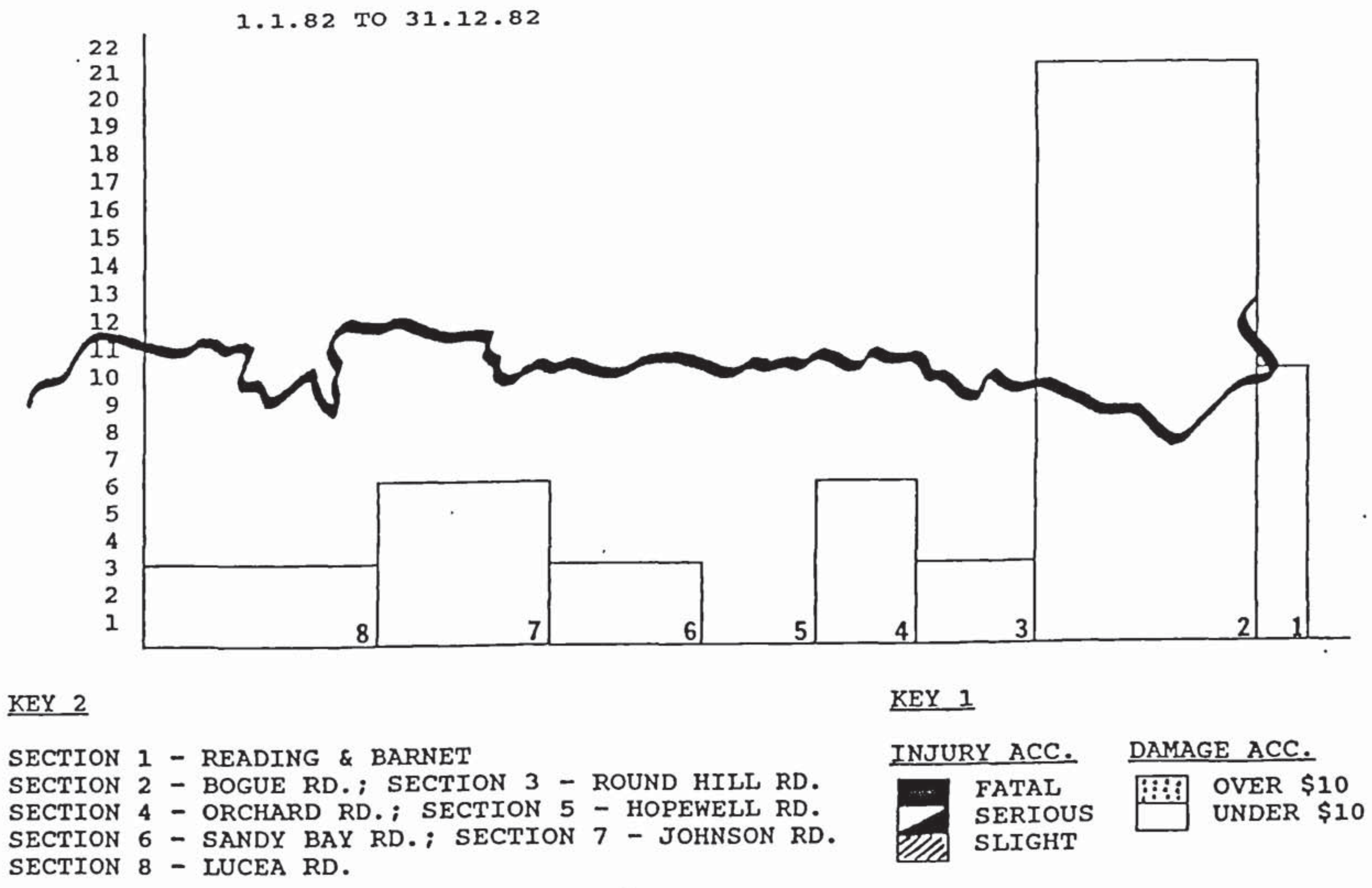
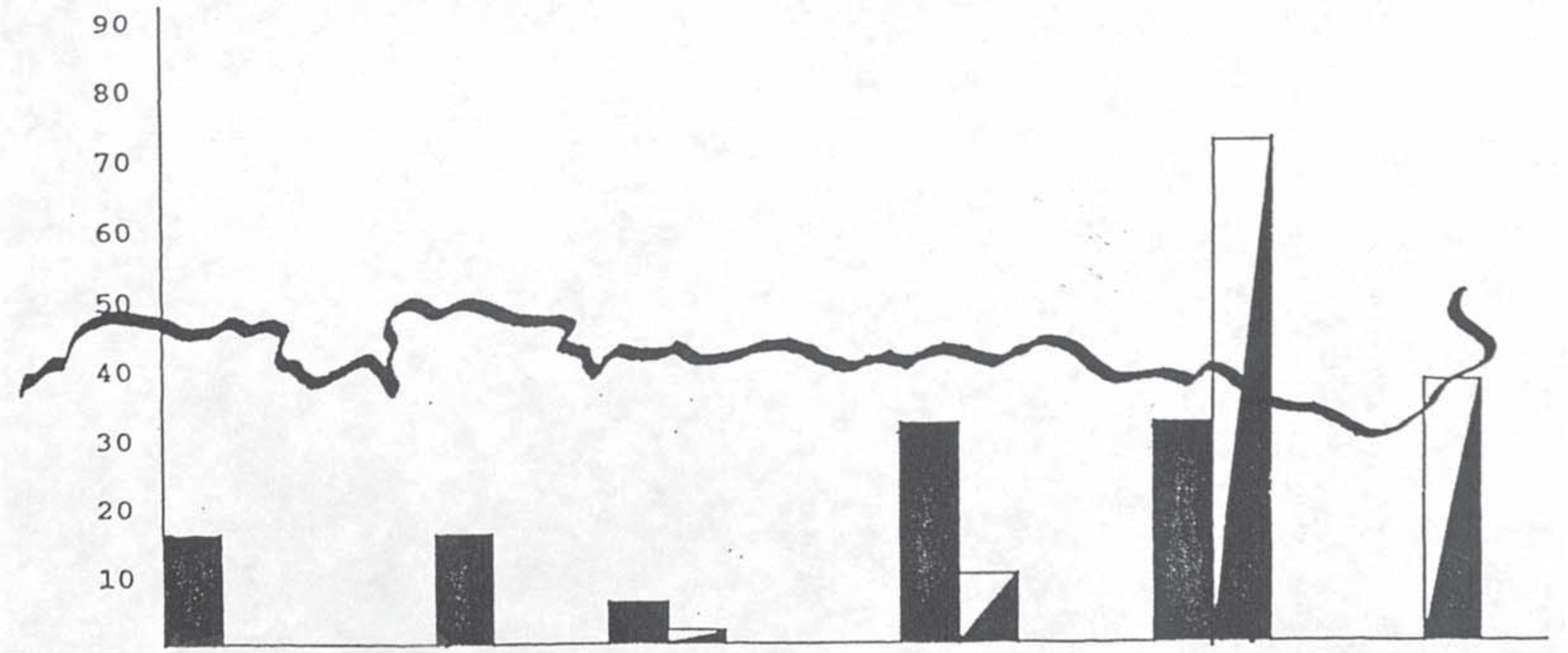


Fig. 7-4. Number of accidents occurring at the various sections of the road of study for 1982, presented in a histogram form.

1.1.82 TO 31.12.82



KEY 2

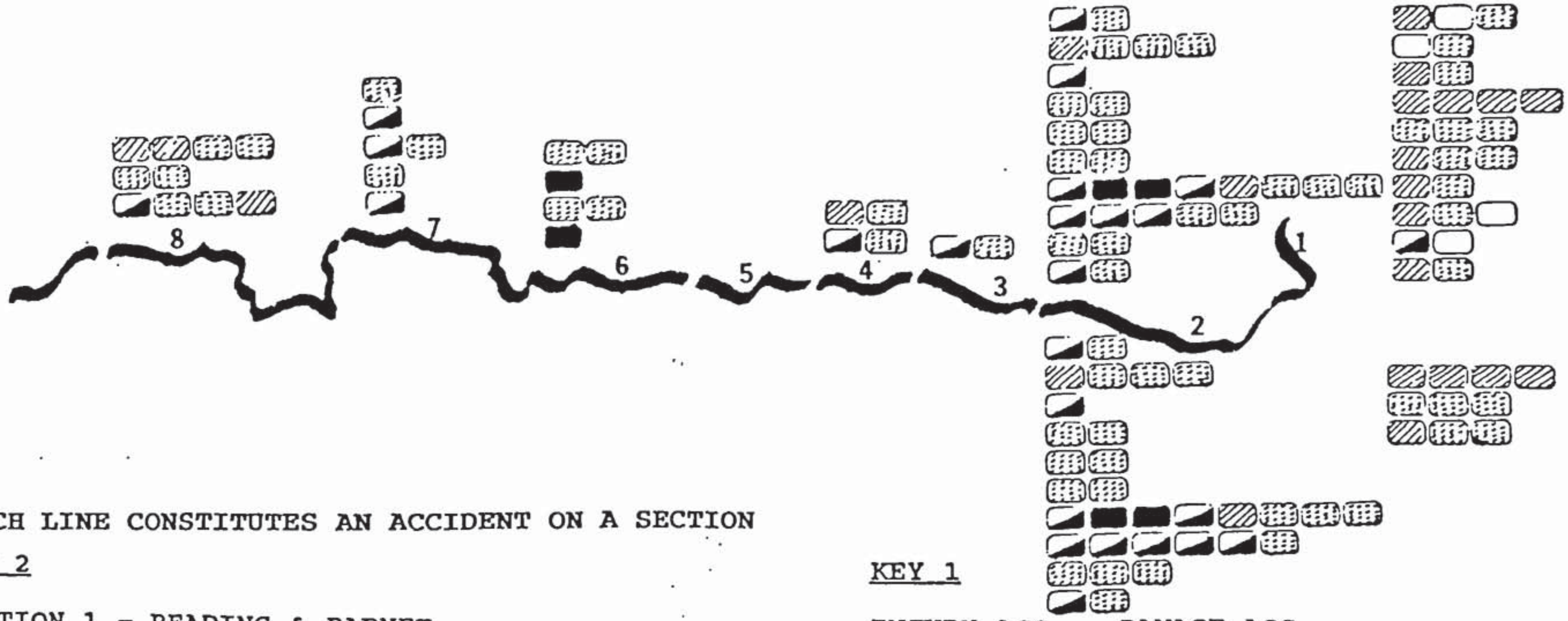
SECTION 1 - READING & BARNET
SECTION 2 - BOGUE RD.; SECTION 3 - ROUND HILL RD.
SECTION 4 - ORCHARD RD.; SECTION 5 - HOPEWELL RD.
SECTION 6 - SANDY BAY RD.; SECTION 7 - JOHNSON RD.
SECTION 8 - LUCEA RD.

KEY 1

INJURY ACC.		DAMAGE ACC.	
■	FATAL	▨	OVER $10
◪	SERIOUS	☐	UNDER $10
▨	SLIGHT		

Fig. 7-5. Percentage histogramic distribution of fatal and serious injury accidents by section of the road of study for 1982.

1.1.83 TO 31.12.83



EACH LINE CONSTITUTES AN ACCIDENT ON A SECTION

KEY 2

SECTION 1 - READING & BARNET
SECTION 2 - BOGUE RD.; SECTION 3 - ROUND HILL RD.
SECTION 4 - ORCHARD RD.; SECTION 5 - HOPEWELL RD.
SECTION 6 - SANDY BAY RD.; SECTION 7 - JOHNSON RD.
SECTION 8 - LUCEA RD.

KEY 1

INJURY ACC.		DAMAGE ACC.	
■	FATAL	▦	OVER $10
◩	SERIOUS	☐	UNDER $10
▨	SLIGHT		

Fig. 7-6. Accident distribution on the Montego Bay to Lucea Road for 1983.

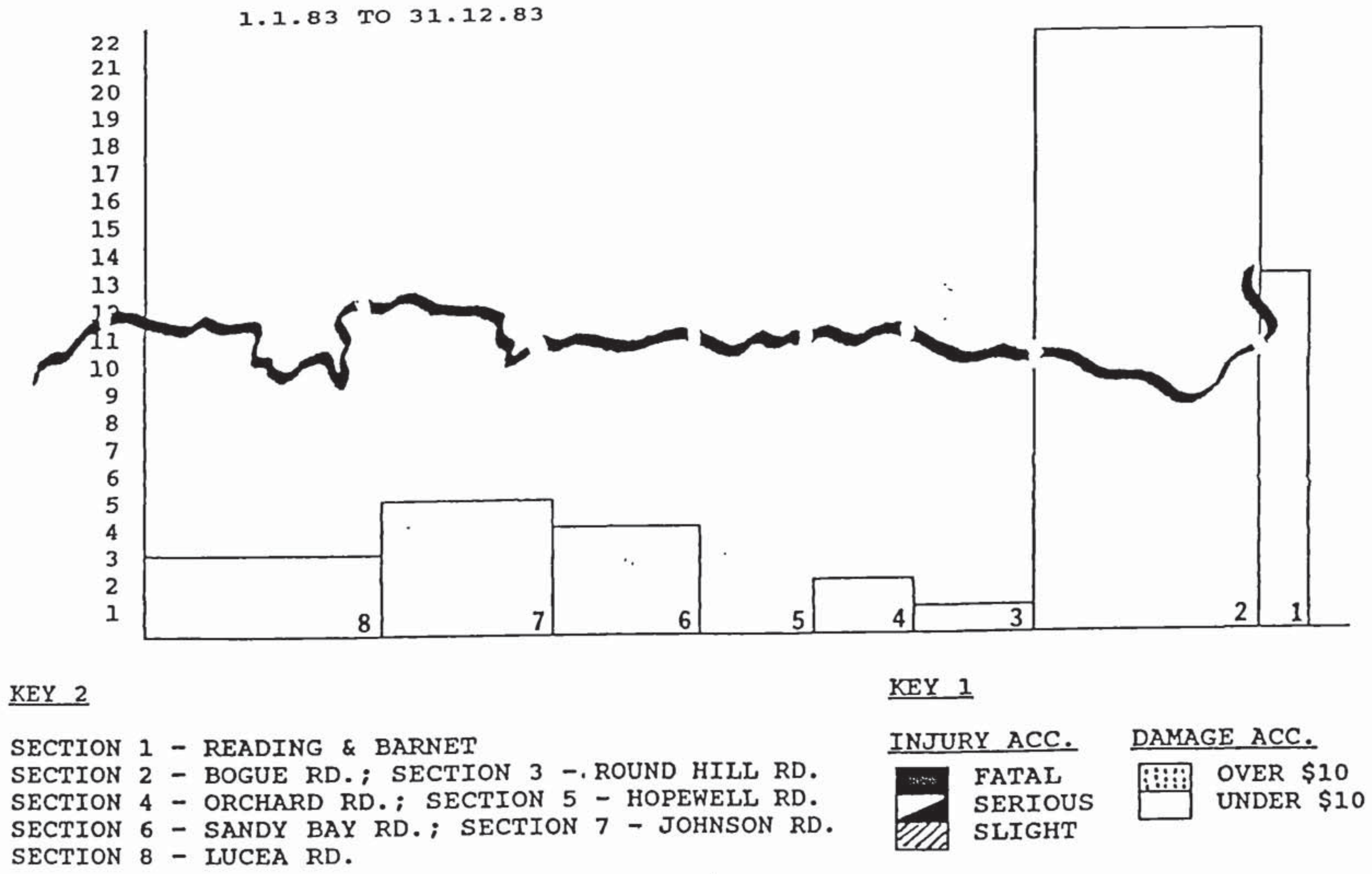


Fig. 7-7. Number of accidents occurring at the various sections of the road of study for 1983, presented in a histogram form.

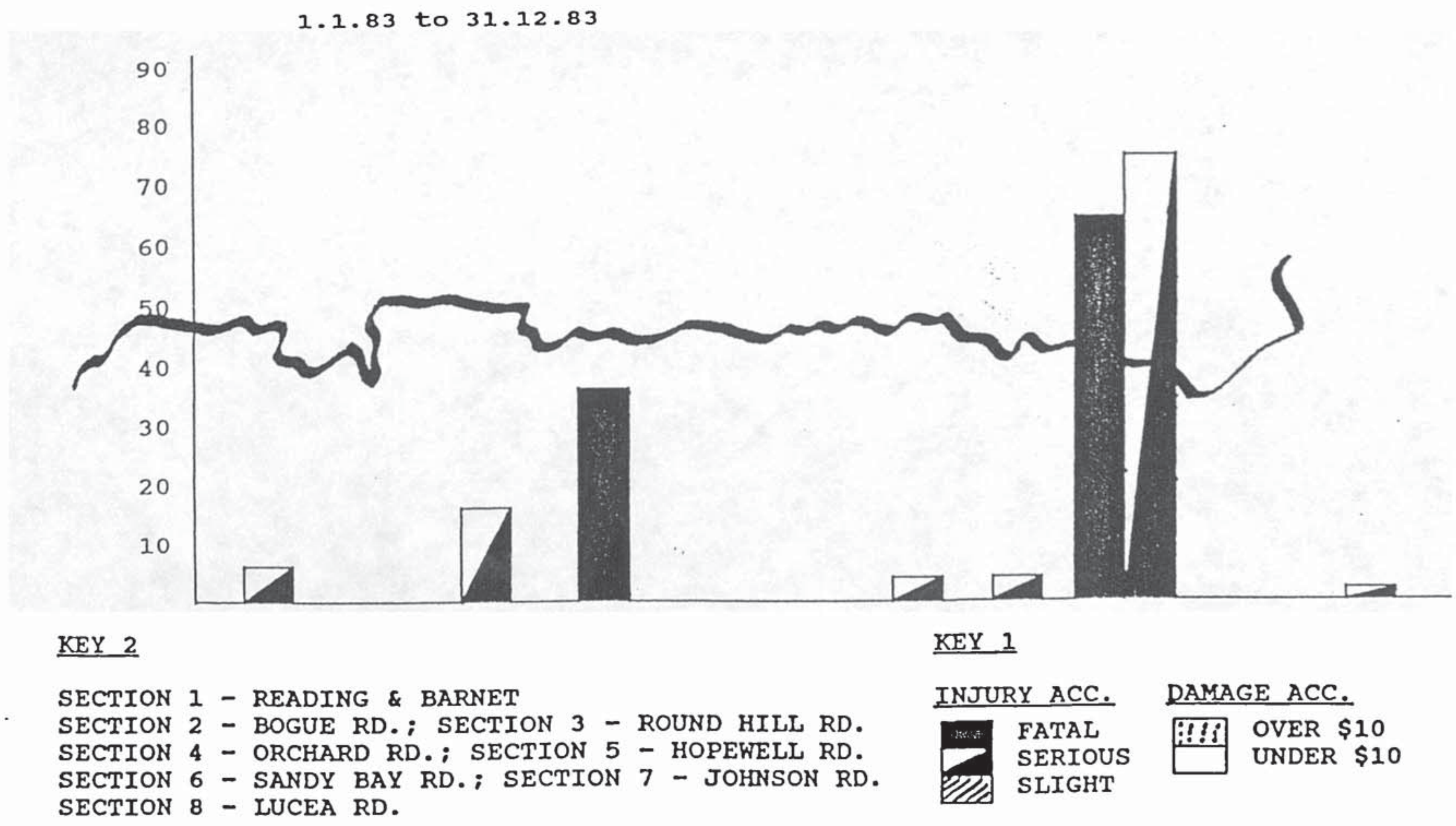
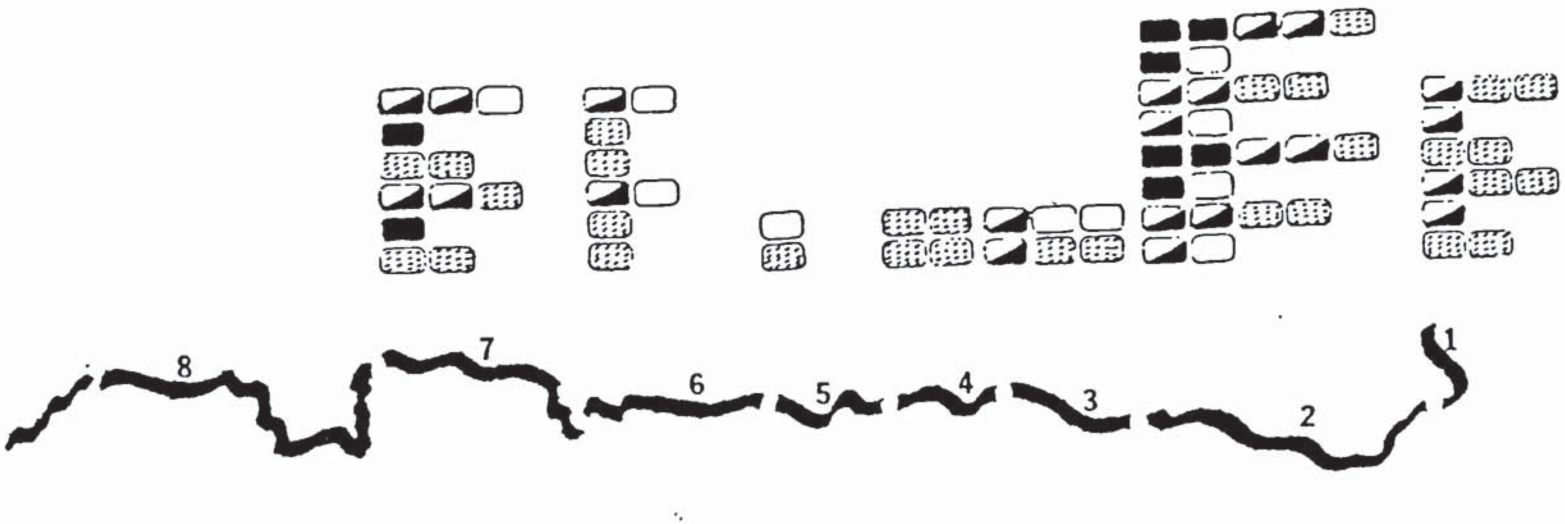


Fig. 7-8. Percentage histogramic distribution of fatal and serious injury accidents by section of the road of study for 1983.

1.1.84 TO 31.12.84



EACH LINE CONSTITUTES AN ACCIDENT ON A SECTION

KEY 2

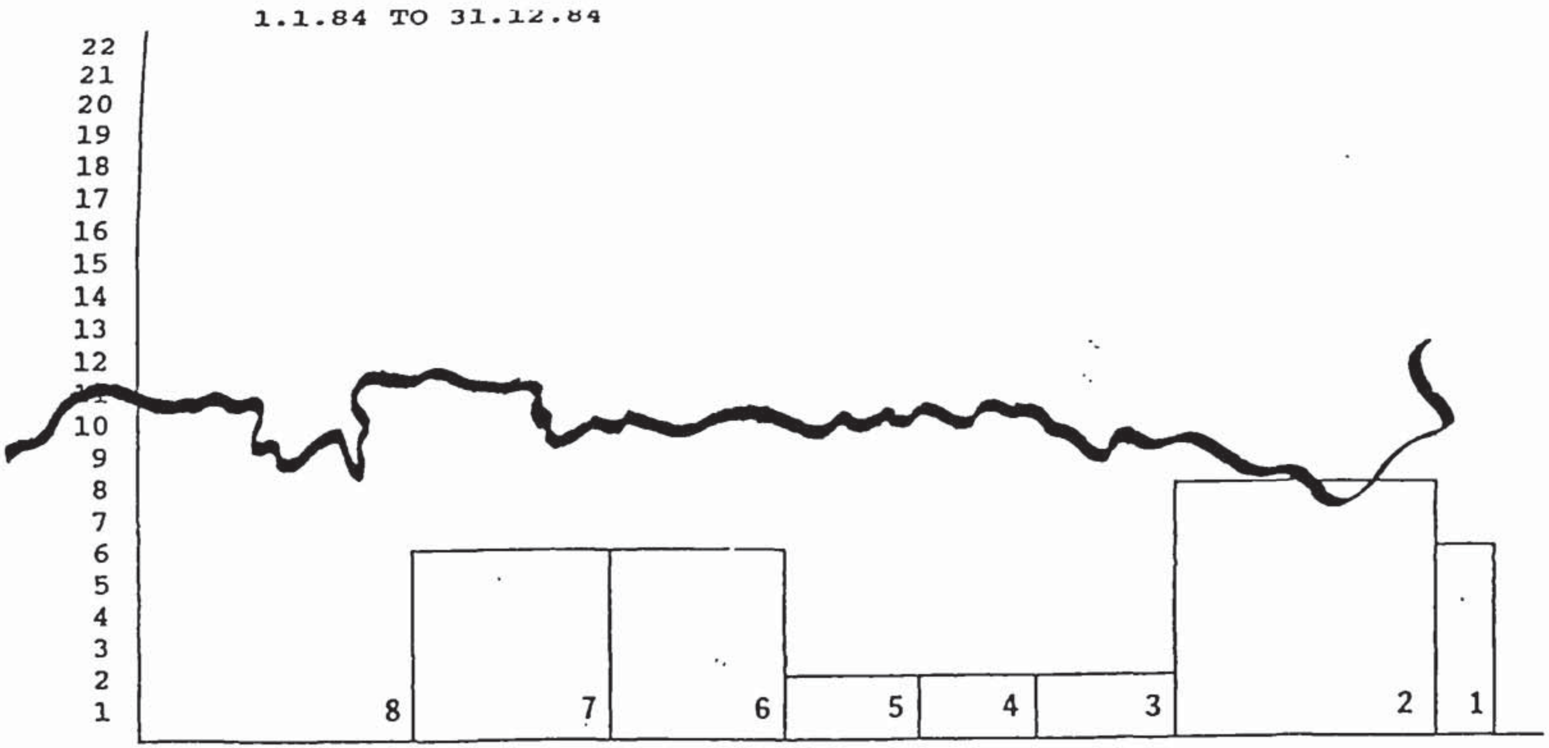
SECTION 1 - READING & BARNET
SECTION 2 - BOGUE RD.; SECTION 3 - ROUND HILL RD.
SECTION 4 - ORCHARD RD.; SECTION 5 - HOPEWELL RD.
SECTION 6 - SANDY BAY RD.; SECTION 7 - JOHNSON RD.
SECTION 8 - LUCEA RD.

KEY 1

INJURY ACC.
■ FATAL
◩ SERIOUS
▨ SLIGHT

DAMAGE ACC.
▦ OVER $10
☐ UNDER $10

Fig. 7-9. Accident distribution on the Montego Bay to Lucea Road for 1984.



KEY 2

SECTION 1 - READING & BARNET
SECTION 2 - BOGUE RD.; SECTION 3 - ROUND HILL RD.
SECTION 4 - ORCHARD RD.; SECTION 5 - HOPEWELL RD.
SECTION 6 - SANDY BAY RD.; SECTION 7 - JOHNSON RD.
SECTION 8 - LUCEA RD.

KEY 1

INJURY ACC.		DAMAGE ACC.	
■	FATAL	▦	OVER $10
◩	SERIOUS	☐	UNDER $10
▨	SLIGHT		

Fig. 7-10. Number of accidents occurring at the various sections of the road of stsudy for 1984, presented in a histogram form.

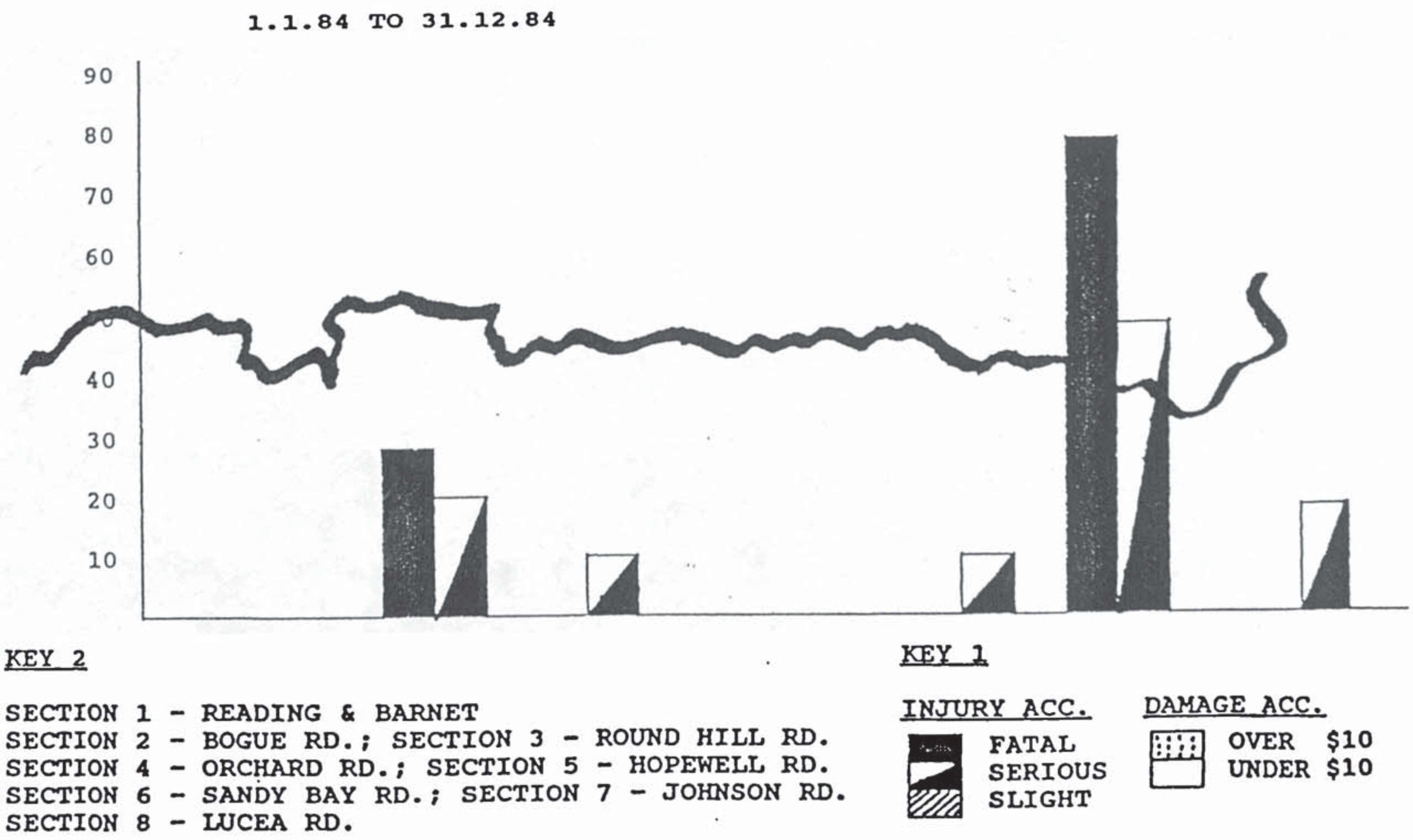


Fig. 7-11. Percentage histogramic distribution of fatal and serious injury accidents by section of the road of study for 1984.

and Bogue roads, respectively). The main reason for the high accident occurrence in these two sections was the high population density in these areas. Also, the highest volume of vehicle traffic occurs in these sections. They are also spots where drivers start to speed up; they are just leaving urban areas and entering rural areas. Therefore, combining the above three factors, one would most certainly expect a higher number of accidents.

The high density of traffic in the Montego Bay area has caused the roads to deteriorate faster than in any other location on the Road of Study. Also, the high concentration of tourists, who in the main have never driven in Jamaica, tends to contribute to the higher volume of road accidents in this particular area. The same factors contribute to a higher number of road accident occurrences in sections 1 and 2 for the years 1983 and 1984.

One of the most interesting sections of the road was Section 5. No accidents occurred on this section in the years 1982 and 1983. At first, this data was very puzzling, but after investigation and discussion with personnel in the Ministry of Construction and the Police Department (particularly with the Chief Surveyor at the Ministry of Construction), it was found that this section of the road had been extensively improved in 1981, by a private party who was planning construction of a marina in that area.

An examination of the 1984 data on Section 5 reveals that a few accidents actually took place in this section during this year. This finding may be attributable to deterioration of the road surface within the previous three years. Officials interviewed pointed out that the Road of Study had not been properly maintained during this period, because of the shortage of funds.

Section 8 of the Road of Study was found to be interesting as well, because although it is right outside a fair-sized city, not many accidents seem to have occurred in this area. Of these accidents, in 1982, a high percentage were fatal. There does not appear to be an obvious reason for this, other than the high concentration of pedestrians in Section 8. The number of accidents decreased quickly to zero within the next two years. The most apparent reasons for this rapid elimination of accident occurrences must be the tight enforcement of the speed limit and safe driving practices along this section by the Jamaican police.

The Lucea Police Station is situated in this section of the road. Therefore, intensive law enforcement is easily accomplished here. Photograph 7-1 shows a police car patrolling the Road of Study in this location (Section 8). This is the only place on the Road of Study where such continuous monitoring by the police can be found.

Photograph 7-1. Police car patrolling Section 8 of the Road of Study, near the Lucea Police Station.

Chapter 8

The Cost of Accidents in Jamaica

8-1. Introduction

Many methods have been developed by different researchers in the past 20 years in an effort to arrive at a scientifically acceptable method, which is generally applicable, to calculate the cost of accidents. Unfortunately, the various researchers have not been in agreement with each other.

All it may seem one would have to do is to calculate the damage to property and the cost of repair, the extent of the injuries to the people involved and the cost of medical therapy, adding some costs to account for the policemen's time and the processing of the documentation and records. But that is not sufficient. There are many other costs involved in a road accident which a full investigation must take into account. Such costs include value of time lost by the accident victims, cost of the emotional trauma, loss of income by the victim's family, time lost by others at the scene of the accident (e.g., time lost in waiting for the accident scene to be cleared), etc.

These above-mentioned points are only a few elements of the whole picture. They are also very difficult to evaluate monetarily.

The economic evaluation of highway projects requires that costs are compared to benefits in monetary terms. While some elements of benefit may be subjective, there is pressure to place monetary values on as many benefits as possible. To that end, many countries, such as the UK and the USA, estimate the economic costs of accidents. Governments seem to place a monetary value on everything, even people's lives. If a person is adding value to the society, then he or she would have a higher price tag than a person who is a detriment to society. Therefore, if the valuable person dies or is seriously injured in a road accident, the society as a whole will suffer.

Another point that must be carefully considered is that most people associate value with the type of profession a person follows. For example, it might be assumed that all doctors are valuable to society. This is not always true, because there may be a number of doctors who are actually hurting people more than they are curing them. The same thing can be said of any other profession.

Also, it is very difficult to evaluate pain and suffering in monetary terms. The question is how much money a person's son or mother or brother is worth to them, after they are dead or permanently disabled? People have been intrigued by this question for many centuries. The first study done on this subject was in 1729 by Jonathan Swift in his essay, A Modest Proposal. In this essay, Swift brought reason to bear on the question. The value of human life, he demonstrated, was simply a function of supply and demand. Further, the optimal time to end it was that at which the selling price, minus the cost of production, was a maximum. Unfortunately, he was ahead of his time and his essay did not get too much attention. Many more researchers have tried to tackle this question in this century (Fromm, G. 1965;; *Dawson, R.F.F. 1967; Mishan, E. 1971; Fourance & Jacobs* 1976). They have all foundered on the difficulty that, in order to be logically consistent, they require that a man be prepared to place a cash value on his own life, and this, common sense tells us, is absurd. So what does a person do? Just pick a figure out of the sky and apply it? This seems to be as logical as any other way.

Doing this type of study for a developing country multiplies the problem manyfold. As mentioned earlier, many other factors come into play in developing countries that, to a certain extent, do not exist in developed ones. For example, religious behaviors play a major role in road accidents in some developing nations. In Iran, religious law governs the penalties and procedures followed in case of an accident (Ayati, 1988). While talking to people on the streets of Baja California in Mexico, the author found that to the majority of citizens a road accident is an act of God:

nothing can be done about it, and it should be accepted as a natural cause of death.

In Jamaica, the biggest problem that the author faced, doing this research, was the lack of some of the most basic information needed for the completion of the investigation. This has been found true in many developing nations, by many other researchers (Jacobs, World Bank, Jabbari, Ayati, etc.). Therefore, the author had to rely on information given to him by officials who were in Jamaica and others that were contacted in the United States through the Jamaican Embassy. Some of these conversations will be quoted below and some will be mentioned. Not all of these figures will be used to document the content of this chapter.

8-2. Cost of Damage to Vehicles

Table 8-1

Cost of Damage to Vehicles in Jamaica
(All costs are in U.S. Dollars at 1985 prices.)

Type of Vehicle	Slight Damage	Severe Damage	Destroyed
Passenger Car (Average value $1,200)	10	500	1,200
Busses/Mini-busses (Average value $3,000)	10	800	3,000
Motorcycles (Average value $100)	10	50	100
Commercial Vehicles (Average value $60,000)	10	2,000	15,000*

* Value of destroyed vehicle (commercial) is only half the average value because most commercial vehicles are large and do not usually get completely destroyed when in an accident.

(Source: Keith Bendles, Police Department, Montego Bay, Jamaica, 10/2/85)

Table 8-2

Percentage of Different Types of Vehicles Involved in Accidents in Jamaica

(Figures are for 1980)

Type of Vehicle	Number of Vehicles	Percentage of Accidents (1980)
Commercial Vehicles	1,993	23
Motorcycles	409	5
Busses and Mini-busses	701	9
Passenger Vehicles	5,511	63
Total	8,694	

(Source: Police Traffic Dept. 1985)

Table 8-3

Cost of Compensation for Injury and Death (in Jamaica)

Type of Injury	Dollar Amount*
Slight Injury	300
Serious Injury	2,000
Death	45,000

*All costs are in U.S. Dollars

(Source: Police Traffic Dept. 1985)

Table 8-4

Number of Accidents in Jamaica in 1980

Type of Accident by Outcome	Number of Accidents
Fatal Accident	264
Serious Injury Accidents	782
Slight Injury Accidents	750*
Damage to Vehicle Accidents	3,042
Total Accidents in 1980	4,838

*The number of slight injury accidents seems very low because of the problem of under-reporting of these accidents in most developing countries and developed countries (Sweden, Africa, Mexico, Iraq).

(Source: Table 2-10)

8-3. The Number of Each Type of Vehicle Involved in Each Category of Road Accident

It is necessary to estimate the number of each type of vehicle involved in each category of road accident. Assume that each type of vehicle has the same chance of getting involved in the various accident categories.

There are three accident categories:

Total Destruction of Vehicle	33.3% of accidents
Severe Damage to Vehicle	33.3% of accidents
Slight Damage to Vehicle	33.3% of accidents

Table 8-5

Number of Vehicles Involved in Each Category of Accident

Vehicle Type	Slight Damage 33.3%	Severe Damage 33.3%	Destroyed 33.3%
Passenger Vehicles	5,511* x .333 = 1,836	5,511 x .333 = 1,836	5,511 x .333 = 1,836
Buses and Minibuses	781* x .333 = 260	781 x .333 = 260	781 x .333 = 260
Motorcycles	409* x .333 = 136	409 x .333 = 136	409 x .333 = 136
Commercial	1,993* x .333 = 665	1,993 x .333 = 665	1,993 x .333 = 665

*See Table 8-2

Table 8-6

Total Cost of Destroyed or Damaged Vehicles (in U.S. Dollars)* (1980)

Vehicle Type	Slightly Damaged	Seriously Damaged	Destroyed
Passenger Vehicles	1,836 x 10 = 18,360	1,836 x 500 = 918,000	1,836 x 1,000 = 2,208,200
Buses and Minibuses	260 x 10 = 2,600	260 x 900 = 208,000	260 x 3,000 = 780,000
Motorcycles	136 x 10 = 1,360	136 x 50 = 6,000	136 x 100 = 13,600
Commercial	665 x 10 = 6,650	665 x 2,000 = 1,330,000	665 x 15,000 = 9,975,000
Total	$28,970	$2,462,800	$12,976,800

*Total cost of other destroyed or damaged objects: no data available. 20% of vehicle cost is assumed. Hence, $28,970 + 2,462,800 + 12,976,800 = $15,468,570 X .20 = $3,093,714. Damage grand total is $15,468,570 + 3,093,714 = $18,562,284.

8-4. The Cost of Physical Injuries, Including Working Hours, but Excluding Permanent Disability

No data is available in Jamaica on the cost of repairing injuries caused by accidents or otherwise. There are no records of how many hospital beds exist in Jamaica, due to the large number of small, mobile community hospital units spread out over the country. These are especially common in remote areas in the middle of Jamaica, where easy access is unavailable.

However, one can make some educated guesses in order to come to some sort of acceptable conclusion. Estimates will be based on the author's visits to Jamaica and the many conversations with high ranking officials and government employees, as well as visits to the Jamaican Consulate in Los Angeles, the World Bank in Washington D.C., USA, T.R.R.L. in Crowthorne, Berkshire, UK, and the Jamaican Embassy in Washington, D.C., USA. The majority of the available literature on this subject, on Jamaica and other developing nations, was reviewed by the author and has proven very useful in making decisions on some assumptions, based upon verified reasoning.

8-4-1. Estimating

Utilizing the figures derived from Table 8-4 above, the unit medical costs and working hours lost in road accident injuries in Jamaica are estimated in Table 8-7 below.

Table 8-7

Unit Medical Cost and Working Hours Lost
in Road Accident Injuries in Jamaica, 1980

(Author's Estimation)

Type of Injury	Average Cost in U.S. $	Average Working Hours Lost
Slight Injury	300	25 days x 8 = 200 hours (assuming 25 days lost and 8 hours per day working period)
Serious Injury	2,000	18 months x 180 = 3,240 hours assuming 18 months lost and 180 hours per month working period)

Due to social habits and the economic situation in Jamaica, which make it difficult for people to afford car purchase, the author found that there is an average of three to four people riding in each car. Buses and mini-busses are usually overloaded (an average of 25 riders per mini-bus). Commercial vehicles are usually used for transporting goods from one point to another. Therefore, there are usually one to two people in a commercial vehicle. But, due to the size of commercial vehicles and the speeds at which they travel, accidents involving commercial vehicles usually are more serious than accidents involving other types of vehicles.

The following ridership averages have been estimated for the purpose of this study (based on the observations of the author):

3 people/car

15 people/mini-bus

1 person/motorcycle

4 people/commercial vehicle

Table 8-8

Percentage of Vehicles Involved in Each Accident Type

	Vehicle Type			
Accident Type	Passenger Vehicles	Buses & Minibuses	Bicycles & Motorcycles	Commercial
Slight Damage	33%	33%	33%	33%
Severe Damage	33%	33%	33%	33%
Destroyed	33%	33%	33%	33%

The numbers calculated above necessarily represent a gross underestimation of the real figures. The Swedish Traffic Safety Group (1983) notes that in developing nations, only about 40% of slight injury cases are reported, and that about 30% of serious injuries become fatal within a two-year period.

Table 8-9

Number of People in Each Category of Accident*

Type of Vehicle	Slight Injury (No. of Persons	Serious Injury (No. of Persons)
Passenger Vehicles	1,836 x 3 = 5,508	1,836 x 3 = 5,508
Busses/Mini-busses	260 x 15 = 3,900	260 x 15 = 3,900
Motorcycles/ Bicycles	136 x 1 = 136	136 x 1 = 136
Commercial	665 x 4 = 2,660	665 x 4 = 2,660
Total	12,204	12,204

* Number of vehicles involved in each category of accident x average number of people in each vehicle.

Therefore, the cost of injury can be calculated by the number of people times the cost of medical care and rehabilitation for each injury:

12,204 people x $300 = $3,661,200 (slight injury)

12,204 people x $2,000/injury = $24,408,000 (serious injury)

Total injury costs: $28,069,200

8-5. The Price of Working Hours Lost

Jamaica has maintained a very low standard of living for most of its population. The government of Jamaica has been forced by international treaties with the U.S. and Canada to limit increases in minimum wages. This policy has helped Jamaica in the export of labor to other countries, but has also slowed the rise in the standard of living. The minimum wage of an unskilled worker in Jamaica amounts to about $10.00 per week in U.S. dollars (EIU Country Profile, 1988-1989).

Table 8-10

Employment and Unemployment Figures by Sector
(October, 1985)

Occupation	Employed (000)	Percent Unemployed in Each Occupation
Agriculture/Forestry/Fishing	278.9	3.1
Mining/Quarry/Refining	6.0	15.5
Manufacturing	100.6	20.8
Construction	34.8	28.5
Transport/Public Utility	34.7	15.8
Commerce	115.3	13.4
Public Administration	81.1	19.0
Other Services	127.2	28.5
Total Including Other	781.0	25.6

(Source: 1988-1989 EIU Country Profile)

In general terms, Jamaica has two classes--the very rich and the very poor. The majority of Jamaicans are from the very poor category (as indicated by the weekly wages of an average Jamaican). A very low level of training exists in Jamaica (see Table 8-12); therefore, it can be assumed that the majority of laborers are unskilled. These laborers work primarily the agriculture and mining industries.

Table 8-11

Trends of Gross National Product* and Domestic Product

Total (J $ MN)**	1983	1984	1985	1986
GNP at Current Prices	6,744.8	8,453.1	9,684.9	13,863.1
GDP at Constant 1974 Prices	1,942.2	1,925.0	1,835.2	1,870.1
Real Increase (%) Per Capita	2.3	-.9	-4.7	1.9
GNP at Current Prices	3,011.2	3,707.5	4,210.8	5,003.4
GDP at Constant 1974 Prices	867.0	844.3	797.9	795.7
Real Increase (5)	0.8	-2.6	-5.5	-.3

*Gross national product (GNP) is the dollar value at current market prices of all final goods and services produced annually by the nation's economy.

** 1 U.S. $ = 5.485 Jamaican $, 1987 exchange; 1 U.S. $ = 3.15 Jamaican $, 1983 exchange

(Source: EIU Country Profile, 1988-1989)

Looking at the GNP at current prices, we can see how low the standard of living is in Jamaica. In terms of U.S. dollars, the GDP is $912 U.S. per capita, which is well below the average for developing nations of $1,400 per capita per year (Jacob & Sager, 1983).

Therefore, to do the costing procedure, it is necessary to find out what proportion of employees are unskilled and what percentage are skilled. For the purpose of this investigation, it is assumed that the majority of workers in agriculture and mining are unskilled.

Table 8-12

Population in Private and Selected Non-private Households By Type of Educational Institution Being Attended, by Sex (1982)

Type of Educational Institution	Both Sexes	Male	Female
Total	2,178,843	1,066,292	1,112,551
Nursery/Infants	84,160	40,744	43,146
Primary	371,326	187,756	183,570
Secondary	158,063	74,215	83,848
University	5,913	2,530	3,303
Other	29,206	11,435	17,731
None	1,278,418	625,223	653,195
Not Stated	251,757	124,389	127,368

(Source: Population Census Report, 1982)

Of course, this is not completely true, since the unskilled workers have to be guided by skilled technicians. But this is not done for all of the other industries; the figures given in the Employment and Unemployment by Sector tables provided by EIU for 1988-1989 will be used:

Agriculture	278,900/2,000,000 = 14.00%
Mining	6,000/2,000,000 = .30%
Manufacturing	100,000/2,000,000 = 5.03%
Construction	34,800/2,000,000 = 1.74%
Transportation/ Public Utilities	34,700/2,000,000 = 1.74%
Commerce	115,300/2,000,000 = 5.77%
Public Administration	81,100/2,000,000 = 4.10%
Other Services	127,200/2,000,000 = 6.40%
	40.00%

The above exercise shows that in 1980 only 40% of the total population worked in the various categories. The remainder of the population is assumed to be comprised of children, old people and unemployed people.

From the above, it can be deduced that 14% of the working population engaged in agriculture, forestry and fishing is unskilled, and 0.3% of the population working in mining, quarrying and refining is also unskilled. Therefore, the total of unskilled workers in the labor force (14.3%) would be receiving a weekly income of less than $10.00 in U.S. dollars.

The rest of the working population would be assumed to be skilled, and earning about $25.00 per week in U.S. dollars. The rest of the population, who fall into the country's upper class, must not be forgotten. But the number of these people is too small for this investigation to take into consideration (5% of the total population of the country fall into this category).

Table 8-13

Average Monthly Income of a Jamaican Citizen

Class Designation	Percent in Country (Average of Employed and Unemployed)	Monthly Income in U.S. Dollars
Lower Class	60%	$ 40
Upper Lower Class	35%	100
High Class	5%	Unknown

In an analysis of hospital patients, Adeloye and Adeku (1970) found that the majority of hospital patients who had been injured in traffic accidents were children under the age of nine years. Asogwa (1987b) cites youngsters and young men as being particularly exposed to road accidents in Nigeria. Over 50% of road accident victims in developing nations are under the age of 30, and over 80% are men (Swedish Traffic Safety Group, 1983).

The number of fatalities must be multiplied by seven in order to get a true picture (14% of personal injury accidents became fatal) in developing countries (Jacob & Sager, 1976). Thus, we can see that the majority of people involved in accidents in developing countries are the productive part of society. 50% are under the age of 30 and 80% are male.

A typical family in Jamaica would consist of four to five people. A father, a mother, and two children (ten to twelve and five to eight years old). Marriage in Jamaican society is not an important ceremony; therefore, one finds many families formed by unmarried parents. Also, many Jamaicans marry very young.

If it is assumed that the mother works (which is quite likely) and one of the children also works (which is also quite likely), then the average income of the family would be 2.3 times the national average for family income--100% for the father, 100% for the mother. (There is no discrimination of any kinds against women in Jamaica.) Actually, according to the author's observation, Jamaican women make up the majority of the work force in some industries and children can make up to 30% of others.

An average of $70 per month will be used here (see Table 8-13 on Average Monthly Income derived from EIU figures of 1988-1989). Thus, $70 x 2.3 = $161 per month.

If all family members had the same percentage of accident exposure, the straightforward equation,

$$\frac{\text{Family Average Monthly Income}}{\text{Number of Working People in Family x 180 Hours/Month}}$$

would give us average value of one working hour for that family.

Obviously, this is not very accurate, because the percentage of exposure of different age groups and with different sexes varies greatly. As mentioned earlier, Adeloye and Adeker (1970) found that most hospital patients who had been injured in traffic accidents were children under nine years of age. Although the above study was carried out in Africa, similar statistics are found in Jamaica. This is basically because children do not have after-school facilities to keep them occupied, and therefore take to the streets for recreation.

Table 8-14

Percentage Distribution of Population by Marital Status
(1982 Census)

Marital Status	Average	Male	Female
Total = 100			
Newly Married	73.6	74.7	72.5
Married	15.0	15.0	15.0
Widowed	2.2	1.1	3.4
Divorced	0.4	0.4	0.4
Legally Separated	0.3	0.3	0.3
Not Stated	8.5	8.5	8.5

(Source: Population Census Report, 1982)

Therefore, if the father is 50% exposed to accidents (STSG, 1983), the mother would be about 20% exposed and the children would be about 30% exposed:

1 (father) + 20% (50%) mother + 30% (50%) child =

$$1 + .1 + .15 = 1.25$$

The average value of the working hour is:

$$\frac{\$161/\text{month}}{1.25 \text{ X } 180} = \$0.75 \text{ (in U.S. dollars) per hour}$$

The results are summarized in Table 8-15 below.

Table 8-15

The Cost of Medical Expenses and Working Hours
Lost in Road Accidents in Jamaica

Severity of Injuries	Medical Cost	Cost of Working Hours Lost
Slight	12,204* x $300** = $3,661,200	12,204 x 200*** x .75 = $1,830,600
Serious	12,204 x $2,000** = $24,408,000	12,204 x 3,240*** x .75 = $29,655,720

* See Table 8-9.
** See Table 8-3.
*** See Table 8-7.

8-6. The Cost of Pain, Suffering, Psychological and Emotional Damages

It is very hard to put a monetary value on pain, suffering, psychological and emotional damages. Basically, this is because each person is affected differently in cases of injury and death. Therefore, it would be necessary to evaluate each particular case separately and give it a monetary value. This is obviously not possible, so some generalization is required.

The best way of estimating this sort of cost is to base it on the court award. This can also be very difficult, because court awards differ so much from case to case. It all really depends on the ability of the attorney. In the U.S., for example, this has been a very controversial subject, because there has been so much money involved in court cases.

This problem, however, can be corrected, if handled by means of disability and life insurance. This may be a very insensitive way of dealing with it, but it is the best way the author has found. In Jamaica, insurance companies do exist and they are trying to sell insurance policies. However, due to the existing low standard of living in Jamaica, there are very few people who can afford to buy such insurance (the average wage for an unskilled worker is $10 per week) (EIU, 1988-1989). Hence, this problem is likely to continue to exist in most developing countries, including Jamaica.

There have been no studies conducted in Jamaica in regard to compensation for pain, suffering, psychological and emotional injury, adding to the difficulty of setting a value on this category of damages. The author, however, would suggest for Jamaica, 1- $1,000 per slight injury and shock, 2- $5,000 per serious injury and disability and 3- $20,000 per fatality as sufficient compensation for emotional trauma due to road accidents (all monetary valuations are given in U.S. dollars at 1985 prices).

8-7. The Cost of Time Wasted in Road Accidents in Jamaica

The value of time is one of the most difficult concepts on which to put a price. This would not only be expected in

Table 8-16

World Bank Estimates of Time/Price in Developed and Developing Countries

	% of the Average Hourly Wage	
	Developed	Developing
Work to Work	50 - 100	50
Home to Work	25 - 50	25
Leisure	0 - 25	0

developing nations, but it would be even harder to price time in developed nations.

It is evident that, in developing nations, time seems less valuable than in developed nations.

To really evaluate time for a particular country or nation, it is important to look at many factors, e.g., sociological, historic, ethnic, religions, etc.). For example, in some Moslem countries (such as Iran, Turkey and Saudi Arabia), people have to stop all work for a certain time period, five times a day, for the purpose of prayer. Obviously, in some people's thinking, this would be an absolute waste of time, but in the view of others, it is a necessity. In some developed countries (France, Spain and Italy), people take two- to three-hour breaks for lunch. This would also be considered an absolute waste of time in other countries. Therefore, it is really very difficult to summarize when talking about the value of time in this context.

The World Bank is one of the few organizations that have attempted to measure the percentages of the average hourly wage spent on different activities within the working day.

In the author's estimate, the above table is very inaccurate, and cannot be based on factual data gathered from developing nations (the World Bank staff must be working too hard!!).

For the purpose of this research, the author has devised the following table, similar to the above in form, but which differs in content.

Table 8-17

Time/Price in Developed and Developing Nations

	% of the Average Hourly Wage	
	Developed	Developing
Work to Work	40 - 60	30
Home to Work	10 - 25	0 - 25
Leisure	25 - 50	25 - 50

The above table is a much more realistic and accurate table with which to work (based on the personal experience of the author, as the author has lived and worked in both developed and developing nations).

There are no data available in Jamaica on the value of time wasted in accidents; therefore, some educated estimates will have to be made. Using Roach (1985) as a guide, the number of hours wasted in an accident is four.

Using the above revised World Bank's Time/Price table, and the extreme high-end figures for Jamaica, it will be assumed that 30% of road travel is from work to work, 25% from home to work and 50% in leisure activities. The rate of real, valuable time, therefore, is:

(30% x 30% + (25% x 25%) + 50% x 50%) =

.09 + .0625 + .25 = .4025

Therefore, the cost of time wasted in road accidents in Jamaica in 1980 is:

4,838 (total number of accidents in 1980) x
5 (average number of people involved in accidents) x
4 (average number of hours wasted in accidents) x
.4025 (estimated ratio, above calculation) x
$.75 (price of one working hour -- see Section 3-5) =
$29,209.43.

8-8. The Victim's Lost Future Output

Although there are no existing data to make these calculations easy, the victim's lost future output can be calculated using prior research and some estimates. A study done in some developing countries (Africa) by the Swedish Traffic Safety Group (1983) deduced that over 50% of accident victims are under 30 years old and 80% are men.

A 30-year-old person would probably have an average of 20 years of work remaining in his or her life. If we assume that the other 50% of accident victims are divided equally between people under and over the age of 30, then a good estimate of the number of years left in the average work life of a Jamaican accident victim would be 20 years.

The EIU Sector table (see page 181 above) shows that, in 1985 only 40% of the Jamaican population worked. For the purpose of this calculation, however, the figure of 40% cannot be used, because people who are working are more exposed to traffic accidents than others. Therefore, an estimate of 60% will be used here.

Taking the figures for accidents in 1980, 264 fatal and 792 serious injury accidents would give us a total of 1,046 people as victims of accidents in Jamaica (serious injuries usually result in disabilities, because of the lack of medical attention) (Swedish Traffic Group 1983, Jacob & Sager, 1976). In order for a true picture to be drawn, the average weekly wage of an average Jamaican will have to be pro-rated to 20 years in the future.

With a 3.8% average increase in GNP in the five years demonstrated, the same average rise may be assumed for every five-year period. Thus, but the end of 20 years, the total rate of increase in GNP would be 15.2%. The total population of Jamaica, in 1982, was 2,190,000. In 1970, the population was 1,848,400 (Population Census Report, 1985). Therefore, the percentage change is 18.5%, and if we assume that the trend will continue for the next 20 years, the

Table 8-18

Trend of Gross National Product and Gross Domestic Product

	1983	1984	1985	1986	1987
	Total (J & mn)				
GNP at Current Prices	6,744.8	8,453.1	9,684.9	11,758.0	13,863.1
GDP at Constant 1974 Prices	1,942.2	1,925.0	1,835.2	1,870.1	1.967.5
Real Increase (%)	2.3	-0.90	-4.7	1.9	3.2

(Source: EIU Country Profile, 1988-1989)

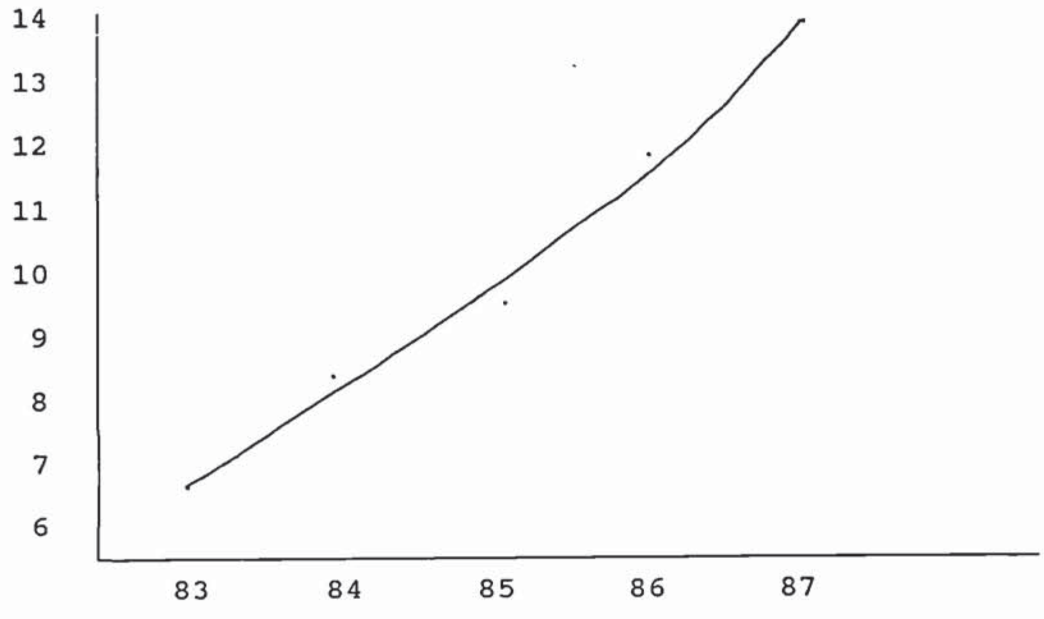


Fig. 8-1. Total earnings of Jamaicans at current prices, from 1983 to 1987(derived from Table 3-16 above).

change will be approximately 36%, making the total population 2,978,944.

If the total number of accidents doubles in 20 years, the total number of casualties can be predicted at 2,092, and resulting losses in GNP can be calculated as follows:

2,092 - 2,978,944 = .00070%

13,863.1 + 15.2% = 15,970.29 mn J $

15,970.29 x .0007 = 11.179 mn J $ of losses in GNP.

8-9. Other Costs Involved in Road Accidents

Due to the complexity of the road accident phenomenon, many other costs must be considered before a complete picture can be drawn.

In order to estimate all the other costs involved, much additional data will have to be obtained. Unfortunately, none of the data needed is available in Jamaica. Therefore, a list of the remaining costs is simply provided below.

Cost of Administrative Expenses

1- Cost of Police Administration

2- Cost of Insurance

3- Cost of Legal Systems

Cost of accidents in Jamaica compared to GNP for 1985 is about 4.6%, which is extremely high compared to most developed countries and even most developing countries (e.g., Iran = 2%, Ayati, 1988).

Table 8-19.

Summary Table for Cost of Accidents in Jamaica in 1980
(All prices in U.S.$

Cost of Destroyed or Damaged Vehicles and Other Objects	Cost of Injury Medical	Cost of Working Hours Lost in Accidents	Cost of Pain and Suffering
$18,562.284	$24,408,000	$29,655,720	$9,940,000

Total = U.S.$82,566,004

8-10. The Problem with Local and Hard Currency in the Calculation of Accident Costs

One of the most important factors affecting the determination of accident costs in developing nations is the problem with exchange rates. This is especially true in developing countries with weak economies. Such countries have currencies which are not worth much outside their own border. Therefore, when buying from abroad, these countries have to make payment in hard currency (e.g., U.S. Dollar, British pound, German mark, etc.).

At the same time, countries with weak economies usually import most of their goods and services. Thus, they do not usually have much to export, but the export of goods and services is their main source of hard currency. Hence, "black markets" for exchanging local currency for hard currency is a normal way of doing business for these countries.

In many countries, though this activity is illegal, governing bodies are aware that such transactions are occurring and frequently look the other way. They know that their people are often unable to obtain hard currency by other means.

On the other hand, in some countries (e.g., Iran), this kind of money changing is not illegal and the government itself does it quite frequently. In fact, the Islamic Republic News Agency regularly publishes the unofficial foreign exchange rates in its Economic Bulletin. Table 8-18 uses these figures indicates that Iran's currency has been steadily losing value during the period under study (March, 1984 to February, 1989). Although the official foreign exchange market (reckoned on the basis of Saudi Rial (SDR) rates) (Ayati, 1988) registered a decline of 9.6% in the value of the dollar (from Rls. 81.211 on February 20, 1986 to Rls. 73,427 on February 21, 1987), the unofficial exchange market, during the same period, revealed an increase in the value of the dollar of about 34.3% (from Rls. 655 to Rls. 880). (See table 8-18.)

From the example of Iran, above, one can easily realize how much more expensive it is to do business in a black market atmosphere. What is really happening is that the businessmen who are buying necessary goods from abroad are paying ten times as much for the goods as they would if hard currency were available to them. This enormous cost will obviously be passed on to the consumer, who, in turn, will be unable to afford the goods.

In Jamaica, for example, this problem is very apparent. Because of the Jamaican public's low standard of living, and the foreign exchange problem, spare parts for car service are luxury items and few are able to afford them. Therefore, Jamaicans often drive their cars until they begin to fall apart. This is also true in the case of government vehicles. Photograph 5-18 shows the poor condition of a police vehicle. While conducting research for this study, the author rode in many official vehicles from the Ministry of Works and the Police Department which were in a very unsafe condition.

In Mexico, the same problem exists, but to a lesser extent. Mexico has the advantage that almost all vehicles driven there are also manufactured in the country, under license from the auto manufacturing giants, e.g., Ford, General Motors, Chrysler, Toyota, etc.

Mexican currency is in pesos, for which two (and sometimes more) rates of exchange against the U.S. dollar have been in force since August of 1982. Table 8-19, below, shows the enormous deviation in the exchange rate for the Mexican peso over the last several years. Since December of 1982, the two main rates have been the controlled (official) rate and the free rate (for a time, in 1985, there was also a "super free" rate). The controlled rate applies to income from exports of goods and services, funds used by inbound industries for local expenditures other than fiscal assets, and loans received after December 20, 1982. The free rate applies to all other transactions, such as those associated with tourism and profit remittance.

When first introduced, the controlled rate was increased each day by 0.13 pesos against the U.S. dollar. The free rate followed suit in September of 1983, under instructions from the Central Bank. The rate of depreciation was then twice accelerated before the system was changed in August, 1985. Instead of the daily programmed devaluation, a controlled float was put into place.

The gap between the two exchange rates was kept at manageable levels until late 1987, when the government decided to stop supporting the free rate, which was under pressure because of capital flight. When it fell steeply, the authorities were left with little alternative but, on December 14th, to devalue the controlled market peso from 1,822 to 2,209.7 against the U.S. dollar. It stayed at that level until January 5th, when a further token adjustment, to 2,210.2, was made. At the beginning of February, it was announced that the cost of the U.S. dollar would be increasing by three pesos on each working day in February, but at the end of the month, the exchange rate was frozen in support of the government's anti-inflation drive. It remained frozen in July, the controlled rate being close to 2,257 pesos to the dollar, and the free rate rose to 2,290 pesos to the dollar (EIU Country Profile, 1988-1989).

Studying the huge fluctuations in the Mexican peso against the dollar, discussed above, one would conclude that the Mexican people, between 1981 and 1987, have actually lost buying power against the U.S. dollar by a multiplier of

57. This problem has made it even more difficult for countries like Mexico to spend money on improving their transport system. The only way they can afford improvement is to borrow money from organizations like the World Bank, which puts them deeper and deeper in debt, as they have been unable to repay these loans.

Table 8-20

Comparison of the Exchange Rates for the U.S. Dollar in Lire (L) and Deutch Marks (DM) in International Markets and Iran's Unofficial Market, March, 1986 through February, 1987

Month	London Closing Rates		Iran's Unofficial Market		Iran/Int'l	
	DM	L	DM	L	DM	L
1986:						
March	2.25	0.68	2.30	0.70	+0.05	+0.01
April	2.31	0.67	2.29	0.69	-0.018	+0.016
May	2.19	0.65	2.23	0.67	+0.035	+0.024
June	2.25	0.66	2.28	0.73	+0.033	+0.072
July	2.18	0.65	2.21	0.69	+0.028	+0.034
August	2.08	0.67	2.12	0.68	+0.04	+0.01
September	2.04	0.67	2.08	0.69	+0.038	+0.024
October	2.003	0.69	2.02	0.88	+0.023	-0.016
November	2.033	0.70	2.03	0.70	+0.0047	-0.006
December	2.001	0.699	2.004	0.708	+0.004	+0.008
1987:						
January	1.903	0.673	1.93	0.710	+0.028	+0.037
February	1.818	0.655	1.84	0.69	+0.022	+0.035

(Source: Ayati, 1988)

Chapter 9

Observations, Recommendations and Conclusions

9-1. Observations

9-1-1. On-site Data Collection

During the course of the research, the writer found many flaws in the methods of data collection utilized by the Jamaican authorities. Some of the most crucial of these flaws are a lack of information regarding type of collision, condition of the road, victim demography (especially whether a member of the native or tourist population), and traffic flow.

9-1-1-1. Type of Collision

Identification of the type of collision, whether front to back or side to side, etc., is one of the most important datum in attempting to determine the causes of road accidents and how to avoid them. It was found that this type of information does not exist in the data collected by the Jamaican authorities at the present time. Without this information, it is difficult to draw conclusions which lead toward finding solutions for the Jamaican road accident problem.

9-1-1-2. Condition of the Road

Road condition, in most cases, includes:

1- road marking and signing;

2- geometric design of the road (junction, main road, dual or single carriageway;

3- condition of pavement; and

4- roadside facilities.

When investigating road conditions using the data collected by the Jamaican authorities, it is easy to become confused. Early in this investigation, it became apparent that most of the above data on road conditions is collected by police officers. Unfortunately, however, important information is not transferred to the data in the Traffic Accident Returns tables (Appendix B), the most accessible and easiest to understand source of information available anywhere in Jamaica for this type of investigation. Therefore, these important data may be unavailable to researchers in the field of road safety.

The Accident Report Booklet shown in Appendix A includes the first accident report taken by the police officers at the scene of the accident. These booklets are available, but not easy to utilize. They are, in most cases, stacked on top of each other in big boxes or on shelves. Therefore, it would be extremely time consuming for a researcher to access data not already converted into the Traffic Accident Returns tables.

It seems that the section of the Accident Report Booklet labeled "additional particulars" contains some of the most important data collected, but because it is not specific enough to be tabulated, these data are usually left out when tabular conversions are constructed.

9-1-1-3. Victim Demography

The Jamaican economy is greatly dependent upon tourism. Therefore, victims of accidents are likely to be not only natives, but foreigners as well. In addition, accidents which take place on a road or in a traffic system which services the tourist industry may produce different demographics and affect the Jamaican economy differently than accidents in other locations.

9-1-1-4. Traffic Flow

A junction that has *200 cars flowing through it each day* and 10 accidents is more dangerous than a junction that has a flow of 1000 cars and 20 accidents. The only traffic flow studies the Jamaicans have conducted are on the main urban junctions, which are not helpful in the present study. Thus, as numbers providing the rates of accidents are not presently available, it has been necessary, for the purposes of this research, to rely only on statistics regarding the number of accidents recorded for each section of the study road. Therefore, the term "black spot," as used in this study, indicates only the number of accidents recorded for that section, not the rate of accidents.

9-1-2. Road Maintenance and Proper Signage

9-1-2-1. Road Maintenance

Road conditions are crucial to the safety of users, whether drivers, passengers or pedestrians. Roads deteriorate with time and use. Therefore, they need to be constantly and properly maintained. Unfortunately, this element of road safety is neglected in developing nations. The main reasons for this neglect seem to be, first, the lack of understanding of the dangers inherent in road deterioration and the importance of road safety to the nation as a whole, and second, the shortage of funds.

Vehicles are made to operate and perform on specific kinds of roads under specific conditions. Once these conditions are altered, the performance of vehicles differs and can decline. Most of the roads in Jamaica have been designed by poorly qualified people (most of them were not Jamaicans). For example, the road of study was designed by students of a university in England, built by an American company about 15 years ago (Ministry of Construction, 1984), and has not been properly maintained since.

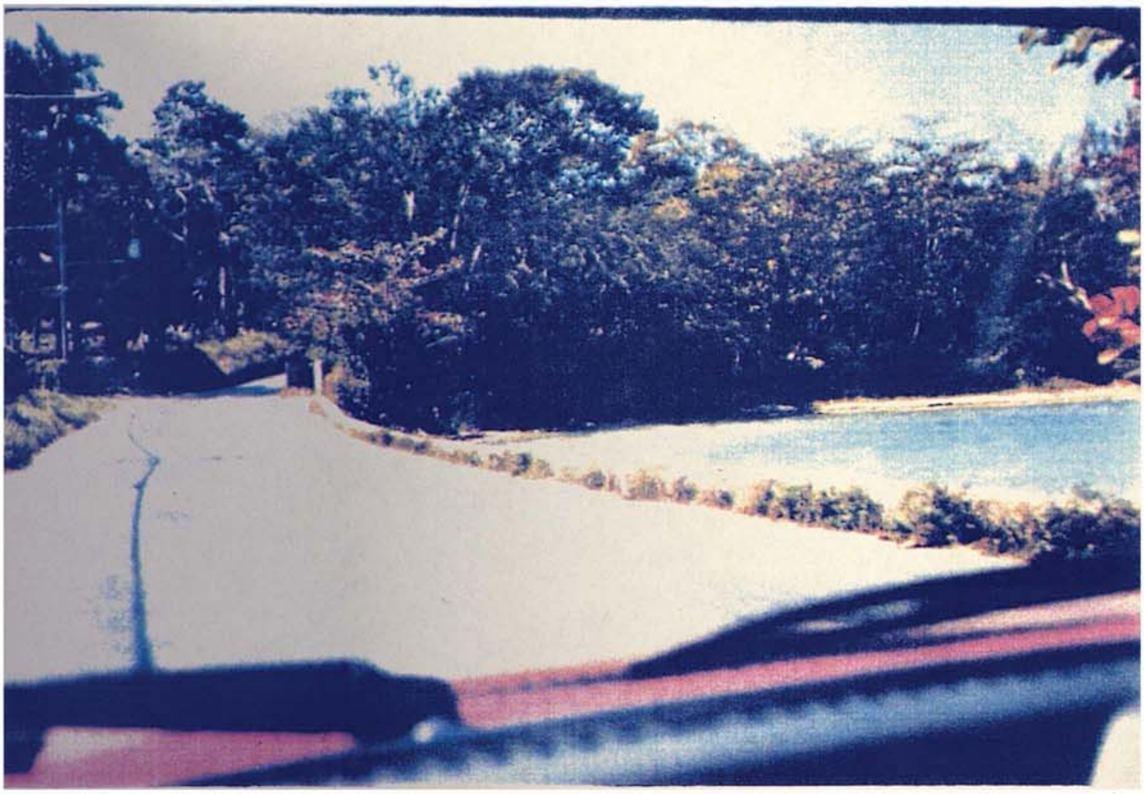
Fortunately, the weather conditions in Jamaica are not severe, otherwise the damage to the road surface would have been much more extensive. Although the candidate did not have the necessary tools to measure the design characteristics of the road of study, through observation and with help from an expert in the field of road design (Dr. Jabbari), it became apparent that the design of this road left much to be desired.

Photographs 9-1 *through* 9-4 *were* taken at different locations along the road of study. They clearly show how bad the surface is on this particular road. This characteristic can be seen in every road in Jamaica.

During the course of data collection for this study, as noted in Chapter 7, it was determined that, in Section 5 of the study road (Hopewell Road), there appeared to be very few accidents in 1982 and 1983. After interviewing some officials at the Ministry of Construction and paying a visit to the road, it became clear that there had been many improvements made on that section of the road in 1980. This was accomplished by a private party intending to build a marina and other tourist attractions along Hopewell Road. Photographs 9-5 and 9-6 show the improvements made that year in the road surface along this section. This finding demonstrates that road maintenance plays a crucial role in reducing road accidents in Jamaica.

Photograph 9-1. The poor road surface on the Road of Study in Jamaica.

Photograph 9-2. The poor road surface on the Road of Study in Jamaica.



Photograph 9-3. The poor road surface on the Road of Study in Jamaica.

Photograph 9-4. The poor road surface on the Road of Study in Jamaica.

Photograph 9-5. Improvement of the road surface performed by a private party, Section 5 of the Road of Study in Jamaica.

Photograph 9-6. Improvement of the road surface performed by a private party, Section 5 of the Road of Study in Jamaica.

Photograph 9-7. Native population of Jamaica obliged to share the Road of Study with high speed traffic for lack of proper sidewalks.

Photograph 9-8. Native population of Jamaica obliged to share the Road of Study with high speed traffic for lack of proper sidewalks.

9-1-2-2. Preparation of Safe Sidewalks for Pedestrians

Roads in Jamaica go through many little towns and villages. These roads are usually shared with vehicular traffic by many of the natives when they commute from one point in a village to another or from one village to another. Unfortunately, this sharing of the roadway has proven to be very dangerous. Jamaican natives, who live in these small villages, do not seem to realize the damage that moving vehicles can cause, perhaps because most of them have never owned a vehicle.

Data gathered from Jamaican statistics on road accidents show that most accidents occurring close to towns and villages along the road of study have been fatal or caused serious injuries. Most of those seriously injured were pedestrians. It is likely that most of these villages evolved after and as a result of the construction of the road. Otherwise, it would be difficult to understand why sidewalks were not considered in the design and construction of the roadway. Photographs 9-7 through 9-12 show how the natives are obliged to share the roadway with vehicles traveling at high rates of speed, simply because there are no sidewalks for them to use.

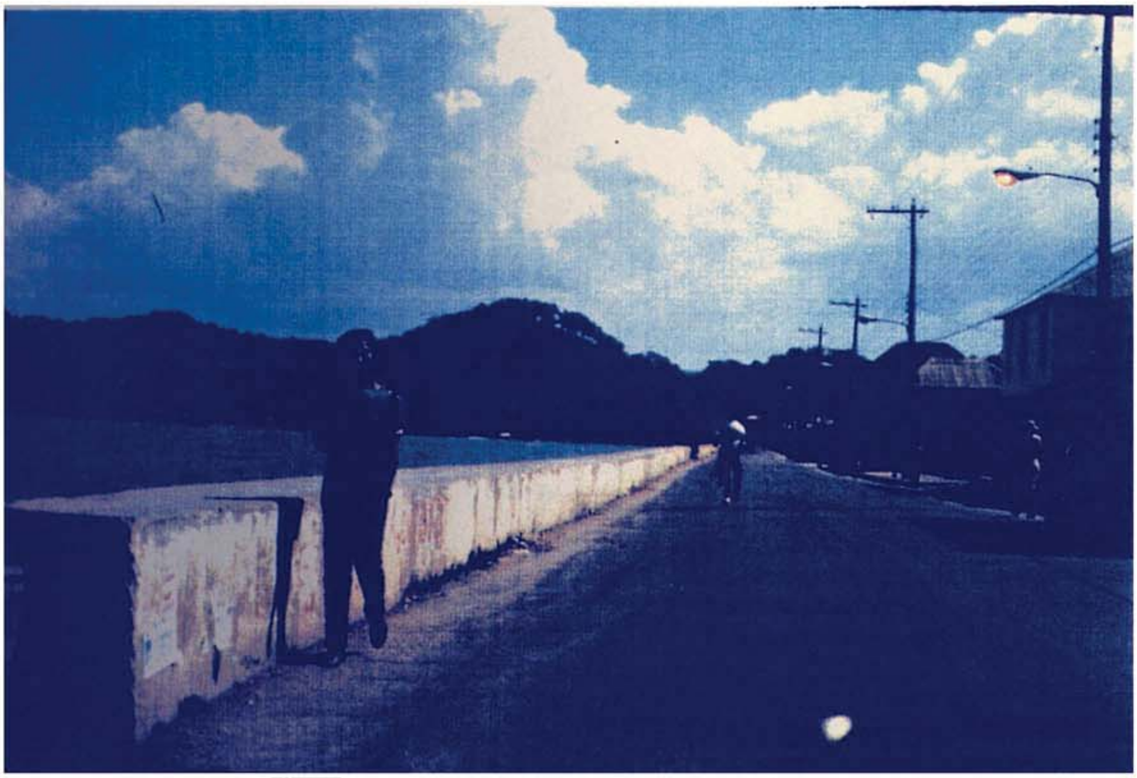
Photograph 9-7. Native population of Jamaica obliged to sh
the Road of Study with high speed traffic f
lack of proper sidewalks.

Photograph 9-8. Native population of Jamaica obliged to share
the Road of Study with high speed traffic for
lack of proper sidewalks.

Photograph 9-9. Native population of Jamaica obliged to share the Road of Study with high speed traffic for lack of proper sidewalks.

Photograph 9-10. Native population of Jamaica obliged to share the Road of Study with high speed traffic for lack of proper sidewalks.

Photograph 9-11. Native population of Jamaica obliged to share the Road of Study with high speed traffic for lack of proper sidewalks.



Photograph 9-12. Native population of Jamaica obliged to share the Road of Study with high speed traffic for lack of proper sidewalks.

9-1-2-3. Clear and Proper Signage

Proper road signage can cost a great deal. Jamaica's topography does not make signage any easier or cheaper. Jamaican roads go through many different kinds of terrain. This fact alone makes it essential to have proper and clear signage.

The road of study displays many problems with signing. Some of these are:

1- lack of signs (Photograph 9-13),

2- improper positioning of signs (Photographs 9-14 & 9-15),

3- clarity of signs (Photograph 9-16),

4- signs as road hazards (Photograph 9-17),

5- maintenance of signs (Photograph 9-18).

To remedy all of the above signing problems, the Jamaican government would have to spend a great deal of time, effort and capital resources, which either do not exist or are not readily available in Jamaica.

9-1-3. Control of Vehicle Spare Parts Prices by the Government

One of the biggest problems that has contributed in the past, and is still contributing to the problem of road accidents, is vehicle maintenance. Most of the vehicles seen in Jamaica are poorly maintained. One of the reasons for this is that vehicle spare parts are extremely expensive. Jamaica

Photograph 9-13. Lack of signage on the Road of Study in Jamaica.

Photograph 9-14. Improper positioning of signs on the Road of Study in Jamaica.

Photograph 9-15. Improper positioning of signs on the Road of Study in Jamaica.

Photograph 9-16. Example of unclear signage on Jamaican roads.

Photograph 9-17. Road signs in Jamaica can be hazardous to road users.

Photograph 9-18. Lack of maintenance of road signage in Jamaica can render them useless.

presents a very small market for vehicle spare parts, so a very few companies control the sale of spare parts for the whole island. This monopoly has operated to keep prices high.

The standard of living in Jamaica is very low; most people are lucky to eat every day. Therefore, most people who own vehicles cannot afford to pay high prices for spare parts. That is the reason that vehicles in Jamaica stay unmaintained, in many cases for the greater part of the life of the vehicle.

Photograph 9-19 shows a police car. One can easily see how poorly this vehicle has been maintained. It takes little imagination to envision the condition in which poor people's vehicles are kept, having seen the condition of a police car.

Photograph 9-19. The condition of a Police car in Jamaica.

9-1-4. Control of Drugs and Alcohol

The problems of alcohol and drugs are important factors in the road safety equation in Jamaica. Indications are that drug use contributes to a great majority of the accidents on the island.

Marijuana (Ganja in Jamaica) is the drug of preference and very casually used in Jamaica. As a matter of fact, it is for some people (Rastafary) an integral part of their lifestyle and religious observances. Nevertheless, the issue of marijuana, other drug and/or alcohol use, however dangerous to road safety, is not addressed in the data gathered locally as to the cause of accidents. This is because the Jamaican police have no means of measuring the level of alcohol and/or drugs in the systems of accident victims or in citizens causing accidents. This failure to provide crucial information regarding the cause of accidents represents a major obstacle to research and may result in misinterpretation of the available data.

9-2. Recommendations

9-2-1. Type of Collision

The candidate recommends that the Jamaican authorities include information on the type of collision (front to back, side to side, etc.) in their data collection. Collecting this type of information does not require one to be an expert in road safety or highway design. Any policeman should be able to easily determine whether an accident was a front to back, side to side, or other type of collision.

9-2-2. Condition of the Road

It is strongly recommended that information labeled "additional particulars" in the police accident report booklet (Appendix A) be included in the tables of accident data. This step will greatly facilitate evaluation and investigation of the problem of road accidents.

9-2-3. Victim Demography

Because of the nature of the Jamaican economy and its great dependence upon tourism, the data should have a section noting whether the victims of accidents are natives or foreigners (The Economist Intelligence Unit [EIU], volumes on Jamaica, Mexico and Iran, 1988-1989). The nationality of the subjects involved also should be mentioned, in order to relate accidents to different road and traffic systems.

9-2-4. Traffic Flow

Traffic flows should be done for each section of the Road of Study for a better understanding and definition of high accident locations.

9-2-5. Road Maintenance

A major element of road safety is constantly and properly maintained roads, designed by qualified engineers. This study has demonstrated that even minimal road upgrading and maintenance can have a significant effect on the number and severity of road accidents. Every effort should be made to improve road design and maintenance

9-2-6. Safe Sidewalks

Pedestrian fatality and injury will continue to be a problem in Jamaica until the government takes steps to make the roads safe for the people to travel on or along. Sidewalks can be constructed without going to a great expense. They do not have to be paved or precisely designed. At the least, the sides of the roads could be leveled and the vegetation removed along the margins of the road, so that pedestrian traffic is possible and unimpeded. This measure, it is believed, would greatly reduce the number of serious injuries and fatalities.

9-2-7. Clear and Proper Signage

Because of the limitation of resources to address this problem, a short term solution is suggested. Effort might be focused on maintenance and repositioning of existing signage, so that signs now in place may be made functional for road workers.

9-2-8. Vehicle Spare Parts

It is essential to road safety that good vehicle maintenance be encouraged by the Jamaican government. The writer strongly recommends that the Jamaican government consider price controls on vehicle spare parts. The difficulty of effectuating and implementing such a decision is not underestimated, as personal interests may have to be sacrificed in order to remedy an appalling situation in the national interest.

9-2-9. Control of Drugs and Alcohol

It is recommended that a priority should be to provide the police with a means of measuring the level of alcohol and/or drugs consumed by people involved in road accidents. Then, enforcement of sentences on those found using these substances should be more strict. Finally, drug and alcohol related causes should be recorded by the police, at the scene of the accident, so that researchers can more accurately identify factors contributing to the problem of road accidents in Jamaica and suggest measures appropriate to finding a solution.

9.3 Conclusions

It is clear that the trend in road safety has been negative in developing countries for the last 20 years. In many countries the number of accidents has trebled during the

70s and the number of fatalities has doubled (Henrickson, 1990).

Many less developed countries have low or widely varying road and street standards, where the variation itself creates risk. The degree of separation in the traffic flow may be low or nonexistent. Furthermore, vehicles in these countries are in poor condition. The main concern of vehicle owners is to keep their vehicles in running condition, which can be rather difficult owing to the scarcity of spare parts and workshops to handle repairs. Road safety is often a secondary consideration.

It would seem possible to improve road safety in developing countries by a great percentage using some very simple safety programs, programs like vehicle improvements, information and education, accident information reporting, improvements in roads, and traffic police and law enforcement. Most of those activities are not costly and will give a very high rate of return, especially if the road safety programs can begin while the number of cars is low.

The difference in fatality rates between developed and developing countries is a clear indication that road accidents can be controlled using a variety of basic methods. For example, 35 cars are needed to kill one person in Nigeria, 60 in Pakistan, 756 in Ethiopia, while 3800 are needed in the United States and 4500 in Sweden (Rumar, 1990). If accident rates can be controlled in developed countries, why should they not be controllable in the developing world?

In fact, success in controlling accident rates has been achieved in several developing countries, like India, Thailand and Kenya. In Thailand, for example, the fatality rate per 100 million vehicle miles has been reduced from 21 in 1978 to 9 in 1985. The drop can be attributed to a 10-year safety program being carried out by the Thai government.

As suggested by Dr. MacKay and WHO (see Chapter 1), and supported by this research, there are many factors which do not exist in developed countries that play a large role in the high rate of accidents in developing countries. Nevertheless, a high degree of accident control can be accomplished with a minimal investment of resources.

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APPENDICES

APPENDIX A

APPENDIX B

Accident' Code Numbers

CODE NUMBERS

DRIVERS AND CYCLIST

1	Fatigue or asleep
2	Ill
3	Under the influence of drinks or drugs
4	Physical defects
5	Learner driver
6	Inexperience with type of vehicle in use at the
7	Proceeding at excessive speed having no regard to _______on
3	Failing to keep to near side or to the proper traffic lane
	Cutting in
0	Overtaking improperly on near side
11	Overtaking improperly on offside
12	Swerving
13	Failing to stop to afford free passage to pedestrian
14	Turning round in road negligently
15	Reversing negligently
16	Failing to comply with Traffic Signs or signals
17	Failing to signal or giving indistinct or incorrect signals
18	Pulling out from near side without due care
19	Pulling out from off side without due care
20	Changing from one Traffic Lane without due care
21	Cyclist riding more than two abreast
22	Cyclist riding with head down
23	Inattentive or attention diverted
24	Hampered by passengers, animals or luggage in/or on vehicle
25	Turning left without due care
26	Turning right without due care
27	Driver negligently opening side door of vehicle
28	Door not properly fastened (e.g.) back door of goods vehicle
29	Negligently opening rear door of (e.g.) door of back vehicle
30	Crossing without due care at road junction
31	Pedal cyclist holding to another vehicle
32	Losing control
33	Dazzled by light of another vehicle
34	Moving off without taking proper precautions
35	Stopping suddenly
36	Misjudging clearance, distance of speed (vehicle or object)
37	Following too closely behind another vehicle
36	Other apparent error of judgement or negligence

MOTOR CYCLIST AND PILLION PASSENGERS ONLY

39	Skidding (all vehicles)
40	Motor Cyclist not wearing crash helmets
41	Pillion passengers not wearing crash helmet
42	Pillion passengers wearing crash helmets

PEDESTRIAN

43	From near side
44	From off side
45	Heedless to Traffic - Crossing road mask by stationary vehicle
46	Heedless to Traffic - Crossing road mask by moving vehicle
47	Heedless to Traffic - Crossing road mask by moving vehicle
48	Heedless to Traffic - Walking or standing in road
49	Heedless to Traffic - Playing in road
50	Heedless to Traffic - Stepping, walking or running off foot path or verge into road
51	Slipping or falling
52	Physical defects of sudden illness
53	Under the influence of drinks or drugs
54	Holding on to a vehicle
55	Error of judgement, or negligence other than above

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DRIVERS AND CYCLIST

1	Fatigue or asleep
2	Ill
3	Under the influence of drinks or drugs
4	Physical defects
5	Learner driver
6	Inexperience with type of vehicle in use at the time
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	Cutting in
0	Overtaking improperly on near side
11	Overtaking improperly on offside
12	Swerving
13	Failing to stop to afford free passage to pedestrian
14	Turning round in road negligently
15	Reversing negligently
16	Failing to comply with Traffic Signs or signals
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19	Pulling out from off side without due care
20	Changing from one Traffic Lane without due care
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51	Slipping or falling
52	Physical defects of sudden illness
53	Under the influence of drinks or drugs
54	Holding on to a vehicle
55	Error of judgement, or negligence other than above

PASSENGERS

56 Boarding or alighting from P.P.V. vehicle without due care
57 Boarding or alighting from vehicle other that P.P.V. without due care
58 Falling when inside of falling from vehicle

PASSENGERS

59 Passengers opening door without due care
60 Other negligence on part of passengers
61 Stealing ride
62 Negligence on part of conductor or goods vehicle attendant
63 Under the influence of drinks or drugs

ANIMALS

64 Dog in carriageway
65 Other Animals in carriageway including bolting horses

OBSTRUCTIONS

66 Stationary vehicle dangerously placed
67 Collision with vehicles involved in previous road accident
68 Other obstructions

VEHICLE DEFECTS

69 Mechanical defects or failure of brakes
70 Mechanical defects or failure of tyres or wheels
71 Mechanical defects or failure of steering
72 Mechanical defects failure of chain
73 Mechanical defects of failure of frame
74 No front light
75 Inadequate front light
76 No rear light
77 Inadequate rear light
78 Unattended vehicle running away
79 Drivers view obstructed (i.e.) by equipment, load or obscured windscreen
80 Vehicle overload, shifted or defective load
81 Any other feature of vehicle or equipment which contributed to the accident

TRAMWAYS OR RAILWAYS

82 Tracks in bad repairs
83 Wheels of vehicle catching in tramways, tract or in Railway track

ROADS

84 Pot hole
85 Defective man hole cover
86 Other Road Surface condition
87 Road Work in progress
88 View obscured etc. by lay out in road (including object off carriage way)
89 Slippery road surface due to other factures that weather
90 Other road conditions etc.

WEATHER

91 Fog or mist
92 Strong wind
93 Heavy rain
94 Glaring sun

OTHER FACTURES

95 Other factures
96 Not traced

PASSENGERS

56	Boarding or alighting from P.P.V. vehicle without due care
57	Boarding or alighting from vehicle other that P.P.V. without due care
58	Falling when inside of falling from vehicle

PASSENGERS

59	Passengers opening door without due care
60	Other negligence on part of passengers
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90	Other road conditions etc.

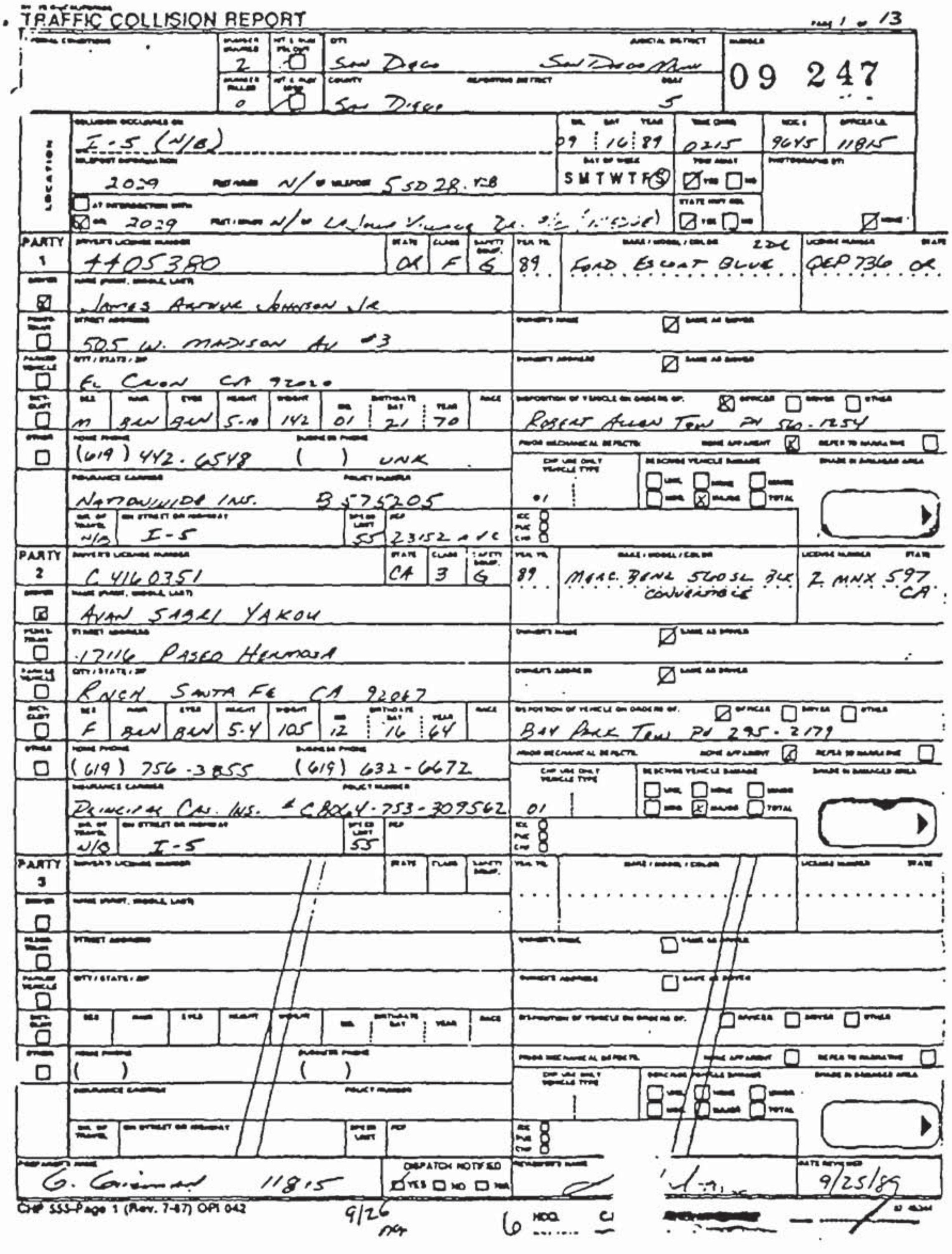
WEATHER

91	Fog or mist
92	Strong wind
93	Heavy rain
94	Glaring sun

OTHER FACTURES

95	Other factures
96	Not traced

APPENDIX C



TRAFFIC COLLISION REPORT

PAGE 1 OF 13

SPECIAL CONDITIONS

NUMBER INJURED: 2 | HIT & RUN FELONY: ☐ | CITY: San Diego | JUDICIAL DISTRICT: San Diego Mun | NUMBER: 09 247

NUMBER KILLED: 0 | HIT & RUN MISD: ☐ | COUNTY: San Diego | REPORTING DISTRICT: | BEAT: 5

LOCATION

COLLISION OCCURRED ON: I-5 (N/B)

MO. 09 | DAY 16 | YEAR 89 | TIME (2400): 0215 | NCIC #: 9645 | OFFICER I.D.: 11815

MILEPOST INFORMATION: 2029 FEET N/ OF MILEPOST 5 SD 28.42B

DAY OF WEEK: S M T W T F [✓ S] | TOW AWAY: ☒ YES ☐ NO | PHOTOGRAPHS BY:

☐ AT INTERSECTION WITH

☒ OR: 2029 FEET N/ OF La Jolla Village Dr. o/c (measured) | STATE HWY REL: ☒ YES ☐ NO | ☒ NONE

PARTY 1 ☒ DRIVER ☐ PEDESTRIAN ☐ PARKED VEHICLE ☐ BICYCLIST ☐ OTHER

DRIVER'S LICENSE NUMBER: 4405380 | STATE: OR | CLASS: F | SAFETY EQUIP.: G | VEH. YR.: 89 | MAKE / MODEL / COLOR: Ford Escort Blue 2DR | LICENSE NUMBER: QEP 736 | STATE: OR

NAME (FIRST, MIDDLE, LAST): James Arthur Johnson Jr

STREET ADDRESS: 505 W. Madison Av #3 | OWNER'S NAME: ☒ SAME AS DRIVER

CITY / STATE / ZIP: El Cajon CA 92020 | OWNER'S ADDRESS: ☒ SAME AS DRIVER

SEX: M | HAIR: BRN | EYES: BRN | HEIGHT: 5-10 | WEIGHT: 142 | BIRTHDATE MO. 01 DAY 21 YEAR 70 | RACE:

DISPOSITION OF VEHICLE ON ORDERS OF: ☒ OFFICER ☐ DRIVER ☐ OTHER — Robert Allan Tow PH 560-1254

HOME PHONE: (619) 442-6548 | BUSINESS PHONE: ( ) UNK

PRIOR MECHANICAL DEFECTS: NONE APPARENT ☒ REFER TO NARRATIVE ☐

INSURANCE CARRIER: Nationwide Ins. | POLICY NUMBER: B 575205

CHP USE ONLY VEHICLE TYPE: 01 | DESCRIBE VEHICLE DAMAGE: ☐ UNK ☐ NONE ☐ MINOR ☐ MOD ☒ MAJOR ☐ TOTAL | SHADE IN DAMAGED AREA

DIR. OF TRAVEL: N/B | ON STREET OR HIGHWAY: I-5 | SPEED LIMIT: 55 | PCF: 23152 a VC | ICC ○ PUC ○ CHP ○

PARTY 2 ☒ DRIVER ☐ PEDESTRIAN ☐ PARKED VEHICLE ☐ BICYCLIST ☐ OTHER

DRIVER'S LICENSE NUMBER: C 4160351 | STATE: CA | CLASS: 3 | SAFETY EQUIP.: G | VEH. YR.: 89 | MAKE / MODEL / COLOR: Merc. Benz 560 SL Blk Convertible | LICENSE NUMBER: 2 MNX 597 | STATE: CA

NAME (FIRST, MIDDLE, LAST): Avan Sabri Yakou

STREET ADDRESS: 17116 Paseo Hermosa | OWNER'S NAME: ☒ SAME AS DRIVER

CITY / STATE / ZIP: Rnch Santa Fe CA 92067 | OWNER'S ADDRESS: ☒ SAME AS DRIVER

SEX: F | HAIR: BRN | EYES: BRN | HEIGHT: 5-4 | WEIGHT: 105 | BIRTHDATE MO. 12 DAY 16 YEAR 64 | RACE:

DISPOSITION OF VEHICLE ON ORDERS OF: ☒ OFFICER ☐ DRIVER ☐ OTHER — Bay Park Tow PH 295-2179

HOME PHONE: (619) 756-3855 | BUSINESS PHONE: (619) 632-6672

PRIOR MECHANICAL DEFECTS: NONE APPARENT ☒ REFER TO NARRATIVE ☐

INSURANCE CARRIER: Principal Cas. Ins. | POLICY NUMBER: #CBX64-753-309562

CHP USE ONLY VEHICLE TYPE: 01 | DESCRIBE VEHICLE DAMAGE: ☐ UNK ☐ NONE ☐ MINOR ☐ MOD ☒ MAJOR ☐ TOTAL | SHADE IN DAMAGED AREA

DIR. OF TRAVEL: N/B | ON STREET OR HIGHWAY: I-5 | SPEED LIMIT: 55 | PCF: | ICC ○ PUC ○ CHP ○

PARTY 3 ☐ DRIVER ☐ PEDESTRIAN ☐ PARKED VEHICLE ☐ BICYCLIST ☐ OTHER

DRIVER'S LICENSE NUMBER: | STATE: | CLASS: | SAFETY EQUIP.: | VEH. YR.: | MAKE / MODEL / COLOR: | LICENSE NUMBER: | STATE:

NAME (FIRST, MIDDLE, LAST):

STREET ADDRESS: | OWNER'S NAME: ☐ SAME AS DRIVER

CITY / STATE / ZIP: | OWNER'S ADDRESS: ☐ SAME AS DRIVER

SEX: | HAIR: | EYES: | HEIGHT: | WEIGHT: | BIRTHDATE MO. DAY YEAR | RACE:

DISPOSITION OF VEHICLE ON ORDERS OF: ☐ OFFICER ☐ DRIVER ☐ OTHER

HOME PHONE: ( ) | BUSINESS PHONE: ( )

PRIOR MECHANICAL DEFECTS: NONE APPARENT ☐ REFER TO NARRATIVE ☐

INSURANCE CARRIER: | POLICY NUMBER:

CHP USE ONLY VEHICLE TYPE: | DESCRIBE VEHICLE DAMAGE: ☐ UNK ☐ NONE ☐ MINOR ☐ MOD ☐ MAJOR ☐ TOTAL | SHADE IN DAMAGED AREA

DIR. OF TRAVEL: | ON STREET OR HIGHWAY: | SPEED LIMIT: | PCF: | ICC ○ PUC ○ CHP ○

PREPARER'S NAME: G. Grimm 11815 | DISPATCH NOTIFIED: ☒ YES ☐ NO ☐ NA | REVIEWER'S NAME: | DATE REVIEWED: 9/25/89

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9/26

6 HOQ

[redacted]

NARRATIVE/SUPPLEMENTAL

10-25	[illegible]	[illegible]	[illegible]	09 247

☐ [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible]

☐ [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible]

☐ [illegible] ☐ [illegible]

WITNESS #1 (SGT. J. [illegible], RELATED THAT HE AND OFCR HILL WERE FIRST AT THE SCENE. W-1 OBSERVED P-2 SEATED IN THE DRIVER'S SEAT [illegible]. W-1 CONTACTED D-1 HE SMELLED A STRONG ODOR OF AN ALCOHOLIC BEVERAGE EMANATING FROM D-1'S BREATH.

WITNESS #2 (OFCR K HILL) RELATED UPON HIS ARRIVAL HE OBSERVED P-1 (JOHNSON) SEATED IN THE DRIVER'S SEAT. W-2 BASICALLY STAYED ON THE RT SHOULDER [illegible] (P-2).

BOTH WIT 1 AND WIT 2 ARE MEMBERS OF UCSD POLICE DEPT.

OPINIONS AND CONCLUSIONS:

THIS T/C OCCURRED AS P-1 (JOHNSON) [illegible] N/B I-5 #2 LN AT A STATED SPEED IN EXCESS OF 55 MPH N/O LA JOLLA VILLAGE DR. D-2 (VAHDU) WAS N/B I-5 [illegible] N/O D-1'S LOCATION AT 55 MPH. DUE TO D-1'S STATE OF INTOXICATION, P-1 FAILED TO MAKE A SAFE LANE CHANGE INTO THE N-3 LANE AND DRIFTED INTO THE N-4 LN AND STRUCK V-2 IN THE REAR. V-1 THEN SPUN OUT AND CAME TO REST AGAINST THE CENTER DIVIDER CABLE. V-2 STRUCK THE RT. BERM AND RAN OFF THE ROAD AND STRUCK A 55 MPH POST THEN CONTINUED DOWN THE EMBANKMENT INTO A CONCRETE CULVERT (DITCH).

POINTS OF IMPACT:

POI #1 (V-1 VS V-2): LOCATED ([illegible] FT) N/O THE MIDDLE OF LA JOLLA VILLAGE DR. AND [illegible] 6 FT W/O THE E/[illegible] EDGE OF I-5 N/B. POI #1 ESTABLISHED BY THE BEGINNING OF DEBRIS [illegible]

G. [illegible]	11815	09-16-87		

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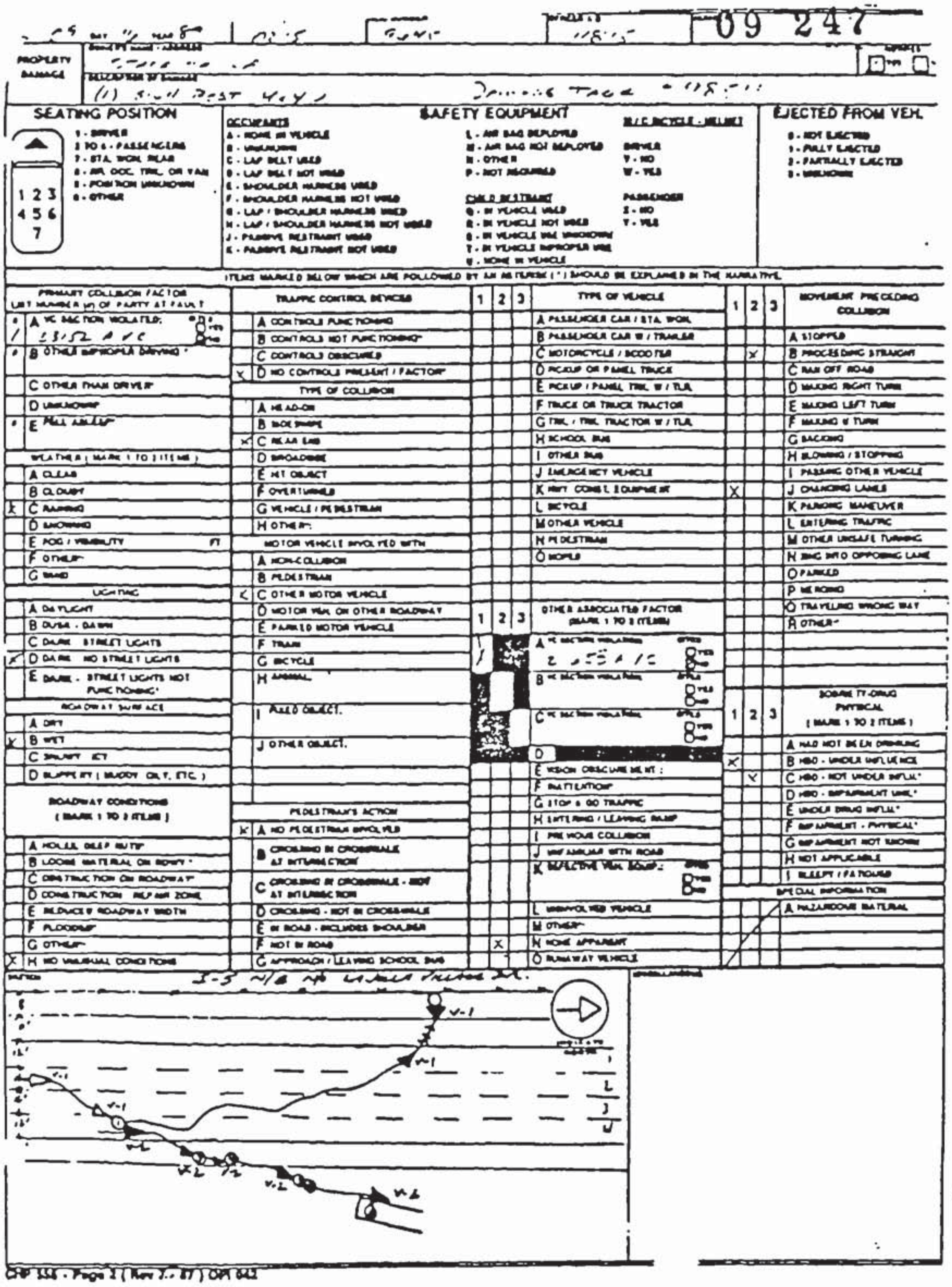

– 25 DAY 11 YEAR 8– | 0015 | Sunr[illegible] | 1185 | 09 247

PROPERTY DAMAGE — OWNER'S NAME - ADDRESS: State of CA — NOTIFIED ☐ YES ☐

DESCRIPTION OF DAMAGE: (1) Guard Rail [illegible] Driving Tag # 118[illegible]

SEATING POSITION

1 2 3
4 5 6
7

- 1 - DRIVER
- 2 TO 6 - PASSENGERS
- 7 - STA. WGN. REAR
- 8 - RR. OCC. TRK. OR VAN
- 9 - POSITION UNKNOWN
- 0 - OTHER

SAFETY EQUIPMENT

OCCUPANTS
- A - NONE IN VEHICLE
- B - UNKNOWN
- C - LAP BELT USED
- D - LAP BELT NOT USED
- E - SHOULDER HARNESS USED
- F - SHOULDER HARNESS NOT USED
- G - LAP / SHOULDER HARNESS USED
- H - LAP / SHOULDER HARNESS NOT USED
- J - PASSIVE RESTRAINT USED
- K - PASSIVE RESTRAINT NOT USED

- L - AIR BAG DEPLOYED
- M - AIR BAG NOT DEPLOYED
- N - OTHER
- P - NOT REQUIRED

CHILD RESTRAINT
- Q - IN VEHICLE USED
- R - IN VEHICLE NOT USED
- S - IN VEHICLE USE UNKNOWN
- T - IN VEHICLE IMPROPER USE
- U - NONE IN VEHICLE

M/C BICYCLE - HELMET

DRIVER
- V - NO
- W - YES

PASSENGER
- X - NO
- Y - YES

EJECTED FROM VEH.
- 0 - NOT EJECTED
- 1 - FULLY EJECTED
- 2 - PARTIALLY EJECTED
- 3 - UNKNOWN

ITEMS MARKED BELOW WHICH ARE FOLLOWED BY AN ASTERISK (*) SHOULD BE EXPLAINED IN THE NARRATIVE.

	PRIMARY COLLISION FACTOR LIST NUMBER (#) OF PARTY AT FAULT
1	A VC SECTION VIOLATED: 23152 A VC ○ YES ○ NO
	B OTHER IMPROPER DRIVING *
	C OTHER THAN DRIVER *
	D UNKNOWN *
	E FELL ASLEEP *

	WEATHER (MARK 1 TO 2 ITEMS)
	A CLEAR
	B CLOUDY
X	C RAINING
	D SNOWING
	E FOG / VISIBILITY FT
	F OTHER *
	G WIND

	LIGHTING
	A DAYLIGHT
	B DUSK - DAWN
	C DARK - STREET LIGHTS
X	D DARK - NO STREET LIGHTS
	E DARK - STREET LIGHTS NOT FUNCTIONING *

	ROADWAY SURFACE
	A DRY
X	B WET
	C SNOWY - ICY
	D SLIPPERY (MUDDY, OILY, ETC.)

	ROADWAY CONDITIONS (MARK 1 TO 2 ITEMS)
	A HOLES, DEEP RUTS *
	B LOOSE MATERIAL ON ROADWAY *
	C OBSTRUCTION ON ROADWAY *
	D CONSTRUCTION - REPAIR ZONE
	E REDUCED ROADWAY WIDTH
	F FLOODED *
	G OTHER *
X	H NO UNUSUAL CONDITIONS

	TRAFFIC CONTROL DEVICES
	A CONTROLS FUNCTIONING
	B CONTROLS NOT FUNCTIONING *
	C CONTROLS OBSCURED
X	D NO CONTROLS PRESENT / FACTOR

	TYPE OF COLLISION
	A HEAD-ON
	B SIDE SWIPE
X	C REAR END
	D BROADSIDE
	E HIT OBJECT
	F OVERTURNED
	G VEHICLE / PEDESTRIAN
	H OTHER *:

	MOTOR VEHICLE INVOLVED WITH
	A NON-COLLISION
	B PEDESTRIAN
X	C OTHER MOTOR VEHICLE
	D MOTOR VEH. ON OTHER ROADWAY
	E PARKED MOTOR VEHICLE
	F TRAIN
	G BICYCLE
	H ANIMAL:
	I FIXED OBJECT:
	J OTHER OBJECT:

	PEDESTRIAN'S ACTION
X	A NO PEDESTRIAN INVOLVED
	B CROSSING IN CROSSWALK AT INTERSECTION
	C CROSSING IN CROSSWALK - NOT AT INTERSECTION
	D CROSSING - NOT IN CROSSWALK
	E IN ROAD - INCLUDES SHOULDER
	F NOT IN ROAD
	G APPROACH / LEAVING SCHOOL BUS

1	2	3	TYPE OF VEHICLE
			A PASSENGER CAR / STA. WGN.
			B PASSENGER CAR W / TRAILER
	X		C MOTORCYCLE / SCOOTER
			D PICKUP OR PANEL TRUCK
			E PICKUP / PANEL TRK. W / TLR.
			F TRUCK OR TRUCK TRACTOR
			G TRK. / TRK. TRACTOR W / TLR.
			H SCHOOL BUS
			I OTHER BUS
			J EMERGENCY VEHICLE
X			K HWY. CONST. EQUIPMENT
			L BICYCLE
			M OTHER VEHICLE
			N PEDESTRIAN
			O MOPED

1	2	3	MOVEMENT PRECEDING COLLISION
			A STOPPED
			B PROCEEDING STRAIGHT
			C RAN OFF ROAD
			D MAKING RIGHT TURN
			E MAKING LEFT TURN
			F MAKING U TURN
			G BACKING
			H SLOWING / STOPPING
			I PASSING OTHER VEHICLE
			J CHANGING LANES
			K PARKING MANEUVER
			L ENTERING TRAFFIC
			M OTHER UNSAFE TURNING
			N XING INTO OPPOSING LANE
			O PARKED
			P MERGING
			Q TRAVELING WRONG WAY
			R OTHER *

1	2	3	OTHER ASSOCIATED FACTOR (MARK 1 TO 2 ITEMS)
/			A VC SECTION VIOLATION: 2[illegible] A / C CITED ○ YES ○ NO
			B VC SECTION VIOLATION: CITED ○ YES ○ NO
			C VC SECTION VIOLATION: CITED ○ YES ○ NO
			D
			E VISION OBSCUREMENT:
			F INATTENTION *
			G STOP & GO TRAFFIC
			H ENTERING / LEAVING RAMP
			I PREVIOUS COLLISION
			J UNFAMILIAR WITH ROAD
			K DEFECTIVE VEH. EQUIP.: CITED ○ YES ○ NO
			L UNINVOLVED VEHICLE
			M OTHER *
	X		N NONE APPARENT
			O RUNAWAY VEHICLE

1	2	3	SOBRIETY-DRUG PHYSICAL (MARK 1 TO 2 ITEMS)
			A HAD NOT BEEN DRINKING
X			B HBD - UNDER INFLUENCE
	X		C HBD - NOT UNDER INFLU. *
			D HBD - IMPAIRMENT UNK. *
			E UNDER DRUG INFLU. *
			F IMPAIRMENT - PHYSICAL *
			G IMPAIRMENT NOT KNOWN
			H NOT APPLICABLE
			I SLEEPY / FATIGUED

SPECIAL INFORMATION
- A HAZARDOUS MATERIAL

SKETCH: I-5 N/B N/O La Jolla Village Dr.

MISCELLANEOUS

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STATE OF CALIFORNIA

INJURED / WITNESSES / PASSENGERS

PAGE 3

DATE OF COLLISION	TIME (2400)	NCIC NUMBER	OFFICER I.D.	NUMBER
[illegible]	[illegible]	[illegible]	[illegible]	09 247

WITNESS ONLY	PASSENGER ONLY	AGE	SEX	EXTENT OF INJURY ("X" ONE)				INJURED WAS ("X" ONE)					PARTY NUMBER	SEAT POS.	SAFETY EQUIP.	EJECTED
				FATAL INJURY	SEVERE WOUND	OTHER VISIBLE INJURY	COMPLAINT OF PAIN	DRIVER	PASS.	PED.	BICYCLIST	OTHER				
☐	☐	24	F	☐	☐	☐	☒	☒	☐	☐	☐	☐	1	1	G	0

NAME / D.O.B. / ADDRESS: Avan [illegible] Yakov 12-16-61 17116 [illegible] CA 92127 TELEPHONE 619 757-1855

INJURED ONLY: TRANSPORTED BY: Hartsons Amb # 135 TAKEN TO: Scripps Mem Hosp La Jolla CA

DESCRIBE INJURIES: Complained of pain to neck, l/shoulder and minor lacerations hand fingers. Treated by Dr. [illegible].

☐ VICTIM OF VIOLENT CRIME NOTIFIED

☐	☐	27	M	☐	☐	☐	☒	☐	☒	☐	☐	☐	2	3	G	0

NAME / D.O.B. / ADDRESS: Richmond Ross [illegible]/10-15-6[illegible]/5435 Calumet Av La Jolla CA 92037 TELEPHONE (619) 454-1864

INJURED ONLY: TRANSPORTED BY: Hartson Amb # 135 TAKEN TO: Scripps Mem Hosp La Jolla CA

DESCRIBE INJURIES: Complained of pain to [illegible], [illegible] and lacerations to [illegible]

☐ VICTIM OF VIOLENT CRIME NOTIFIED

☐	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐				

NAME / D.O.B. / ADDRESS: TELEPHONE

INJURED ONLY: TRANSPORTED BY: TAKEN TO:

DESCRIBE INJURIES:

☐ VICTIM OF VIOLENT CRIME NOTIFIED

☐	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐				

NAME / D.O.B. / ADDRESS: TELEPHONE

INJURED ONLY: TRANSPORTED BY: TAKEN TO:

DESCRIBE INJURIES:

☐ VICTIM OF VIOLENT CRIME NOTIFIED

☐	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐				

NAME / D.O.B. / ADDRESS: TELEPHONE

INJURED ONLY: TRANSPORTED BY: TAKEN TO:

DESCRIBE INJURIES:

☐ VICTIM OF VIOLENT CRIME NOTIFIED

☐	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐				

NAME / D.O.B. / ADDRESS: TELEPHONE

INJURED ONLY: TRANSPORTED BY: TAKEN TO:

DESCRIBE INJURIES:

☐ VICTIM OF VIOLENT CRIME NOTIFIED

PREPARER'S NAME	I.D. NUMBER	MO. DAY YEAR	REVIEWER'S NAME	MO. DAY YEAR
[illegible]	[illegible]	[illegible]		

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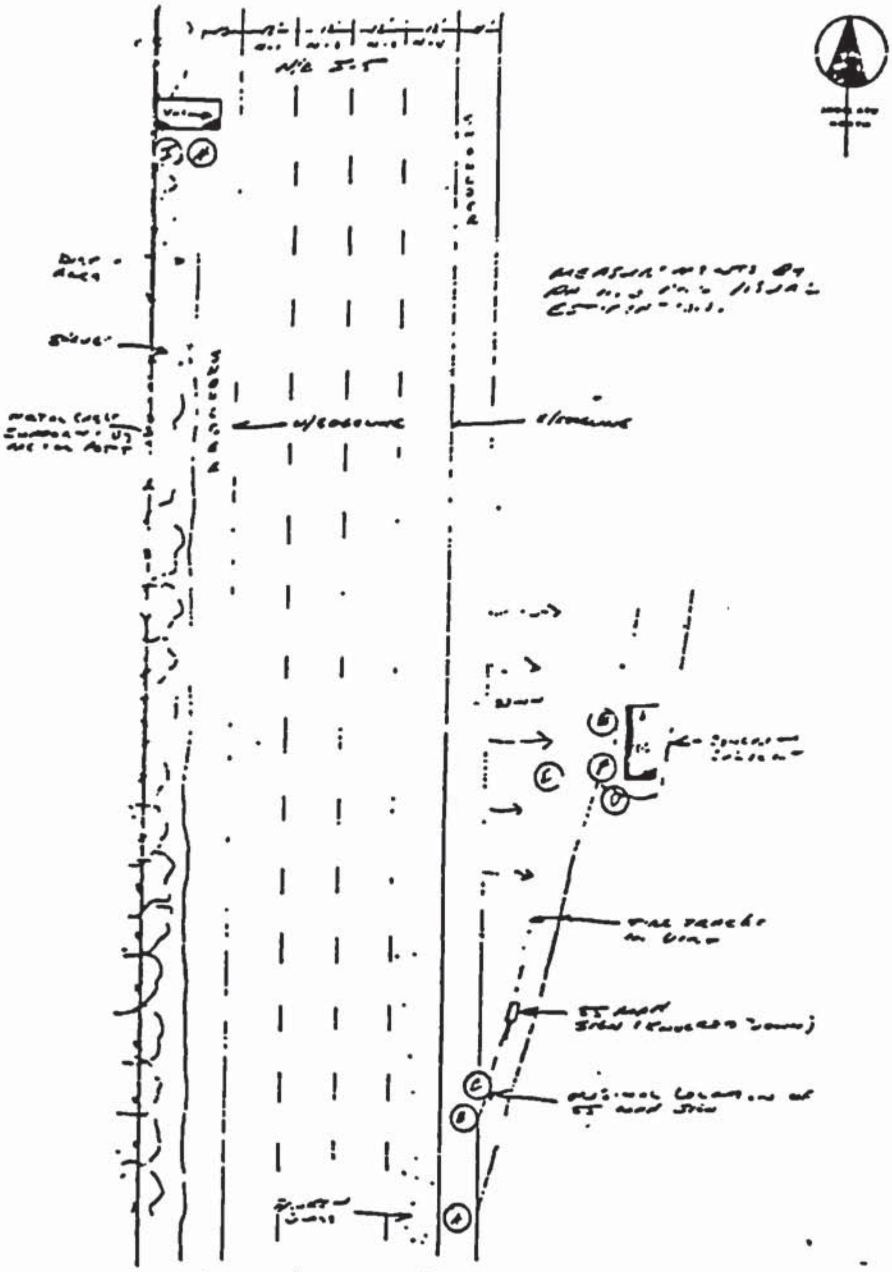
87 43537

FACTUAL DIAGRAM

PAGE

DATE OF COLLISION	TIME (2400)	NCIC NUMBER	OFFICER I.D.	NUMBER
[illegible]	[illegible]	[illegible]	[illegible]	09 247

ALL MEASUREMENTS ARE APPROXIMATE AND NOT TO SCALE UNLESS STATED (SCALE:



DRAWN BY	I.D. NUMBER	MO. DAY YR.	REVIEWER'S NAME	MO. DAY YR.
C Leach	[illegible]	[illegible]		

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NARRATIVE/SUPPLEMENTAL

[illegible] | [illegible] | [illegible] | [illegible] | 09 247

☐ NARRATIVE ☐ COLLISION REPORT ☐ [illegible] ☐ FATAL ☐ HIT & RUN UPDATE

☐ SUPPLEMENTAL ☐ OTHER ☐ HAZARDOUS MATERIALS ☐ SCHOOL BUS ☐ OTHER

CITY / COUNTY / JUDICIAL DISTRICT | REPORTING DISTRICT / BEAT | CITATION NUMBER

LOCATION / SUBJECT | STATE HIGHWAY RELATED ☐ YES ☐ NO

LEGEND

A TIRE MARKS ON BERM, BEGIN TRACK IN THE DIRT
21[illegible] FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND AT THE EAST EDGE OF THE EAST SHOULDER

B. TIRE MARK IN BERM, BEGIN TRACK. IN THE DIRT
21[illegible] FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND AT THE EAST EDGE OF THE EAST SHOULDER

C. ORIGINAL LOCATION OF 55 MPH SIGN (WOOD POST)
[illegible]157 FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND 5 FT EAST OF THE EAST EDGE OF THE EAST SHOULDER

D. END TIRE TRACK IN THE DIRT
22[illegible] FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND 40 FT EAST OF THE EAST EDGE OF THE EAST SHOULDER

E END TIRE TRACK IN THE DIRT
22[illegible] FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND 34 FT EAST OF THE EAST EDGE OF THE EAST SHOULDER

F. VEH-2 LEFT REAR TIRE
2279 FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND 50 FT EAST OF THE EAST EDGE OF THE EAST SHOULDER

G. VEH-2 LEFT FRONT TIRE
22[illegible] FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND 50 FT EAST OF THE EAST EDGE OF THE EAST SHOULDER

(OVER)

L LEACH | [illegible] | 09 11 85

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STATE OF CALIFORNIA
NARRATIVE/SUPPLEMENTAL

PAGE 6

DATE OF ORIGINAL INCIDENT	TIME (2400)	NCIC NUMBER	OFFICER I.D.	NUMBER
09·16 89	0215	96115	11815	09 247

☐ NARRATIVE ☐ COLLISION REPORT ☐ 555 UPDATE ☐ FATAL ☐ HIT & RUN UPDATE

☐ SUPPLEMENTAL ☐ OTHER ☐ HAZARDOUS MATERIALS ☐ SCHOOL BUS ☐ OTHER

CITY/COUNTY/JUDICIAL DISTRICT | REPORTING DISTRICT/BEAT | CITATION NUMBER

LOCATION/SUBJECT | STATE HIGHWAY RELATED ☐ YES ☐ NO

H. VEH-1 RIGHT FRONT TIRE.

2334 FT NORTH OF THE NORTH EDGE OF LA JOLLA VILLAGE DR
AND 5 FT WEST OF THE WEST EDGE OF THE N-1 LANE

I. VEH-1 RIGHT REAR TIRE

2339 FT NORTH OF TH NORTH EDGE OF LA JOLLA VILLAGE DR
AND 15 FT WEST OF THE WEST EDGE OF THE N-1 LANE.

PREPARER'S NAME	I.D. NUMBER	MONTH/DAY/YEAR	REVIEWER'S NAME	MONTH/DAY/YEAR
L LEACH	1563	09-16-89		

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NARRATIVE/SUPPLEMENTAL

PAGE 7

DATE OF INCIDENT/OCCURRENCE 09-16-89
TIME 0115
NCIC NUMBER 9415
OFFICER I.D. 11815
NUMBER 09 247

☐ NARRATIVE ☐ COLLISION REPORT ☐ SB UPDATE ☐ FATAL ☐ HIT & RUN UPDATE
☐ SUPPLEMENTAL ☐ OTHER ☐ HAZARDOUS MATERIALS ☐ SCHOOL BUS ☐ OTHER

CITY/COUNTY/JUDICIAL DISTRICT
REPORTING DISTRICT/BEAT
CITATION NUMBER
LOCATION/STREET
STATE HIGHWAY RELATED ☐ YES ☐ NO

FACTS

NOTIFICATION:

ON 09-16-89 AT APPROX. 0110 HRS I MONITORED A RADIO CALL OF AN ACCIDENT NO DETAILS N/B I-5 VICINITY OF GENESEE AV. I RESPONDED FROM I-5 AT DEL MAR HTS RD AND ARRIVED AT 0122 HRS. UPON MY ARRIVAL I DETERMINED THIS COLLISION WAS N/B I-5 .4 MILES N/O LA JOLLA VILLAGE DR. THIS COLLISION INVOLVED TWO VEHICLES AND TWO INJURED PERSONS.

ALL SPEEDS AND MEASUREMENTS WERE APPROXIMATES. ALL MEASUREMENTS WERE BY OFCR G. LEACH 5563 BY PACING AND VISUAL ESTIMATION.

SCENE:

THIS T/C OCCURRED ON I-5 N/B .4 MILES N/O LA JOLLA VILLAGE DR. I-5 N/B AT THIS LOCATION IS A FOUR LANE HI-WAY CONSTRUCTED OF GROOVED CONCRETE. I-5 N/B HAS A GRADUAL INCLINE TOWARDS THE NORTH. THE N/B LANES ARE SEPARATED AND DIVIDED BY PAINTED WHITE (BROKEN) LINES AND RAISED BOTTS DOTS. THE W/EDGE OF THE N-1 LN IS BORDERED BY A YELLOW EDGELINE, AN ASPHALT SHOULDER, A DIRT SHOULDER AND A METAL POSTS AND CABLE CENTER DIVIDER. THE E/EDGE OF THE N-4 LN IS BORDERED BY A WHITE EDGELINE, ASPHALT SHOULDER, ASPHALT BERM, AND A DIRT EMBANKMENT THAT DECLINE TOWARDS THE EAST (SEE FACTUAL DIAGRAM). THERE WAS A LITTLE MIST/MOISTURE IN THE AIR AND ON THE ROADWAY SURFACE.

PREPARER'S NAME G. Coleman
I.D. NUMBER 11815
DATE 09-16-89
REVIEWER'S NAME
DATE

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NARRATIVE/SUPPLEMENTAL

☐ ☐ ☐ ☐ ☐
☐ ☐ ☐ ☐ ☐

PARTIES:

PARTY #1 (JOHNSON):

V-1 (FORD ESCORT) WAS LOCATED ON ITS WHEELS FACING IN AN EASTERLY DIRECTION IN THE CENTER DIVIDER AREA. V-1 SUSTAINED MINOR T/C DAMAGE FROM THIS T/C. V-1 SUSTAINED DAMAGE TO THE FRONT (MOSTLY R/SIDE AND TO THE R/REAR CORNER (TAIL LIGHT BROKEN BY CD [illegible] P-1 (JOHNSON) WAS CONTACTED STANDING NEXT TO UCSD POLICE SGT. HUTCHISON #652 JUST N/O V-1. P-1 WAS IDENTIFIED BY HIS VALID OREGON DRIVERS LICENSE AND MILITARY IDENTIFICATION. P-1 WAS DETERMINED TO BE THE DRIVER BY HIS OWN ADMISSION, P-1 WAS SOLE OCCUPANT IN V-1, AND WITNESS' SGT HUTCHISON AND OFCR HILL'S [illegible].

PARTY #2 (YAKOU):

V-2 (MERCEDES BENZ) WAS LOCATED ON ITS WHEELS FACING IN A NORTHERLY DIRECTION IN A CONCRETE CULVERT (DITCH). V-2 SUSTAINED MAJOR T/C DAMAGE FROM THIS T/C. V-1 SUSTAINED DAMAGE TO THE ENTIRE LEFT SIDE, REAR BUMPER, AND CONVERTIBLE TOP (W/S). P-2 (YAKOU) WAS CONTACTED AT THE EMERGENCY ROOM AT SCRIPPS MEMORIAL HOSP., LA JOLLA. P-2 WAS IDENTIFIED BY HER VALID CDL. P-2 WAS DETERMINED TO BE THE DRIVER OF V-2 BY HER ADMISSION, PASS. LAKHANI'S STATEMENT, P-2 POSITION IN V-2 UPON MY ARRIVAL AND INJURIES TO P-2 ARE CONSISTENT WITH BEING SEATED IN THE LEFT SIDE (DRIVER) OF V-2.

G. Coleman 11615 09-16-89

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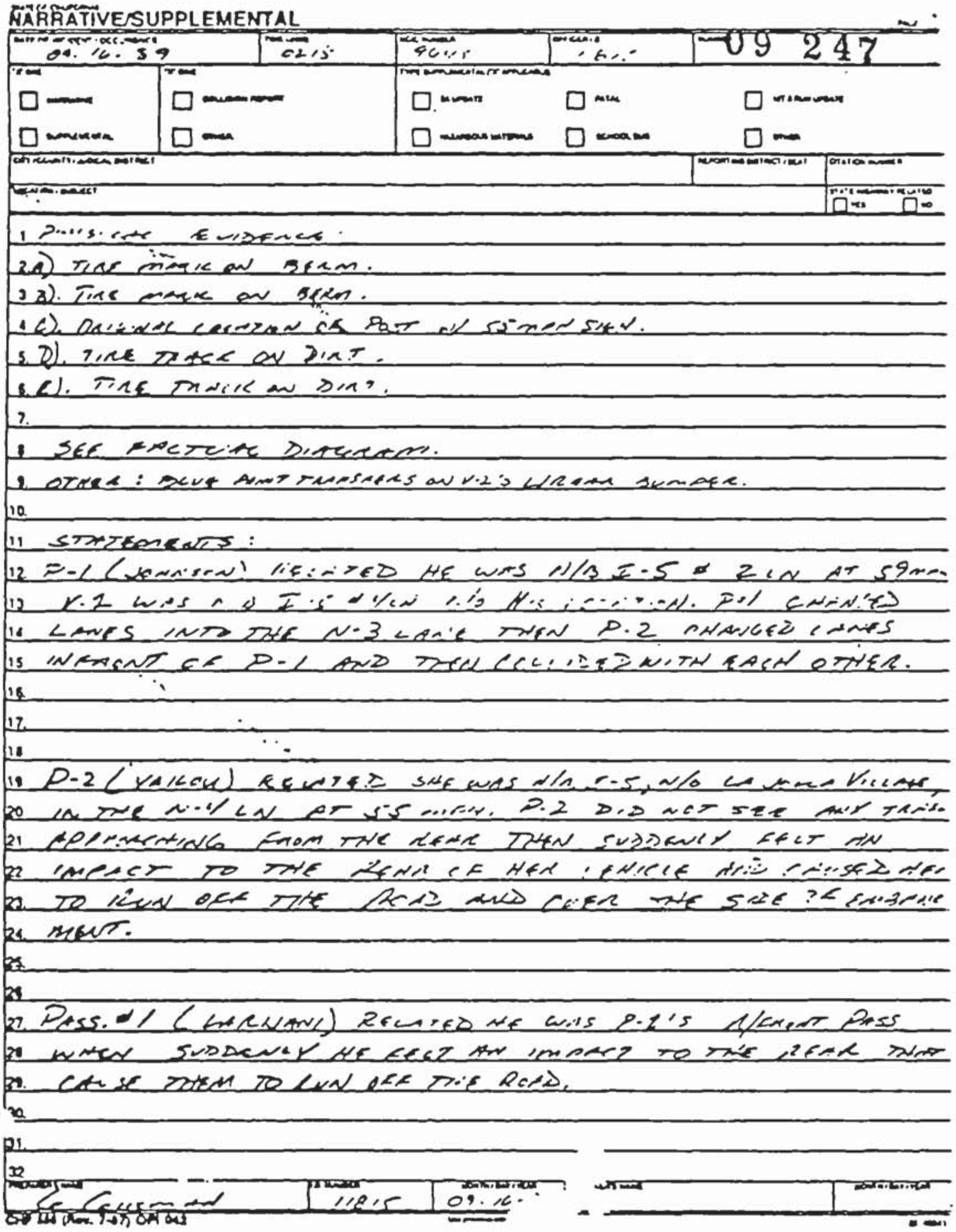

NARRATIVE/SUPPLEMENTAL

09. 16. 89 | 0215 | 9045 | 09 247

PHYSICAL EVIDENCE:

A) TIRE MARK ON BERM.

B). TIRE MARK ON BERM.

C). ORIGINAL LOCATION OF POST W/ 55 MPH SIGN.

D). TIRE TRACK ON DIRT.

E). TIRE TRACK ON DIRT.

SEE FACTUAL DIAGRAM.

OTHER: BLUE PAINT TRANSFERS ON V-2'S L/REAR BUMPER.

STATEMENTS:

P-1 (JOHNSON) RELATED HE WAS N/B I-5 # 2 LN AT 59 MPH. V-2 WAS N/B I-5 #4 LN [illegible]. P-1 CHANGED LANES INTO THE N-3 LANE THEN P-2 CHANGED LANES INFRONT OF P-1 AND THEN COLLIDED WITH EACH OTHER.

P-2 (YAKLEY) RELATED SHE WAS N/B I-5, N/O LA JOLLA VILLAGE, IN THE N-4 LN AT 55 MPH. P-2 DID NOT SEE ANY TRAFFIC APPROACHING FROM THE REAR THEN SUDDENLY FELT AN IMPACT TO THE REAR OF HER VEHICLE AND CAUSED HER TO RUN OFF THE ROAD AND OVER THE SIDE OF EMBANKMENT.

PASS. #1 (LARNANI) RELATED HE WAS P-2'S R/FRONT PASS WHEN SUDDENLY HE FELT AN IMPACT TO THE REAR THAT CAUSE THEM TO RUN OFF THE ROAD.

11815 | 09. 16-

NARRATIVE/SUPPLEMENTAL

09-16-87	[illegible]	[illegible]	[illegible]	09 247

☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐

State highway related ☐ ☐

POI # 2 (V-1 [illegible] -VS- [illegible]): LOCATED APPROX. 2339 FT N/O THE N/EDGE OF LA JOLLA VILLAGE DR. AND 18 FT W/O THE W/RDWY EDGE OF I-5 N/B.

POI # 3 (V-2-VS-BERM): LOCATED APPROX 2112 FT N/O THE N/EDGE OF LA JOLLA VILLAGE DR AND 10 FT E/O THE E/RDWY EDGE OF I-5 N/B.

POI # 4 (V-2 VS BERM): LOCATED APPROX. 2142 FT N/O THE N/EDGE OF LA JOLLA VILLAGE DR. AND 13 FT E/O THE E/RDWY EDGE OF I-5 N/B.

POI # 5 (V-2 VS SIGN POST): LOCATED 2157 FT N/O THE N/EDGE OF LA JOLLA VILLAGE DR. AND 15 FT E/O THE E/RDWY EDGE OF I-5 N/B.

POI # 6 (V-2'S R/REAR FENDER -VS- EAST WALL OF CONCRETE CULVERT): LOCATED APPROX 2779 FT N/O THE N/EDGE OF LA JOLLA VILLAGE DR. AND APPROX. 70 FT E/O THE E/RDWY EDGE OF I-5 N/B.

POI'S 2-6 WERE DETERMINED BY PHYSICAL EVIDENCE.

INTOXICATION NARRATIVE:

D-1 (JOHNSON) HAD A DISTINCT ODOR OF AN ALCOHOLIC BEVERAGE ON HIS BREATH. HIS EYES WERE RED AND WATERY AND HIS SPEECH WAS SLURRED. I GAVE D-1 SEVERAL (4) PREDEMONSTRATED FIELD SOBRIETY TESTS WHICH HE FAILED TO DO AS DEMONSTRATED.

G. [illegible]	11615	09-16-87		

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NARRATIVE/SUPPLEMENTAL

-16-89				09 247

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☐ ☐ ☐ ☐ ☐

[illegible] P1 ([illegible]) AND WITNESSES' STATEMENTS, I FORMED THE OPINION [illegible] WAS DRIVING [illegible] THE INFLUENCE OF ALCOHOL.

I ARRESTED P-1 (JOHNSON) FOR 23152 A VC DUI. 23157 VC IMPLIED CONSENT AND MIRANDA RIGHTS WERE ADVISED. P-1 WAS HAVING A HARD TIME DECIDING WHICH TEST WAS THE FASTEST TO COMPLETE AND SUBMITTED TO A BLOOD TEST. THE BLOOD TEST WAS OBTAINED BY S. ROBERTS RN AT 0415 HRS. P-1 DID NOT WAIVE HIS RIGHTS AND WAS BOOKED IN SCCJ FOR 23152 A VC DUI.

P-2 (YAKOU) STATED SHE HAD ONE DRINK EARLIER IN THE EVENING. AFTER EXAMINING P-2, I DETERMINED P-2 DID NOT DISPLAY ANY OBJECTIVE SYMPTOMS OF INTOXICATION AND WAS NOT UNDER THE INFLUENCE OF ALCOHOL OR DRUGS. (DUE TO P-2'S INJURIES, NO FSTS WERE GIVEN).

CAUSE:

P-1 (JOHNSON) CAUSED THIS T/C BY BEING IN VIOLATION OF THE FOLLOWING VEHICLE CODE SECTIONS:

1). 23152(A) VC - DRIVING UNDER THE INFLUENCE OF ALCOHOL. (PRIMARY COLLISION FACTOR)

2). 21658(A) VC AND WHILE DRIVING INTOXICATED, P-1 MADE AN UNSAFE LANE CHANGE (ASSOCIATED CAUSE).

THE ABOVE VIOLATIONS ARE BASED ON P-1'S OBJECTIVE SYMPTOMS OF INTOXICATION (AS OUTLINED UNDER INTOX. NARR. PG. 11 LINE 29) THE STATEMENTS OF WIT HUTCHISON AND HILL AND THE LOCATION OF VEH DAMAGE

G. Cummins	11815	09-12-89		

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APPENDIX D

APPENDIX E

```
PROGRAM - MVROAD                                                PAGE      1

    real run

FILENAMES
---------
                              INPUT CONTROL DATA FILE
        outnet   .DAT         INPUT NETWORK
        outrpmat.DAT          INPUT TRIP MATRIX
                              INPUT TREE FILE
                              INPUT TURN PENALTY FILE
                              INPUT CAPACITY RESTRAINT DATA FILE
        outnetrd.DAT          OUTPUT NETWORK
        outskmrd.DAT          OUTPUT COST SKIM MATRIX
                              OUTPUT TREE FILE
        outdmprd.DAT          DUMPED NETWORK FILE

PARAMETERS
----------
  SPREAD =      0       MULTIROUTE LINK COST VARIATION INDEX
  TABLE  =    101       INPUT TRIP MATRIX NUMBER
  ITER   =      5       NUMBER OF CAPACITY RESTRAINT ITERATIONS
  MAXC   =    200       MAXIMUM LINK COST * 10
  VOLUME =      2       STORAGE OF VOLUMES IN OUTPUT NETWORK
                         = 1 : ADD TO EXISTING PRELOAD VOLUME
                         = 2 : REPLACE EXISTING PRELOAD VOLUME
                         = 3 : PLACE IN VOLUME FIELD
  NTREE  =      0       ITERATION NUMBER FOR WHICH TREES ARE SAVED
                         =0 : TO SAVE FOR EACH ITERATION
  MXTREE =   5000       MAXIMUM TREE COST * 10

OPTIONS
-------
  PRNET  =      F        =T TO PRINT INPUT NETWORK ONLY
  PRELOD =      T        =T IF PRELOADS ARE CONSIDERED IN LINK LOADING

  BUILD  =      T        =T IF NEW TREES ARE TO BE BUILT FOR EACH ITERATION
                         =F IF TREES ARE RESTORED FOR FIRST ITERATION
  THRU   =      T        =T IF TREES CAN BE BUILT THROUGH ZONE CENTROIDS
  SAVE   =      F        =T IF NEW TREES ARE TO BE SAVED
  TURNPN =      F        =T IF TURN PENALTIES ARE SUPPLIED

  TESTT  =      F        =T IF TEST TREES ONLY ARE TO BE BUILT
  PRTREE =      F        =T IF SELECTED TREES ARE TO BE PRINTED
  SHORTR =      F        =T IF TREE PRINT IS IN BACKNODE FORM
                         =F IF TREE PRINT IS IN FULL TRACE FORM
```

```
  LOAD    =      T        =T IF ASSIGNMENT IS TO BE DONE
  STORE   =      T        =T IF OUTPUT NETWORK IS TO BE SAVED

  CAP     =      T        =T IF CAPACITY RESTRAINT IS TO BE APPLIED
  PLITER  =      F        =T FOR NETWORK REPORT ON LAST ITERATION ONLY
  SKIM    =      T        =T IF SKIMS ARE TO BE SAVED
  DUMP    =      T        =T FOR DUMPED NETWORK FILE
  NSELCT  =      T        =T FOR SELECTED NODE PRINT
  TSELCT  =      T        =T FOR TURNING VOLUME REPORT
  TLITER  =      F        =T FOR TURNING VOLUME REPORTS ON LAST
                             ITERATION ONLY

INPUT NETWORK CHARACTERISTICS
-----------------------------
  LABEL   =  <>
  ZONES   =      13        HIGHEST ZONE IN NETWORK
  NODES   =      51        HIGHEST NODE IN NETWORK
  LTYPE   =       2        HIGHEST LINK TYPE IN NETWORK
  NOLINK  =     154        NUMBER OF LINKS IN NETWORK
                           (INCLUDING REVERSE OF ONE-WAY LINKS

OUTPUT NETWORK LABEL :  <'jamaica output network & hopfully flow'>
----------------------

MATRIX HEADER LABELS
--------------------          (NOTE: -1 INDICATES A MATRIX FILE WHICH HAS NO HE

INPUT FILE  1:
      ZONES       =  13
      MATRICES    =   1
      LABEL <'jamaican road matrix generation'

OUTPUT MATRIX LABEL
-------------------

             <'jamaica skim matrix'

LINK COST WEIGHTING FACTORS
---------------------------
  LINK    DISTANCE    TIME
  TYPE     FACTOR    FACTOR
          (DFACT)   (TFACT)
    1       1.00      0.00
```

APPENDIX F

California Accident Reduction Factors

Improvement	Reduction Factor
Channelization	
Install Median Barrier	36%
Install Painted or Raised Median	8%
Install Reflectorized Traffic Buttons	25%
Add Turn Lane and Signal	36%
Add Turning Lane	25%
Channelization	30%
Access Control	
Modify Entrance Ramp	30%
Modify Exit Ramp	20%
Add Acceleration/Deceleration Lanes	10%
Construction/Reconstruction	
Widen Shoulder	5%
Widen Travelway	28%
Flatten Side Slopes	46%
Construct New Frontage Roads	40%
Improve Horizontal and/or Vertical Alignment	40%
Modernize Travelway to Design Standards	15%
Improve Median and/or Shoulders on Divided Highway	42%
Reconstruct Curve (for Superelevation - 65%)	42%
Construct Pedestrian Walkway	60%
Widen Existing Bridge	44%
Replace Narrow Bridge	62%
Widen Small Structures	40%
Modernize Bridge Rail to Design Standard	5%
Construct Pedestrian Crossover (pedestrian accidents only)	95%
Construct Pedestrian Crossover (total accidents)	5%
Add Turning Lane	25%
Install Grade Separation	55%
Construct Interchange	55%
Reconstruct Intersection	40%
Construct Turn-Arounds	40%
Add Acceleration/Deceleration Lanes	10%
Construct Emergency Truck Deceleration Beds	20%
Construct Emergency Truck Deceleration Beds (Truck Accidents)	60%
Lighting	
Install Safety Lighting	25%

Improvement	Reduction Factor
Install Safety Lighting - Bridge	50%
Install Safety Lighting - Bridge Underpass	10%
Install Safety Lighting at Intersection (New)	75%
Install Safety Lighting at Intersection (Improvement)	50%
Miscellaneous	
Install Livestock Fencing	90%
Flatten Side Slope	46%
Construct New Frontage Roads	40%
Improve Guardrail to Design Standards	5%
Modernize Drainage to Design Standards	30%
Install Protection at Twin-Bridge Median Opening	50%
Modify Non-Breakaway Object within 30 ft.	25%
Safety-Treat Sign Supports	25%
Safety-Treat Luminaire Supports	25%
Install Surveillance and Control System	27%
Safety-Treat Concrete Headwalls	30%
Remove Curb and/or Riprap	20%
Remove/Relocate Fixed Objects	85-99%
Install Delineators	30%
Install Protective Guardrail	30%

Improvement	Reduction Factor
Install Delineators - Bridge Underpass	50%
Install Guardrail - Bridge End	50%
Install Impact Attenuation System	80%
Install Railroad Warning Device	50%
Install Rumble Strips	27%
Construct Emergency Truck Deceleration Beds	20%
Construct Emergency Truck Deceleration Beds (Truck Accidents)	60%
Pavement Markings	
Install/Improve Edge Marking	25%
Install Reflectorized Pavement Markings	20%
Install Painted or Raised Median	8%
Install Reflectorized Traffic Buttons	25%
Install Centerline Striping	65%
Pavement Treatments	
Resurface (Wet accidents, 42%)	21%
Stabilize Shoulder	28%
Widen Shoulder	5%
Widen Travelway	28%

Improvement	Reduction Factor
Groove to Prevent Hydroplaning	21%
Groove to Prevent Hydroplaning (wet accidents)	42%
Add Asphalt Seal Coat	21%
Add Asphalt Seal Coat (Wet accidents)	42%
Install ACP Overlay	21%
Deslick	20%
Install Rumble Strips	27%
Regulations	
Eliminate Parking	32%
Curtail Turning Move	40%
Signalization	
Install Railroad Warning Device	50%
Install/Improve Warning Signal	42-56%
Add Pedestrian Signal	13%
Improve or Modernize Signals	25%
Add Turn Lane and Signal	36%
Add Turn Signal (No Lane)	22%
Install New Traffic Signal	29%
Signs	
Install/Improve Warning Signs	35%
Install Stop Ahead Sign	47%
Install Yield Sign	59%
Install Minor Leg Stop Control	48%
Install/Improve Stop Signs	68%

Missouri Accident Reduction Factors

Improvement	Accident Reduction (Percent)													
	All	Fatal Injury	PDO	Head On	Rear End	Right Angle	Side Swipe	Left Turn	Rt. Turn	Fixed Obj.	Ped.	Night	Ran Off Road	Wet Pvmt.
PAVEMENT MARKINGS														
General Pavement Markings						10	20	10			10	10		
Double Yellow Center Lines	5													
Right Edge Lines	2												25	
Reflectorized Raised Pavement Markers	5													
No Passing Stripes	65													
PAVEMENT TREATMENTS														
Deslicking[a]	20	15												50

a/ On two or more lanes.
b/ Two lanes.
c/ Minor street must be 35% or more of total intersection volumes; total intersection volume must be < 8,000 ADT.

Improvement	Accident Reduction (Percent)													
	All	Fatal Injury	PDO	Head On	Rear End	Right Angle	Side Swipe	Left Turn	Rt. Turn	Fixed Obj.	Ped.	Night	Ran Off Road	Wet Pvmt.
Resurfacing[a]	42	46												
SIGNS														
Upgrade Signs				20	10						10	10		
Overhead Lane Signs					10		20							
Overhead Warning Signs					20	20		20	20					
Four-Way Stop Signs[c]	70	≈67												
Special Curve Warning Signs	75													
Minor Leg Stop Control	48[b] ≈38[a]	71[b] ≈18[a]												

[a] On two or more lanes.

[b] Two lanes.

[c] Minor street must be 35% or more of total intersection volumes; total intersection volume must be < 8,000 ADT.

Improvement	Accident Reduction (Percent)													
	All	Fatal Injury	PDO	Head On	Rear End	Right Angle	Side Swipe	Left Turn	Rt. Turn	Fixed Obj.	Ped.	Night	Ran Off Road	Wet Pvmt.
Yield Sign	≈59[b] ≈46[a]	80[b]												
Directional or Warning Signs at Intersections	29[b] 41[a]	≈59[b] ≈47[a]	≈26[a]											
Warning Signs and Delineators at Intersections	20[a]	≈27[a]												
Warning Signs on Sections	14[b] ≈20[a]	≈14[b] ≈26[a]												
REGULATIONS														
Eliminate Parking	32[a]	3[a]												
Change Two-Way Operation to One-Way	25													
Prohibit Turns	40[a]	39[a]												

[a] On two or more lanes.

[b] Two lanes.

[c] Minor street must be 35% or more of total intersection volumes; total intersection volume must be < 8,000 ADT.

Improvement	Accident Reduction (Percent)													
	All	Fatal Injury	PDO	Head On	Rear End	Right Angle	Side Swipe	Left Turn	Rt. Turn	Fixed Obj.	Ped.	Night	Ran Off Road	Wet Pvmt.
CHANNELIZATION														
Install Median Barriers		≈61[a]												
Add Painted/Raised Medians	12[a]													
Add Left-Turn Lane w/o Signals	≈19 6[a]	≈80 ≈5[c]												
Turn Bay					20									
New Left Channelization at Signalized Intersection w/ or w/o Left-Turn Phase	w/o 15 w 36													
New Left-Turn Channelization at Unsignalized Intersection w/curbs-painted	Curb 70 Point 15													
Install Two-Way Left-Turn Lanes	35													

[a] On two or more lanes.

[b] Two lanes.

[c] Minor street must be 35% or more of total intersection volumes; total intersection volume must be <8,000 ADT.

Improvement	Accident Reduction (Percent)													
	All	Fatal Injury	PDO	Head On	Rear End	Right Angle	Side Swipe	Left Turn	Rt. Turn	Fixed Obj.	Ped.	Night	Ran Off Road	Wet Pvmt.
ACCESS CONTROL														
Close Median Opening				100	50	100	50	100						
Relocate Drives				20	20	10	10	10	10					
SIGNALIZATION														
Install Warning Signals		≈73[a]												
Flashing Beacons (Red-Yellow)	50													
Flashing Beacons (All Red)	75													
Flashing Beacons at RR Xing	80													

[a] On two or more lanes.

[b] Two lanes.

[c] Minor street must be 35% or more of total intersection volumes; total intersection volume must be < 8,000 ADT.

Improvement	Accident Reduction (Percent)													
	All	Fatal Injury	PDO	Head On	Rear End	Right Angle	Side Swipe	Left Turn	Rt. Turn	Fixed Obj.	Ped.	Night	Ran Off Road	Wet Pvmt.
Advance Warning Flashers	30													
Improve Signals	31 2[a]	≈35												
Add Pedestrian Signals	13 3[a]	56 42												
Add Left-Turn Lane and Signal	27[a]	1[c]												
Add Left-Turn Signal w/o Turning Lane	39[a]	57[b]												
Add Turn Lane, Signal and Illumination	46[a]	76[a]												
Improve Timing					10	10		10	10		10			
12-in. Lens					10									

a/ On two or more lanes.
b/ Two lanes.
c/ Minor street must be 35% or more of total intersection volumes; total intersection volume must be < 8,000 ADT.

Improvement	Accident Reduction (Percent)													
	All	Fatal Injury	PDO	Head On	Rear End	Right Angle	Side Swipe	Left Turn	Rt. Turn	Fixed Obj.	Ped.	Night	Ran Off- Road	Wet Pvmt.
Improve Signals to Correspond to Manual on Uniform Traffic Control Devices					20	20	10	20	20			20		
Add Left-Turn Lane w/o Signal Turn Phase	≈19 6[a]	≈80 ≈54[a]	≈18[a]											
Modify Signals	27													
Actuate					10	10	20	10	20					
Optically Programmed Signals				20	10	10		10						
Pedestrian Phase											60			
Remove Signal					90									
Add Signal					-1/ 2000 vpd	80								

a/ On two or more lanes.
b/ Two lanes.
c/ Minor street must be 35% or more of total intersection volumes; total intersection volume must be < 8,000 ADT.