

The impact of planning in mitigating the effect of floods on road transportation



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Abstract

Road transport is an essential part of the transport system and is regarded as a lifeline for development, especially for people in rural areas, playing a critical role in poverty reduction. South Africa depends heavily on the road network as a communication channel and a link with the international community, especially the six countries it shares borders with. It is against this backdrop that the mitigation of risks impacting road transportation should be an important focus of the disaster risk management framework. In light of the potentially disruptive effect that flood disasters, in particular, have on the South African road network, it is important to understand the degree to which the current South African policy framework is effective in enabling adequate preparedness and responses to flood disasters affecting road transportation.

In this study, the South African disaster management policy of road authorities in the national, provincial and municipal (metropolitan) sphere was evaluated in comparison with three international examples (India, Japan and the United States of America) in terms of five identified policy attributes, namely institutional arrangements, legislative mandate, layout and content, resources and funding, and feasibility.

The research was conducted following a qualitative research approach and utilising a desktop research methodology for data gathering, followed by document analysis using the five attributes referred to above.

The study found that national legislative guidelines and instruments, as well as international examples, create an enabling environment for the development of effective policy to mitigate against flood disaster risks affecting road transportation in all three government spheres. However, it is only in the municipal (metropolitan) sphere that disaster management plans have been developed in compliance with the relevant legislation. These plans cover the management of all disaster risks affecting the municipality's services and infrastructure, not only the risk of flooding and the impact thereof on the road network. Nonetheless, the study found these plans to be feasible as base policy documents to mitigate against the impact of flood disasters on the road network.

As far as the provincial and national road agencies were concerned, no policy had been developed in accordance with the legislative requirements to address the mitigation of disaster risks (including that of flood disasters) in the context of road transportation. The study, therefore, identified a clear need for such policy to be developed in order to enable effectiveness in all areas of the reduction of flood disaster risk in the road transportation sector, namely prevention, mitigation, preparedness, response and recovery.

Key terms: disaster risk management, policy analysis, flood risk; road transportation, risk reduction, risk prevention, risk mitigation, risk response, Disaster Management Act.

Dedication

This research report is dedicated to both my parents Morwaswi and Hlapjadi, my wife Mathukoane and my children.

Both my parents taxed themselves dearly over the years for my education and career development, my late Father would always be appreciative of the effort I put into my educational pursuance. My Mother, who turned 80 years this year (2021), achieving a master's degree was an instruction she gave to me when I graduated for my honours degree. She remains the source of inspiration for greatness, and I guess this serve as a good present for her 80th birthday.

My wife has always been the wind beneath my wings, and my ability to fly higher is embedded in her undying support and encouragement. My children, especially with the arrival of baby Khumo this year instil the desire to do my best.

Declaration

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Signature: _____

A handwritten signature in blue ink, appearing to read "Solly Chuene", written over a horizontal line.

Date: _____

25/04/2021

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Table of Contents

Contents	Page
Abstract	i
Dedication	iii
Declaration	iv
Acknowledgements	v
CHAPTER 1: OVERVIEW AND FORMULATION OF THE PROBLEM	1
1.1 Introduction and background	1
1.2 The problem and its setting	4
1.2.1 Problem statement	7
1.3 Research questions	9
1.4 Limitations of the study	9
1.5 The assumptions	10
1.6 The importance of the study	11
1.7 Aim and objectives of the research	11
1.8 Review of related literature	12
1.9 Research methods	17
1.10 Ethical considerations	20
CHAPTER 2: LITERATURE REVIEW	21
2.1 Introduction	21
2.2 Transport	22
2.3 Natural disasters	23
2.4 Transport and natural disasters	24
2.4.1 The transport disaster risk reduction context	25
2.5 Policy and planning	28
2.5.1 Public policy implementation	29
2.5.2 Public policy challenges and review	29
2.6 Disaster management and policy	30
2.6.1 Spatial planning and disaster risk reduction	31

2.6.2 The disaster risk reduction legislative framework	32
2.7 Disaster risk reduction planning and the transport system	33
2.7.1 Non-policy disaster risk management challenges	34
2.8 Conclusion	36
2.9 Conceptual Framework	37
2.9.1 Conceptual Framework Summary	38
 CHAPTER 3: RESEARCH METHODOLOGY	 40
3.1 Introduction	40
3.2 Qualitative research	41
3.3 Data analysis	43
3.4 Desktop research	43
3.5 Document analysis	47
3.6 Limitations of the study	50
3.7 Ethical considerations of the study	51
3.8 Conclusion	53
 CHAPTER 4: ANALYSIS AND FINDINGS	 54
4.1 Introduction	54
4.2 International disaster management policy frameworks	56
4.2.1 International context 1: USA Disaster Management Planning	57
4.2.2 International context 2: National Disaster Response Plan: India	59
4.2.3 International context 3: The Japanese Disaster Management System	60
4.2.4 The South African Disaster Management Policy Context	63
4.2.5 Highlights from international and SA disaster policy frameworks	65
4.3 The policy framework for flood disaster risk management:	
Road authorities	66
4.3.1 Disaster Management policy framework: National and provincial road authorities	68
a) The SANRAL Act, 1998 and the National Land Transport Act, 2009	68

b)	White Paper on Road Policy, 2018	69
c)	Technical Methods for Highways	71
d)	The Road Incident Management System (RIMS), 1996	72
e)	The Road Asset Management System (RAMS), 2012	73
4.3.2	Disaster risk management policies of metropolitan municipalities	74
a)	City of Cape Town Municipal Disaster Risk Management Plan	75
b)	City of Johannesburg Metropolitan Municipality	77
c)	City of Tshwane Metropolitan Municipality	79
d)	Nelson Mandela Bay Municipality	81
4.4	Summary of findings	84
4.4.1	Institutional arrangements	84
4.4.2	Legislative mandate	85
4.4.3	Layout and content	86
4.4.4	Funding arrangements	87
4.4.5	Feasibility	88
4.5	Conclusion	88
CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS		90
5.1	Introduction	90
5.2	Conclusions drawn from the study	91
5.3	Answering the research questions	94
5.3.1	Subsidiary research questions	95
5.3.2	Main research question	96
5.4	Policy development recommendations	97
5.5	Recommendations for further study	98
References		100
List of figures		
Figure 1: South African road map		2
Figure 2: South Africa and neighbouring countries road map		3

Figure 3: Integration of climate change and disaster risk reduction in road infrastructure planning	38
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List of pictures

Picture 1: Bridge washed away by floods	5
Picture 2: Urban road flooded in Centurion, Gauteng	6
Picture 3: Mobility disabled on a tourism route in Mopani District Municipality	6
Picture 4: A national road (N2) flooded in a 2017 storm in Durban, KwaZulu-Natal	7

List of tables

Table 1: Road authority policies	67
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CHAPTER 1: OVERVIEW AND FORMULATION OF THE PROBLEM

1.1 Introduction and background

A disaster is a naturally or technologically induced calamity happening beyond the coping capacity of the affected community (Nimpuno and Hilman, 1998; Furin, 2016). Disasters have had and continue to have a huge impact on human lives, infrastructure, and the environment, also causing major economic loss. Disasters can strike anytime, anywhere, and anyone and people across the globe have to live with that reality. The incidence of disasters continues to rise with more and more people affected, the accompanying loss of life and a high cost to repair or replace damaged infrastructure (Independent Evaluation Group, 2006; McNutt and Leshner, 2013).

Different types of disasters, especially natural disasters, affect people in different ways, and in South Africa, over the years, floods have hit different districts or municipalities and provinces of the country. Transportation, particularly road transport, has always been one of the sectors affected by the occurrence of floods. Floods are reportedly the type of disaster different countries respond to most frequently. The cost of such responses is rising, as per reports from both the European Union and the World Bank (Independent Evaluation Group, 2006; Arrighi *et al.*, 2018).

While the impact of floods is devastating to humans and the socio-economic infrastructure, the focus here is on the road transport system. South Africa depends heavily on the road network as a communication channel and a link with the international community, especially the six countries it shares borders with, see figures 1 & 2.

“South Africa’s total road network is about 754 000 kilometres, of which over 70 000 km are paved or surfaced roads. The drive from Musina on

South Africa's northern border to Cape Town in the south is a 2 000 km journey of well-maintained roads" (South Africa Info, 2012, n.d.).



Figure 1: South African road map (Source: World Map, 2014)



Figure 2: South Africa and neighbouring countries road map (Source: Geology.com, 2018)

Floods are a common phenomenon in South Africa and conditions inducing their occurrences, such as climate change and urbanization, are becoming more prevalent (Van Niekerk *et al.*, 2018; Miller and Hutchins, 2017). Therefore, it is critical to develop measures to reduce the risk and minimize the impact of flooding. Preparedness, response, and reconstruction and rehabilitation are variables of planning in disaster management. That is, planning is a critical means to disaster preparedness and to help deal with disasters before, during and after the incident.

This study will make an assessment of South Africa's road sector disaster management policy framework. That is, how the existing framework guides the management of flood disasters in the country. For the sake of completeness, disaster management policy frameworks from other countries as well as the national disaster framework will be analysed in developing the evaluation framework for this study.

1.2 The problem and its setting

South Africa has encountered flood incidences in various parts of the country, notably the 1958 floods recorded as one of the greatest disasters in South African history, followed by the Laingsburg flood of 1981, the region's worst floods ever in Natal in 1987 and in the Free State in 1988, the Ladysmith flooding of 1994, which was recorded as the worst flood in 78 years, (Grobler, 2001). Most recently, the floods of 2011 were declared a national disaster (Mail and Guardian, 6 January 2011). Between 2011 and 2021 South Africa recorded flood incidences each and every year, affecting several provinces annually and causing serious damages to infrastructure, people displacements and deaths (FloodList, 2021).

The occurrence of floods brings devastating effects, loss of life, loss of shelter and the disruption of basic services such as water and sanitation. Accessibility is affected with roads flooded, and infrastructure damaged as houses collapse and roads and bridges are washed away; this is clear from pictures 1- 4. During the 2011 floods, declared a national state of disaster, in the province of KwaZulu-Natal alone the estimated costs to repair damaged infrastructure, which included water systems, housing, roads, bridges and schools, amounted to R198 million (Red Cross, 2011; Mail and Guardian, 6 January 2011). In recent years 2014 records the most destructive floods in South Africa that has led to infrastructure damages, community displacements and 32 fatalities (FloodList, 2021). In 2021 all the 9 provinces (January - February 8 provinces and May 1 province-Western Cape) of South Africa experienced floods that were disruptive to communities, damaging infrastructure and displacing families (FloodList, 2021)

While the transport sector is negatively affected by flood incidents, the resulting dysfunctional transport system also has major implications affecting delivery and access in respect of socio-economic activities. Major economic activities are also negatively affected, e.g., tourism, which contributes 3% of the country's Growth Development Programme (GDP) as floods commonly disable mobility (Department of Tourism, 2017).



Picture 1: Bridge washed away by floods (Source: Limpopo Provincial Roads, 2012)



Picture 2: Urban road flooded in Centurion, Gauteng (Source: thesouthafrican.com)



Picture 3: Mobility disabled on a tourism route in Mopani District Municipality (Source Limpopo Provincial Roads, 2012)



Picture 4: A national road (N2) flooded in a 2017 storm in Durban, KwaZulu-Natal (Source: floodlist.com)

The cost of the damages has to be analysed against the value of the effort already directed towards flood risk management. Plans, policy and strategies are also to be reviewed, as these documents govern the management of the impact of flooding incidents by road authorities.

1.2.1 Problem statement

Incidents of flooding are a common phenomenon in South Africa having occurred each year between 2011 and 2021, and transport as a sector has always been on the receiving end with mobility disrupted and road infrastructure damaged (FloodList, 2021). The costly implications for the country's road network resulting from flood disasters are irreversible; adding to a distressed, ageing and poorly maintained road infrastructure (Musyoki *et al.*, 2015; Luskova *et al.*, 2018).

Frequencies of disaster incidents such as floods are forecasted through various means per locality, but, even when anticipated, the impact of disasters remains

costly for countries, citizens and the environment (Chan, 2014; Van Niekerk *et al.*, 2018). Preparedness in the form of a policy or planning framework for dealing with disasters, especially common types of disasters such as floods, is critical. It is therefore important to first look at the procedure/guidelines and plans or strategies that are in place for mitigating the effects of potential floods. Furthermore, seen against the backdrop of previous incidences of flooding having had major implications for the road infrastructure and disabling mobility, it is important to consider whether the existing plans/policies invoked to deal with these disasters are effective or efficient (Benson and Clay, 2004).

The level at which policies or plans are developed and implemented is also in question as there have been no reported action or highlighted effort from the road sector in response to flood disasters, as is also relevant from the below report on a flood incident in the Mopani District in 2012.

“The following role players are managing the situation, South African National Defence Force, Disaster Management (Maruleng, Mopani and Cooperative Governance, Human Settlement and Traditional Affairs), South African Police Services divers search and rescue teams, Emergency Medical Services and Fire Brigade” (Republic of South Africa, 2012 , n.d.).

Also critical is how the road sector guides the construction of road infrastructure in relation to contour levels and flood proneness among all road authorities, namely the national, provincial, district/metropolitan, and private authorities. Planning for floods should be undertaken by all road authorities responsible for all classes of roads (in terms of Road Infrastructure Strategic Framework of South Africa and Technical Recommendations for Highways no. 26), namely, Class 1 (Principal Arterial), Class 2 (Major Arterial), Class 3 (Minor Arterial), Class 4 (Collector Street), Class 5 (Local Street), and Class 6 (Walkway) roads (COTO, 2013).

Class 2 and 3 roads will be the subject of this research, considering their function and the frequent effect of floods plus the cost of replacing or repairing damaged infrastructure (Grobler, 2001). Class 1 roads are affected by floods, but often

minimally in terms of the extent of damage and time affecting movement of traffic. Both class 2 and 3 roads are critical for connecting people to the highest levels of service or to freeways, and these have always suffered serious and permanent damage from floods.

For example; the R33 in Limpopo has seen a bridge completely washed away, and movement to/from Lephalale was disabled following a flooding incident in 2014 (Environmental Resources Management Southern Africa, 2017). The R31, the road connecting Kimberly and Kuruman, was closed for several months following heavy downpours in January 2017 (Traveller24, 20 January 2017). The M1 in Durban had to be closed following floods in 2019 (News24, 11 November 2019).

1.3 Research questions

Primary research question

How effective is the current policy framework in mitigating the impact of flood disasters affecting South African roads?

Sub-questions

- i. What is the current level of disaster management policy in the South African road sector?
- ii. What effect does current policy implementation context have on flood disaster management?
- iii. What is the correlation between planning and flood disaster management?
- iv. What failures and successes can be drawn from policy frameworks of other sectors or other countries?

1.4 Limitations of the study

The problem as indicated above broadly reflects a number of challenges/problems that might need to be investigated, some of which will not be investigated by this

research. While it is deemed important to assess transport (all modes) disaster management plans, this study will only focus on roads and only on floods as a disaster type in South Africa. Therefore, other types of disasters and road incidents and accidents will not be dealt with in this study. There are other disaster risks affecting the transport sector such as violent protests, hazardous spill, fire, and snowfall, but this and other transport related disaster risks will be the focus of this study. This study will also not investigate the impact, including the severity of flood disaster risks on transport sector, as such aspect is equally important and may require a dedicated focus. Transport sector has many branches; from which much subject matter can be drawn in relation to (flood) disaster risks affecting mobility and access in the socioeconomic front, the dynamics in each branch or mode may require dedicated focus.

This study will be limited to assessing and reviewing road disaster management related plans and policies in the municipal (metropolitan), provincial and national sphere of the South African government and its agencies. Whilst the flood-related road infrastructure challenges at metropolitan level will be highlighted in relation to national/provincial and municipal planning, analysis of plans will exclude local municipalities due to the number of such municipalities, and hence the number of plans to be assessed.

1.5 The assumptions

The road sector in South Africa has and implements a road disaster management planning framework to prevent, reduce and manage the risk and impact of floods on the road network and transport services. When efficiently implemented, a sound planning framework enables the different authorities to manage disaster risk effectively.

1.6 The importance of the study

South Africa depends largely on the road network. Such dependence extends to regional connectivity, as shown in figure 1. The occurrence of disasters impacts negatively on economic, communication and transportation (passengers and freight) channels and activities. This study will pave the way for the improvement of the road disaster management framework, and hence intends to curb the eventualities resulting from flood incidents.

By providing guidelines for a sound road disaster management planning framework, this study will enable the road sector to ultimately develop measures to ensure continual access to economic activities during disaster eventualities, minimize societal impacts by guiding and enabling processes of evacuation, relief during periods of disaster, and ensuring continual/alternative access, and guiding the provision of funding for response interventions, and infrastructure reconstruction and rehabilitation.

1.7 Aim and objectives of the research

Aim

The study seeks to assess the road disaster management planning framework, and the effectiveness thereof in mitigating the impact of floods in South Africa.

Objectives

- i. To obtain the National Disaster Management Framework from the National Disaster Center and road transport disaster policies and plans from other countries;
- ii. To gather from road authorities (metropolitan, provincial and national) their current road disaster plans/strategies or policies relating to flood risk management; and

- iii. To assess the level and efficiency of the policy framework for disaster management in the road transport sector.

1.8 Review of related literature

The literature reviewed for this study will be natural disasters, particularly floods and their impact on socio-economic activities, as well as the role of planning and policy development in disaster management. The viability of the study will be determined through reviewing academic and related material on the role of planning in disaster preparedness.

Natural disasters

Natural disasters are generally triggered by physical properties and processes; the challenge is to reduce disaster risk vulnerability from different disaster types (Alexander, 2006). Disasters, especially natural disasters, cannot cease to occur, are very prevalent, with incidents causing relatively largescale damage recorded about every two years, dating back to the greatest flood incident in the country in 1958 to the most recent incident in 2019 (Department of Environmental Affairs, 2016; IFRC, 2014).

While understanding that the incidence of disasters is unavoidable, countries should focus on reducing the impact of disasters, protecting vulnerable communities and infrastructure, through disaster preparedness and responses (UNISDR, 2011).

Disasters and transport

Kumar (2009) from the Indian Institute of Technology presents two cases highlighting the relationship between transport and disaster management. In the first case, failure of the transport system results in disaster, as during disaster eventualities transport is required for evacuations, delivery of emergency supplies, and search and rescue operations (Kumar, 2009). In the second case, the occurrence of natural disasters causes' failure or damage to transit systems, due to submerging of transport

infrastructure or transit facilities and costly transport infrastructure damages with bridges or section/s of highways washed away (Kumar, 2009). Denoting transport as an important role player in each phase of disaster management, namely pre-, during, and post-disaster, Kumar (2009: 174) argues that:

“Better existing networks in terms of road, rail, water, air and life line structures such as bridges, telecom network, pipelines, etc. promote better rescue, relief, recovery process, relocation, rehabilitation, and reconstruction.”

Some of the common disaster types affecting roads and transportation are earthquakes and floods. These can make road infrastructure prone to landslides, sediment peaks, can cause roads to become slippery, and embankment scouring. The occurrence of these disasters may result in the closure of roads for several days affecting transport services and impacting the mobility of passengers, goods and services. In some instances, floods, earthquakes and typhoons cause significant damage to properties, bridges and roads when these are washed away, requiring funds for repair or replacement (ADPC, 2006).

The impact of floods (including the South African context)

Different countries across the globe continue to experience unusual weather patterns resulting in catastrophic flood incidents, evidently in countries such as Switzerland and South Africa in the mid- and late 2000s respectively. In both these incidents, as in many others, which resulted from mesosphere dynamics, human lives were lost and properties damaged (IFRC, 2011; Stucki *et al.*, 2008).

Flooding causes extensive disruption to people's lives, by causing damage to livelihoods and critical infrastructure such as roads and bridges (Pregmolato *et al.*, 2017), and this frequently occurs in South Africa as well. With about 100 000 people estimated to have been living on flood plains in 2014, South Africa also faces the challenge of failing infrastructure such as bridges and dams, including poor housing of a lack thereof, and this poses a risk to people's lives and property (Kundu *et al.*, 2014). Incidences of flooding cause havoc in municipalities, provinces, and the

country, as floods disable movement, thereby impacting negatively on the socioeconomic front (The Citizen, 10 December 2019). The aftermath of floods has often left the country struggling to restore, repair or replace the damage to the road infrastructure (Ahadzie and Proverbs, 2011).

Planning and disaster management

Disaster management is often inadequately incorporated into planning, with countries merely responding to incidents rather than putting efforts into planning for the prevention, reduction, response, recovery, reconstruction and rehabilitation actions related to incidences of disaster and the impact thereof (Kassenga *et al.*, 2009). Many governments are integrating disaster risk reduction into their planning processes, but more often than not the inclusion is neither compulsory nor enforceable (UNISDR, 2011).

The effect of spatial planning and land use management in disaster risk reduction is notable, and disaster risk reduction measures in environmental planning and management should also get the necessary attention (UNISDR, 2011). Apartheid spatial patterns in South Africa have led to increased densities in some urban areas, while uncontrolled informal settlements in the post-apartheid era also produce urban densities in which floods and other hazards cannot be easily managed. Spatial planning and land-use management frameworks seek to correct historical imbalances while promoting spatial planning and land use management as a means to ensure that communities are resilient in the face of any economic or environmental shock (Van Niekerk *et al.*, 2018; Republic of South Africa, 2013).

Aimed at making the world safe from natural disasters and building resilience in nations and communities, UNISDR developed Hyogo Framework for Action (HFA) Plan outlines five priorities, which include guiding principles, namely:

- 1) Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation;
- 2) Identify, assess, and monitor disaster risk and enhance early warning;

- 3) Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
 - 4) Reduce the underlying risk factors; and
 - 5) Strengthen disaster preparedness for effective response at all levels
- (UNISDR, 2011:14).

Urban planning is one of the tools for disaster risk reduction, and therefore effective urban planning may reduce the vulnerability of urban dwellers to disasters such as floods (Benson and Clay, 2004; Malele, 2009). Disaster response should be integrated into planning at all spheres (local, district and national). Transport plans are an expression of the total transport network, its development and operations, ensuring socio-economic access including in the event of a disaster. The inability or failure of transport systems to deal with incidences of disaster is a symptom of planning deficiencies (Kumar, 2009).

Some of the goals or objectives of plans or strategies may not be achieved, due to implementation deficiencies, among other things. Planning evaluation should therefore be done to understand planning failures or shortcomings, and also successes and lessons learnt. Planning is not static but demands continued risk and need assessment. It is a critical element of disaster preparedness and an important phase in the disaster management process, influencing the impact of a disaster on a community (Furin, 2016).

In the context of road transport services and infrastructure, disaster response is part of the responsibility of all levels of road authorities. The sector therefore must develop a wide range of mechanisms and tactics to prepare for possible disasters and resultant stresses on the road transport network and systems. From design to operation, road transport systems should have measures in place to mitigate the impact of natural disasters such as earthquakes and floods, among others (Kumar, 2009). The Asian state of the Philippines for example, development is underpinned by massive investment in highways and bridges, has approached safer roads development by mainstreaming disaster risk management into the planning of new road projects (ADPC, 2008).

As part of the Hyogo Framework for Action, the UNISDR postulates that, among other things it is essential for reducing the risk of disasters that community-based risk reduction initiatives are linked to a wider risk reduction system. Decentralized processes are a further key success factor to strengthen and sustain disaster risk reduction activities at the local level. These were reported mostly in high income countries (UNISDR, 2011).

To mitigate the impact on and vulnerability of their communities to disasters, states such as Queensland, Australia, developed guidelines that include a guide to flooding and roads. The guidelines ensure that when disasters strike, people are able to follow the guidelines and escape from disaster, and not to be left in the lurch (Queensland Government, 2012).

Until 2008, in the South African flood research context, there had been limited research integrating hazards and a vulnerability model with flood risk analysis; also, minimal emphasis had been put on “community-based approaches flood risk reduction” (Benjamin, 2008:91). Notable research was undertaken in South Africa by Tempelhoff *et al.* (2009) who focused their study on December 2004 to January 2005 floods in the Garden Route on the impact of the floods on local development and economic activities, tourism products and local institutions. Tempelhoff *et al.* (2009) evaluated existing disaster risk management strategies against the impact of floods in order to determine what could have been done better to mitigate the impact of the floods.

In summary, flooding incidents did not have a significant impact on tourism but local authority disaster preparedness and disaster risk management was a cause for concern (Tempelhoff *et al.*, 2009). Findings of the study highlight the importance of institutional arrangements in disaster management; this informs the current study, which will also assess the role played by road authorities in road disaster management.

1.9 Research methods

The study is an evaluation research in which planning and policy guiding the road transport disaster risk management will be evaluated. Qualitative research methodology will be utilised in this study. Qualitative research method takes a naturalistic inquiry approach to pursue in-depth understanding of social phenomenon, and generally involves non-numerical data for analysis (Patton and Cochran, 2002:2). Qualitative research methods are essential for contemporary planning and focus on the discovery of social meaning and research informing development processes (Silverman, 2011). Data collection and data analysis will be done through qualitative methods, the advantage of which is the application of a relatively universal approach to data collection and techniques for data analysis (Silverman, 2011).

Road authorities and the national disaster centre will be approached for documents and reports for gathering disaster management plans/policy documents from three categories of sources, namely, national, provincial and metropolitan road transport authorities, national disaster management institutions, and international institutions (transport/roads and disaster management authorities). The disaster management frameworks obtained from disaster centres will inform the criteria used for evaluation, while the policy and planning documents from other countries will assist with sector benchmarking, addressing aspects of feasibility and appropriateness. Gathered data will be organized, analysed and presented in terms of evaluation techniques and instruments to be discussed in the sections on the different aspects and stages of the research below.

Criteria governing the admissibility of the data

As outlined above, the data will consist of existing policies and planning frameworks from road authorities at municipal (metropolitan), provincial and national level, including their implementing agencies, if applicable. No plans or policies from outside of these institutions will be analysed or processed in the evaluation of the sector's

performance in terms of flood risk management, in order to independently determine the merits and demerits of the sector's policy/planning framework.

The national disaster management policy guidelines will guide sector requirements and responsibilities in relation to disaster risk preparedness and management. In addition, policies and plans from other countries will be referenced in the appraisal of existing plans/policy relating to flood risk management.

Data location

The location of the above sets of required data are, in sequence:

- i. The National Disaster Management Framework – National and Provincial Disaster Management Centres
- ii. International road transport disaster management policies/plans – Internet
- iii. Road Transport Disaster Management Policy/Planning Framework – National Department of Transport including SANRAL, the nine provincial roads authorities including their agencies, the eight metropolitan road authorities including their road agencies, where applicable.

The National Disaster Management Framework that will be acquired from national and provincial Disaster Management Centres and international road transport disaster management policy/plans acquired from the Internet are acquired with the purpose of generating an evaluation instrument. The above set of data will support the evaluation of disaster management planning for the road sector, focusing on floods, as per the purpose of the study.

Data collection

This research study will only make use of secondary data, from planning and policy documents of both road authorities and disaster centres, gathered through internet/emails. Documents to be requested and used for this study are available for public use, and the requests from disaster centre/s and road authorities including their agencies, will be undertaken to ensure that all relevant documents are

acquired. An Internet search will further assist in acquiring road transport disaster plans from other countries.

The National Disaster Management Framework will be used to set the criteria for the evaluation framework, in terms of compliance, quality and effectiveness of the sector plan. Road transport disaster management plans from other countries will be used to develop a framework for evaluation in terms of sector relevance, appropriateness and sustainability.

Data analysis

Analysis of the evaluation data will be based on existing documents, determined previously as the national disaster management planning/policy framework and road transport disaster plans from other countries. Utilising policy evaluation criteria such as effectiveness, efficiency, adequacy, pareto-optimality, sustainability, relevance and appropriateness (Peel and Lloyd, 2015; The Policy and Operations Evaluation Department, 2006), data analysis of the evaluation will be construed in terms of content, structure, enforceability, resources, financial implications, and feasibility. Key and additional to this aspect of the framework are the institutional arrangements, also entailing the relationship of the sector with other key stakeholders and role players.

Below is an example of this aspect of policy evaluation:

- a) Structure of the document – simplicity, taking into account the nature of the business
- b) Content – whether the policy/plan covers everything (but not anything)
- c) Legislative mandate – enforcement/enforceability
- d) Financial arrangements – whether all activities are budgeted for
- e) Resource allocation – key to ensuring success
- f) Feasibility – whether the plan can be implemented and easily executed
- g) Institutional arrangements – relations within the sector and with other stakeholders

The above aspects of the plan will be given values (weighted) in order to determine the merits and demerits (deficiencies) of the sector planning framework. On each score, aspects or features of the plan will further analysed for appraisal in order to clearly present the comprehensive results of evaluation.

Content analysis of the planning and related documents on road transport disaster management will take place by way of a written-up presentation. The presentation will look primarily at how transport/road authorities plan and execute their plans in order to respond to floods or do flood risk management. An impression of the road transport planning framework against national and international guidelines will also be presented.

1.10 Ethical considerations

Given the nature of this study project, there are certain ethical considerations that need to be taken heed of. “Most of us, as limited as our power and influence might be, probably have the greatest chance of affecting the ethical decisions of our organizations by working for change from within, by raising ethical issues in our own analyses, and by encouraging our colleagues to do likewise” (Patton, *et al.*, 2016:39).

The proximity of the incumbent researcher to the policy framework to be analysed is considered. Cognisant of said proximity, the intention is declared to positively drive change from within without harming the image of the organization/s in question. While the policy context is within the analyst’s field of current practice, a measure of independence is assured by his non-involvement in the formulation of the policy. The study does not aim to bring about damaging or negative attention to policy gaps or inefficiencies, cause public distress or defile any institution. The outcome of the study will be researched alternatives or guiding principles aimed at recommendations for policy improvement and development (Patton *et al.*, 2016).

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This study looks into road transport policy and planning frameworks and the extent to which they enable or effect disaster risk reduction, within the South African context. Transport systems and transport services are central to disaster risk reduction, and yet there is a notable dearth of studies linking transport and disaster risk reduction (Chakwizira, 2019). This chapter explores this limitation in relation to policy and planning. Key issues are identified and examined in this section.

Issues highlighted in this chapter include transportation, the impact of disasters and particularly floods, land-use planning as a variable of disaster risk reduction, the regulative role played by the government sector responsible for road transport including the current approach to planning and implementation, and the legislative and policy context. Linkages between the identified issues will be drawn to reflect on the relationship between them. Reflection on the identified issues will also incorporate the five pillars of disaster risk reduction, namely prevention, mitigation, preparedness, response and recovery (GFDRR, 2017). The key issues are developed in order to evaluate how the policy framework of the department of transport addresses the identified disaster risk management pillars.

Transport is the movement of goods and services from one place to the other, and road transport is one of the most important modes of transport critical for sustainable economic development (Rodrique, 2020). Road networks play critical role in economic growth, but the occurrences of disaster across the globe continue to disrupt transport services and cause damage to roads (Matherly *et al.*, 2013). Disasters are natural phenomena but human activities increase the frequency and intensity of disasters (Rodrique, 2020). Among the different types of disasters, floods are the most prevalent and frequently occurring natural disasters, and also significantly affect the achievement of the UN Sustainable Development Goals (Yang and Liu, 2020). Flood disasters impact on transport systems and in particular on road

transport as a dominant mode in many countries across the globe (Rodrique, 2020). Countries put measures in place to deal with disasters, in the form of guidelines and policies to reduce disaster risk (Matherly *et al.*, 2013). According to the United Nations International Strategy for Disaster Reduction (UNISDR) (2012), Disaster Risk Reduction (DRR) is defined as:

“The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events” (UNISDR, 2012: 3).

To achieve disaster risk reduction as defined above, disaster risk reduction plans should be developed. A disaster risk reduction plan is a document developed by an organisation or a sector, which sets goals and objectives, with related actions, to reduce disaster risk (UNISDR, 2009). Plans and policies are an integral part of a sector or organisation’s disaster management system.

2.2 Transport

The transport system is often described as the lifeblood of modern society, and a smarter utilization of the transport system is important from the perspective of economic, environmental, and social sustainability (Engström, 2016). With the increasing reliance on transport distribution systems, any failure of transportation, due to intentional or non-intentional causes, can have very disruptive consequences on human lives and economic and environmental sustainability (Rodrique, 2020). Transport infrastructure and economic development are closely related (Rodrique, 2020).

Road transport is an essential part of the transport system, and the development of a road transport network plays an important role in economic development (Aldagheiri, 2009; Engström, 2016). Roads are also regarded as a lifeline for development and especially for people in rural areas, playing a critical role in poverty reduction (ADPC,

2014). The function of road infrastructure and road transport is logistic utility, ensuring that commodities are available where and when they are demanded by the consumers. Roads constitute a fundamental part of this system for both passenger and freight transport (Engström, 2016). Transport infrastructure is critical to society and any disruption to one of its components may have a significant impact on the economic and social well-being of a community, region or nation (Rodrique, 2020). Infrastructure is deemed critical on a national level when destruction or disablement due to exposure to risk factors result in danger to or disruption of the political and economic functioning of the state or poses a threat to the life and health of the inhabitants (Luskova *et al.*, 2018).

2.3 Natural disasters

A natural disaster is the occurrence of an extreme hazardous event resulting from natural processes, and impacts on communities causing damage, disruption and casualties, often overwhelming local capacity to cope with it and necessitating external assistance from national or international level (Petrucci, 2012). Examples of natural hazards are tsunamis, earthquakes, landslides, windstorms, floods or droughts. Tropical storms and droughts causing flooding and water scarcity respectively are the most destructive natural events (Askew, 1997). Flooding is the predominant cause of weather related disruption to the transport sector, particularly road networks, in urban areas where water infiltration into the soil is minimal due to low permeability and overwhelmed or blocked drainage capacity (Pregnoiato *et al.*, 2017).

Globally, flooding is the most prevalent and frequently occurring natural disaster type (Svetlana, Radovan and Jan, 2015). Floods are caused by various meteorological events including tropical cyclones, occur when the earth cannot absorb all the rain that falls, and excess water flows over the land (Grobler, 2001). Gupta (2009) defines a flood disaster as an excess of water above the threshold of the carrying capacity in an area, for a prolonged period that inundates the area and causes damage to property, the environment and people.

According to Askew (1997), floods cause about one third of all deaths, one-third of all injuries and one third of all damages from natural disasters worldwide. Gupta (2009), however, argues that flooding causes over one-third of the total estimated costs and is responsible for two thirds of people affected by natural disasters worldwide. Over 90% of people affected by natural disasters live in the most populous Asian countries, such as India, which are prone to recurrent flooding (Gupta, 2009). In Vietnam about 42% of businesses in the city of Can Tho were affected by seasonal flooding from 2011–2014 (GFDRR, 2017).

Floods are also the most frequently occurring natural disaster event in South Africa followed by droughts and fires (Van Niekerk et al., 2018). Floods are a commonly occurring natural disaster in Africa and South Africa, averaging about 35% of natural disasters between 2000 and 2016 (Cilliers, 2017). The largest natural disaster losses in South Africa are caused by flooding (Grobler, 2001). In a period of 10 years since 2011, South Africa experienced floods incidences every year in at least more than one province, frequently higher than any other natural disaster risk type (FloodList, 2021). Recently Tropical Storm Eloise which affected 8 provinces of South Africa and extended to Mozambique, Malawi, Mozambique, Swaziland and Zimbabwe caused damages to an estimated cost of \$10 million (FloodList, 2021). Flood disasters are expected to increase in frequency and are exacerbated by existing land control processes such as lack of regulations enforcement, delays in permit approval, and inadequate monitoring (Tasantab, 2019).

2.4 Transport and natural disasters

For the transport sector, natural disasters have negative impacts on transport infrastructure, including road and railway networks, aviation and maritime infrastructure and also on information and communications networks (GFDRR, 2017). Transport services get disrupted in the event of disasters such as floods, resulting in a worst case scenario of collapsed of bridges and unusable roads requiring much relief and costly restoration (*ibid.*). The increased scale and capacity resulting from the expansion of the transport industry worldwide also leads to increased disaster vulnerability of transport networks (Rodrique, 2020). Disaster

disturbs the basic functions of the transport system, disabling mobility of people and transfer of goods by breaking the resilience of critical infrastructure (Luskova, 2018).

Flooding impacts transportation systems directly by causing physical damage to transport infrastructure and indirectly by causing disruption to traffic flow, business, and community services (Pregnoiato *et al.*, 2017). Studies have shown that, during flooding, roads are among the first causes of death, and disruptions in transport systems are detrimental to society, costing an estimated £100 000 per hour for each main road affected in UK cities (Pregnoiato *et al.*, 2017:68). The number of flooding incidents continues to increase in many countries due to global warming and rapidly changing land use patterns (ADPC, 2014). From least developed to economically advanced, countries continue to experience unprecedented levels of flooding causing serious damage to infrastructure and stalling mobility and access to social amenities and economic activities (United Nations, 2002; ADPC, 2014).

Countries experiencing regular flood events, such as Bhutan, face many challenges as a result of flood related road damage, while relying heavily on roads as a mode of transport for development (ADPC, 2014). In Peru, El Niño-related flooding destroyed 4,793 km (nearly 18%) of the country's roads and 46% (12,064 km) of roads was damaged in the first seven months of 2017 alone (GFDRR, 2017). Chakwizira (2019) analysed the impact of climate change on rural transport in South Africa, finding that climate change leads to roads and paths being flooded more frequently and communities being cut from basic service centres or facing increased travel times. South Africa's road network faces major challenges of aging road infrastructure and massive maintenance backlogs, and the occurrence of floods exacerbates the state of road network collapse (IFRC, 2012).

2.4.1 The transport disaster risk reduction context

Transport systems are critical in the disaster risk management context; in emergencies transport helps to connect pivotal services in order to reduce loss of life and damage to property (GFDRR, 2017). Disaster responses require significant

logistical deployment in order to provide relief to victims and to transport equipment and humanitarian goods (Berkoune *et al.*, 2012). Transport provides the crucial mobility that is required for emergency services to protect people and property (UNISDR, 2009). Transport systems also face challenges in emergency situations. Berkoune *et al.* (2012) propose a formal definition and a mathematical model for the Transportation Problem in Disaster Response Operations (TP-DRO). Berkoune *et al.* (2012) further propose three approaches to finding solutions for transport related challenges encountered during emergencies; firstly using the classic branch-and-bound procedure of the commercial solver, secondly a fast construction heuristic to generate a set of feasible solutions, and thirdly a genetic algorithm approach, which advances high-quality transportation plans for emergency managers.

For the Louis Berger Group, Inc. (2013) successful transport operations during emergencies require multijurisdictional cooperation. The group identified eight principles that advance cooperation of multijurisdictional transport planning role players for disasters and emergencies. According to the eight identified principles, for planning to be effective planning, it must be cooperative, comprehensive, coordinated, informative, exercised, flexible, inclusive, and also continuous (Louis Berger Group Inc., 2013). Transport authorities and stakeholders need to apply these principles when planning for disaster management scenarios in order to reduce the impact of disasters (Louis Berger Group Inc., 2013).

Transport operations for emergency response and disaster risk reduction activities rely on resilient infrastructure. In terms of The Sendai Framework for Disaster Risk Reduction 2015-2030 adopted at the Third UN World Conference in Sendai, Japan, on March 18, 2015; resilience of critical infrastructure such as transportation is key to ensuring its operation, effectiveness and safety during and after disasters in order to provide life-saving and essential services (United Nations, 2015). Mitigation, preparation, response, and recovery in the context of the transport system can be achieved by adopting guidelines that integrate principles shared between transport planning and emergency planning processes (Louis Berger Group, Inc., 2013). Transport authorities should develop programmes to manage existing infrastructure

and facilities through asset management plans and maintenance should integrate resilience in the face of extreme conditions in the design of such infrastructure and should allocate resources for disaster emergencies (GFDRR, 2017). Bikam (2019) in his work in the Vhembe District, in South Africa, recommends strengthening of the road maintenance regulations and governance framework linked to adequate budget allocation and software investment, in order to solve road maintenance challenges.

The United States based Louis Berger Group, Inc. undertook a study in 2013 to determine transportation's role in regional planning, coordination, and operations across all modes for disasters, emergencies, and significant events. The findings of the Louis Berger Group, Inc. (2013) generally show some level of transport planning undertaken with notable funding and prioritisation of emergencies across regions and communities, even though gaps, including levels of emergency planning and prioritisation being very low, were identified. The survey undertaken under the Louis Berger Group, Inc. found transport planning to be undertaken for all modes of transport, but the level of planning decreased across all modes when it came to emergency or disaster transport related planning (Louis Berger Group Inc., 2013).

Transport emergency planning, even in countries with adequate disaster management systems, faces limitations in terms of resources and funding, communication, and institutional alignment and cooperation (Louis Berger Group Inc., 2013). To deal with the identified limitations, the Louis Berger Group, Inc. (2013) recommends an all-hazards approach to regional transportation planning. Muyambo, *et al.* (2017) in their social vulnerability drought risk reduction study of the O.R. Tambo District in the Eastern Cape of South Africa identified limited government involvement as one of several challenges, and recommend the development of policy on drought risk reduction and mitigation in all three spheres of government. As a stakeholder in national disaster management, the national Department of Transport is expected to contribute organisational standardisation of practises (SOP's), protocols and equipment to be used by relevant stakeholders in disaster risk management (Stikova, 2016). Policy development and planning for transport emergencies are critical and require coordination of different stakeholders

and spheres of governance, mobilisation of resources and funding to be undertaken towards the development of all-hazard transport planning (Louis Berger Group Inc., 2013; Muyambo *et al.*, 2017).

2.5 Policy and planning

A policy sets up an agenda and outlines a plan of action to solve identified/forecasted challenges or problems (Signe, 2017). Planning is a rational and systematic process of guiding public and private actions to achieve the goals and objectives; it influences the future by identifying and analysing alternatives and outcomes (Ran and Nedovic-Budic, 2016). Public policy is a broad framework derived from practice, values and ideas providing guidelines for government decision-making processes, for action or inaction towards a public problem or issue (Mackay, 2011). Government policy guides “action and it connotes a broader framework to operationalise a philosophy, principle, vision or decision, mandate etc. which are translated into various programs, projects and actions” (Khan, 2016: 3).

The success of a public policy is dependent on factors such as implementation, and policy review is important to improve or attain a good policy (Khan, 2016). Good policy is characterised by consistency and coherence with related laws, openness and transparency, is time based and self-regulative, and is implementable (Khan, 2016). Public policy implementation and review, and policy consistency with legislation is discussed below. Spatial planning coordinates and improves the impacts of other sectoral policies on land use, and the integration with flood risk management will also be highlighted. Flood disaster risk affects the road sector immensely and disaster management planning is one of the key policy instruments for enabling disaster emergency response and restoration (United Nations, 2002). A good policy context that allows early warnings and preparedness for road transport disaster eventualities may reduce the impact of floods in terms of loss of life, access and mobility, and damage to road infrastructure.

2.5.1 Public policy implementation

Public policy analysis is often done on the basis of content, including the formulation process, implementation and evaluation, the values of policy-makers, the environment of the policy-making system, and the cost of policy alternatives (Maluleke, 2010). Policy implementation is the actioned pursuance of policy objectives in order to solve the identified problem. Factors affecting policy implementation include tractability and the ability of the statute to structure implementation, denoting that policy implementation success is dependent on the definition of the problem and on legislation (Chipangura *et al.*, 2019). Focussing on policy implementation challenges, Khan (2016) divides the performance of policy implementation into three categories based on the ultimate outcome of the policy, the impact of the policy, and the level of impact on socio-economic development. The success of a policy is not only dependent on a well-designed policy but also on the implementation thereof (Khan, 2016).

To overcome the notable challenges to public policy implementation, a myriad of policy attributes are key, both in relation to policy development and to policy implementation (Khan, 2016). In relation to policy development, consideration should be given to theoretical validity, policy legitimisation, regulation, clear goals and objectives, and resource allocation and mobilisation (Khan, 2016). On the implementation side, there should be consideration of organisational alignment, capacity, empowerment, roles and responsibility, monitoring, involvement and engagement, active leadership, overcoming complexities, and the implementation context (Khan, 2016). The above policy development and implementation principles can be applied to road disaster and flood risk management policy.

2.5.2 Public policy challenges and review

Policy reviews reflect on the applicability of a policy over time in the face of changing contextual variables; public policies and their processes can be revisited and revised to conform to a changed policy implementation context (Van Niekerk, 2014). A study conducted by Signe (2017) attempts to address policy failures by analysing the initial

or intended policy goals and the ultimate achieved goals. A policy can be formulated following an informed approach and with guiding principles to ensure progress but can fail notwithstanding this, hence periodic review should form part of the policy lifecycle. The review may clearly identify some challenges, while other challenges may need a thorough investigation.

Policy implementation may also fail due to policy challenges such as goal ambiguity, lack of funding and resources, poor leadership and institutional misalignment, conflict, and a lack of political will (Signe, 2017). Signe (2017) argues that resource allocation, clarification of policy goal/s, improved stakeholder management, and a relatively positive political environment may contribute to successful policy implementation. Policy review in this context becomes an attempt to achieve alignment between the policy goals and the policy environment.

Van Niekerk (2014) does an analysis of the South African Disaster Management Act and Policy Framework through a qualitative study. The results from this study identify as challenges to current national legislation a lack of clear roles and responsibilities for the local municipality tier of government, a lack of commitment by other sector departments, inadequate funding and insufficient disaster risk reduction knowledge and capacity. These findings illustrate the challenges of the current framework in relation to the critical pillars of disaster risk management as identified in the Disaster Management Framework of 2005, namely institutional arrangements and capacity building, therefore providing an opportunity for policy review.

2.6 Disaster management and policy

Disaster emergencies require prompt implementation of pre-planned activities, with decision-making central to saving lives and property. According to Berkoune *et al.* (2012) the decision-making process should produce good operational decisions taken in a limited time. In a context where contingency plans and standard operating procedures are in place, the decision-making process, including resource allocation, is guided and responsive to saving communities from disaster eventualities (Rono-Bett, 2018). Decision-making in disaster management is also, in some instances,

reliant on or influenced by factors such as political will (Rono-Bett, 2018). Disasters can result in long-term societal impacts and therefore disaster risk reduction is critical to minimise these impacts and also to achieve the UN Sustainable Development Goals (SDGs). Nevertheless, there are gaps and uncertainties with regard to appropriate frameworks for integrating implementation and decision-making in disaster risk management frameworks (Volenzo and Odiyo, 2019).

Rono-Bett (2018) analysed Kenya's disaster response decision-making process, which was found to be reliant on what he termed "political economy" due to the country's weak disaster preparedness and coordination. The term political economy implies that decisions depend on the availability and processing of information, institutional arrangements, existing legal and governance frameworks, and financial resources available and allocated. Kenya's disaster management experience stresses the importance of a disaster management legal framework for government to develop disaster preparedness and also to guide the decision-making process in the event of an emergency (Rono-Bett, 2018).

Natural disasters are not only caused by the acts of nature, but also by the types of decisions taken when building roads and towns (ADPC, 2014). It is therefore important that the process of development planning and policy making is designed to promote risk profiling and impact analysis and to provide guidelines to reduce disaster risk (ADPC, 2014). Coordination, hazard analysis, improvement of early warning systems, and evacuation are proposed policy responses to improve disaster preparedness and responses; furthermore, the way in which a disaster risk problem is framed plays an important role in how policy implementation unfolds (Chipangura *et al.*, 2019).

2.6.1 Spatial planning and disaster risk reduction

Spatial planning is increasingly regarded as an important instrument for disaster risk reduction through regulating the function and use of space (Sutanta *et al.*, 2010). Spatial planning is essential for disaster management and to minimise the effect of floods such as damage to property and loss of life and should be integrated in the

first phase of the disaster management cycle to effect flood disaster management (Cilliers, 2017). Land use planning is expected to play a major role in flood risk mitigation and reduction and countries are expected to approach land-use planning with this in mind. Ghana faces the challenge of a failing planning system unable to effectively control physical development leading to the recurrence of flooding in major cities such as Accra and Kumasi (Tasantab, 2019).

Cilliers (2017) investigated the relationship between incidences of flooding and the effect of spatial planning, and the study reveals the benefit of spatial planning in ensuring the minimisation of the risk of flood disaster damage to property and loss of life. Minimising the occupation of flood-prone areas for residential purposes can be achieved through land-use planning and assessment of climatic conditions and environmental suitability (Cilliers, 2017). Through spatial planning, planners and authorities should be able to minimise a community's exposure to flood disaster risk, by avoiding the location of activities or residences in flood-prone areas, except for unexpected or unpredicted natural occurrences as defined by the term disaster (Malele, 2009; Cilliers, 2017). Spatial planning should guide policy development in order to minimise disaster risk, and governments should use the tools available in their policy context to minimise community exposure to disaster. Spatial planning has in recent years featured in several studies as a valuable tool in disaster risk reduction particularly when it comes to flooding. Proactive and preventative general planning is featured in legislative frameworks for disaster management to protect socio-economic development, communities and their infrastructure (Cilliers, 2017).

2.6.2 The disaster risk reduction legislative framework

Policies and laws are part of the non-structural or non-physical disaster risk reduction measures derived from knowledge, research, practices or agreements to reduce risks and impacts (UNISDR, 2009). In the South African context, section 41(l)(b) of the Constitution requires all spheres of government to secure the well-being of the citizens, and also sets out a guiding framework for spheres of government to develop and execute disaster management laws. The Disaster Management Act has been promulgated as the primary legislation dealing with disasters in the country (Constitution of the Republic of South Africa, 1996). Van

Niekerk (2014) argues that there are significant discrepancies between the guiding principles in the Disaster Management Act and the realities within government, and therefore proposes the review of the implementation of the Act and Framework.

2.7 Disaster risk reduction planning and the transport system

Planning will improve the effectiveness of the transport system in dealing with disaster emergencies through focusing on the capacity of the infrastructure and services and on-demand management techniques (Louis Berger Group Inc., 2013). After facing several extreme weather events that led to the loss of lives and damage to properties, Vietnam moved to make its road network resilient, noting the process has to start with the planning and design stage (GFDRR, 2017). In Bhutan, the National Disaster Management Act promulgated in 2013 mandates agencies at local to a national level to mainstream DRR into their development plans and also provides the necessary budget for accomplishing this (ADPC, 2014). The process of mainstreaming DRR has already been instituted through the Monsoon Damage Restoration Budget, as a DRR funding policy measure for the Department of Transport to repair the country's roads damaged by floods (ADPC, 2014).

Flood disasters are unexpected and often unpredicted natural phenomena, which often expose countries' or institutions' challenges in relation to preparedness and limited capacity in terms of legislation, plans, resources and funding, and coordination, institutional arrangements (Stikova, 2016). Policy-based preparedness supported by formal institutions, funding and resources is key for government institutions to be able to overcome the impact of disasters; critical socio-economic infrastructure such as transport should be given priority (Stikova, 2016).

Considering the impact of spatial planning on disaster risk reduction studies, Cilliers (2017) reveals the critical role of spatial planning in disaster risk reduction by identifying the residential suitability or unsuitability of an identified area. This study shows that plans and the approach to development can be changed to integrate DRR in order to minimise the potential impact on socio-economic development. Risk

profiling, impact analysis and risk reduction can be achieved through mainstreaming DRR guidelines into development frameworks and plans (Disaster Risk Preparedness Centre, 2014). Disasters impact negatively on road transport and therefore on economic development; mainstreaming of disaster risk reduction into the road sector means reducing the vulnerability of the road network to various hazards (Disaster Risk Preparedness Centre, 2014).

2.7.1 Non-policy disaster risk management challenges

Disaster risk management challenges faced by transport authorities and users cannot be confined to policy or legislation shortcomings or the absence thereof; they also relate to compliance in implementing the policy and its guidelines or standards (Bikam, 2019). Following the development of the first Disaster Risk Reduction and Mitigation Law for Iraq, approved in 2012, poor governance at both national and local authorities was identified as the cause of Iraq's failed implementation of the strategic steps required in terms of the Hyogo Framework for Action 2005–2015 (Al-Shamsi, 2019). As a consequence of poor governance in the transport sector, communities and socio-economic activities are negatively affected by different types of disaster, mainly floods. According to Glavovic (2010) the different spheres of government can achieve effective governance and help to ensure disaster-resilient communities, and reduce loss of life and damage to property, by using land-use planning and management systems.

Transport is fundamental to and forms an integral part of disaster-resilient communities, and the failure of the road transport system due to floods impacts the supply chain of goods and services (United Nations, 2002; Engström, 2016). Flexibility and redundancy are two of the most prominent principles used in the literature when considering the resilience of a system. In the road transport context, redundancy entails the availability of multiple and alternate routing options and information discrimination, and contributes to the transport system's resistance and response to disruption (Vlajic, 2020; Matherly *et al.*, 2013). Flexibility allows a system to adapt to the new situation presented by a disaster by putting measures in place to fast-track recovery such as relaxing stringent legislation or regulations (Vlajic, 2020;

Matherly *et al.*, 2013). Flexibility is also important as disasters such as floods are acts of nature that require a plethora of activities by different sectors in order to achieve enhanced predictability and more effective responses (ADPC, 2014).

Exacerbated by climate change, natural disasters pose a costly hazard to road transport. Solutions for the challenges and implications of disasters for transport may not only be transport related; non-transport solutions may also be found (ADPC, 2014; Chakwizira, 2019). Partnership and collaboration with other role players are required to solve transport challenges caused by natural disasters (Chakwizira, 2019). Disaster prevention and mitigation actions such as developmental advocacy, policy and legislative actions, risk assessments, multi-hazard early-warning systems, public awareness and education and training, are employed by disaster risk management authorities (Volenzo and Odiyo, 2019).

Central to disaster prevention and mitigation is planning towards resilient communities and effective governance to undertake disaster risk reduction (Volenzo and Odiyo, 2019). Planning research is important to contribute evidence-based lessons that can bring about change by guiding policy development, and informing activities for disaster risk reduction (Davoudi, 2006). Planning, resources, capacity, simulations and statutory authority are the five elements of disaster preparedness to be followed by government agencies (Stikova, 2016). A planning approach that embraces continuous adaptation (e.g., necessitated by climate change) is important because the existence of strong environmental and conservation policies and legislation in many countries does not necessarily imply effective implementation and enforcement (Volenzo and Odiyo, 2019).

Stakeholders are central in serving disaster risk management proactive and measures, and therefore their knowledge, perception, support and participation should be reflected in both risk reduction planning, up to a level of policy formulation and implementation (Volenzo and Odiyo, 2019). Risk communication is “integral to risk assessment, risk control, risk monitoring and review [sic] planning frameworks in climate change action and transformation of socio-ecological systems in sustainable development agenda” (Volenzo and Odiyo, 2019:8). Furthermore, in the road sector

past experience shows that risk sensitive measures need to be applied when upgrading existing or building new roads (ADPC, 2014).

2.8 Conclusion

The transport system provides critical facilities that are socially, economically or operationally essential to the functioning of a society both routinely and in emergencies (UNISDR, 2009). Consideration of the role of the department of transport as a government agency in the planning and setting of policy guidelines for disaster management is fundamental. In principle, disaster management requires government and non-governmental agencies to work together, but government agencies such as the department of transport has a legislated responsibility to deal with disasters and that includes the preparation of plans (Louis Berger Group Inc., 2013).

Seeing that the occurrence of natural disasters is inevitable, it is advisable to plan well to reduce the impact or the risk of disaster and even to benefit from the occurrence of disasters. Disaster practitioners and other trained personnel plan carefully to mitigate the impact of and respond to natural disasters including floods in order to protect their communities. Planning well by embracing nature in managing disasters can also be beneficial to communities and resources (McNutt and Leshner, 2013). Spatial planning is a forward planning tool that is valuable for disaster risk management aimed at safeguarding people's lives and livelihoods (Malele, 2009).

The transport portfolio is multimodal and multifaceted, which is critical for building resilience and effective responses to disaster emergencies (Louis Berger Group, Inc. 2013). Sector departments in all spheres of government are negatively affected by incidences of disaster, and in the transport sector the occurrence of floods disables movement, causes irreversible economic loss, and costly infrastructure damage (Ahadzie and Proverbs, 2011).

While different sectors have existing plans and strategies driven by policies and the legislative framework, the level of integration of both climate change and disaster risk management varies. Effective policy processes should draw on reliable knowledge, and this knowledge is generated not just by events but through ongoing processes (Chakwizira, 2019). Policy analysis shapes the evolution of policy in response to changing dynamics of the challenges to be addressed. A core aspect of mitigating transportation disasters is having infrastructure and modes that are able to withstand and recover from natural and anthropogenic hazards; this can be achieved by combining “redundancy and flexibility” (Rodrique, 2020).

The literature above also reveals that there may be solutions that can be implemented to overcome transport challenges posed by climate change and consequently disasters, but some challenges need non-transport solutions (Chakwizira, 2019). Transport disaster management requires partnership and collaboration with private and public institutions, ensuring risk communication between partners in any context. It is also not merely the existence of policies and legislation that enables disaster risk reduction, but also how policies are implemented and their applicability in relation to the disaster risk in question.

2.9 Conceptual Framework

The literature review informed an enrichment of the conceptual framework for the study. It is clear from the review that policy relating to the reduction of flood disaster risk for the road transport system, should consider the following:

- ❖ Transport infrastructure is critical for economic development in the context of which system failure may lead to costly or irreversible consequences;
- ❖ Road transport is a common or the most prevalent mode of transport, the development and operation of which should ensure resilience;
- ❖ Natural disasters events threaten economic development and reverse the gains of economic growth;
- ❖ The occurrence of disasters and particularly floods impacts negatively on road transport systems globally;

- ❖ Disaster risk reduction should be integrated into the planning, development and operation of road infrastructure;
- ❖ Measures should be in place to address the negative impact of floods on road transport systems, and should be integrated into a policy framework; disaster risk reduction should be mainstreamed in the road sector and a redundancy and flexibility model adopted to effect response and recovery;
- ❖ Climate change, land use management and spatial planning are critical policy issues for transport disaster risk reduction;
- ❖ Issues of governance including decision-making and political will, affect policy implementation and disaster risk reduction; and
- ❖ Policy should also provide guidelines on resources, particularly funding of mitigation, response and recovery.

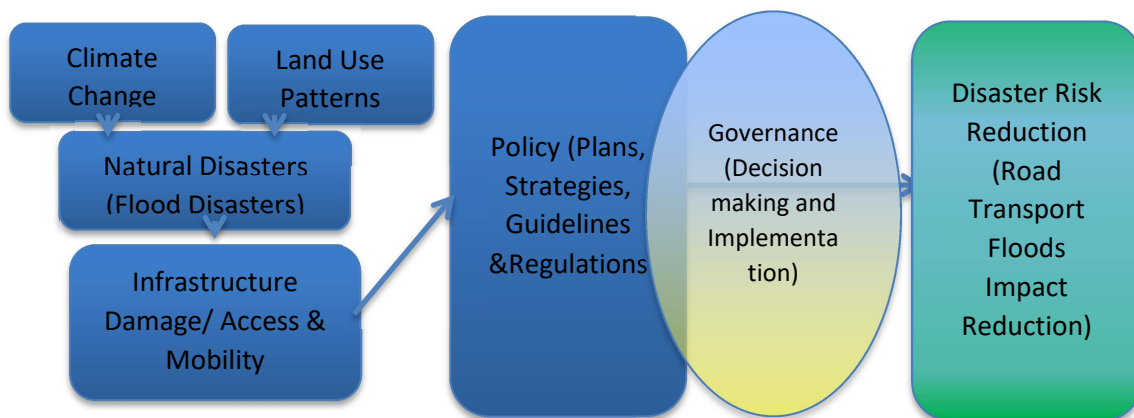


Figure 3: Integration of climate change and disaster risk reduction in road infrastructure planning (By Author)

2.9.1 Conceptual Framework Summary

Here we looked at the literature highlighting the critical role played by transportation systems for service delivery, country's economic development, and humanitarian emergency response. Road transport serves as a crucial link for passenger and freight, and is also regarded as critical infrastructure required in disaster resilience and response (Luskova, 2018). The occurrence of flood disaster undermines the resilience of infrastructure, and disaster preparedness and response is key to maintain and restore socio-economic development. Road transport authorities have the onus to maintain and improve road networks, and that include developing

policies to undertake its responsibilities. A Road transport policy in relation to flood disaster risk management is central in this study.

We also put/defined the conceptual framework which will guide the study forward. The main concepts and ideas in this study are transport infrastructure, road transport, flood disasters, disaster risk reduction, policy, planning and policy evaluation. Other concepts also important in this study are natural disasters, impact of floods, climate change, land use management and spatial planning. Interrelatedness and relationship of these concepts in the conceptual framework is an illustration of what to expect in this study.

CHAPTER 3: RESEARCH METHOD

3.1 Introduction

Research methods “may be understood as all those methods/techniques that are used for conduction of research” (Kothari, 2004:7). Research methods can be classified into three categories, namely a) library research entailing analysis of documents and historical records, b) field research entailing observations and survey, and c) laboratory research (Kothari, 2004). This research follows the library research category, and entails acquiring policy documents and analysing within the context of road transport flood disaster risk management.

This chapter presents the research methods used to answer the research questions of this study, namely: “The impact of planning in mitigating the effect of floods on road transportation”. The author draws data from literature sources and policy documents, and this chapter therefore details the process followed to collect and analyse data and also highlights the limitations of the process. This study is an example of evaluation research, in which planning and policy guiding road transport disaster risk management will be evaluated. Policy evaluations are important in determining the impact and areas of the policy requiring improvement in order to improve the programme or state of affairs (Rossi, Lipsey and Freeman, 2004). While public policies remain statement of intent with instruments to translate into action. Policy evaluation is a detailed process to measure the extent to which a policy context helps achieve the set goals (Rossi, Lipsey and Freeman, 2004).

South African road transport sector policy relating to flood risk management is the subject of evaluation. Disaster management policies from the national disaster centre and selected other countries were obtained to assess them in terms of quality and efficiency. Additional to disaster management policy documents used to answer the research questions in this study, the literature review provides data sourced from books, journal articles, previous research reports, and various reports and articles. Policy evaluation is a conceptual field of governance that has grown over the years

to fill major gaps in researching issues of policy development and management (Gasper, 2006). Policy evaluation takes the approach of policy process evaluation, outcome evaluation, impact evaluation, and cost-benefit evaluation, with the intention to improve and solve challenges on policy from development to implementation (Gasper, 2006; Rossi, Lipsey and Freeman, 2004). The purpose of public policy evaluations are to improve governmental programmes efficiency through scientific evidence providing alternatives or better approach on programmes and policy implementation (Rossi, Lipsey and Freeman, 2004) The following discussion covers the policy evaluation study, which utilises qualitative research methods, with desktop research as a method of data collection as well as document analysis, as well as the limitations of the study and ethical considerations.

3.2 Qualitative research

Qualitative research is concerned with qualitative phenomena relating to quality or kind, it is exploratory by application, and therefore used, for example, “when we don’t know what to expect, how to define issues, lacking understanding of why and how affected populations are impacted by emergency” (Acaps, 2012:7). The word qualitative implies an emphasis on processes and meanings that are rigorously examined or measured in terms of quality, amount, intensity, or frequency (Goundar, 2012). Qualitative research, also based on empiric investigation, explores information from the perspective of groups and individuals and generates case studies and summaries, often textual observations that portray attitudes, perceptions and intentions (Acaps, 2012).

Acaps (2012:3) argues that, through qualitative methods, researchers can “focus on determining the nature of the impact a disaster upon affected populations, answering the questions of how and why coping strategies have adapted, or failed to adapt, to the changed circumstance”. Considering how to determine a suitable method for “Understanding the impact of disaster on affected population” Acaps (2012) argues that, when conducting qualitative research, the researcher is a data collection instrument, while specific skill sets are required for both qualitative and quantitative

research. According to Goundar (2012) qualitative research places emphasis on the socially constructed nature of reality, the intimate relationship between the researcher and what is been studied, and the constraints that shape the inquiry.

Qualitative methodologies follow social constructionist epistemologies and are designed to uncover deeper meanings in social processes (Van den Broeck, 2015). In the social constructionist epistemology, knowledge is “socially constructed, uncover multiple forms of knowledge and combine the analysis of actors, knowledge systems, values, cultures, institutions” (Van den Broeck, 2015: 135). Qualitative methods do not dwell on description in terms of quantity but go beyond understanding cause and effect (*ibid.*). “Qualitative methodologies are well suited to account for social dimensions and egalitarian goals in plan making” (*ibid.*: 135). Following the standardisation nature of planning “some strands in planning theory, practice and research have given greater consideration” to planning equity and advocacy (*ibid.*: 135). Qualitative planning research strongly relates to practice following planning’s normative bias to practice, an action-orientation and aims for social change (*ibid.*).

“The key contribution of qualitative data is that it provides information about the human aspect of the emergency by acknowledging context to the priority needs of affected populations and with it respecting the core principle of needs based assistance and ownership by affected populations” (Acaps, 2012:8). Qualitative research methods are valuable in identifying and exploring intangible factors such as cultural and religious implications (*ibid.*). Data obtained through qualitative methods is mainly presented in case studies, and also in traditionally quantitative methods such as graphs and tables (*ibid.*:3). Qualitative data collection provides the researcher with rich and detailed information, a collection process carried out on limited resources, a process requiring a limited number of respondents, the inclusion of diverse representation, and in-depth analysis (*ibid.*).

3.3 Data analysis

Analysis of qualitative data is descriptive, uses inductive reasoning, and involves a systematic and iterative process of data categorization and integration. Qualitative data analysis also describes research findings from the research participants perspective, and but one of its disadvantage it involves developing generalization only from a limited number of specific observations (Acaps, 2012). A challenge in collecting and analysing qualitative data is finding the right balance to identify trends and overarching issues and to present data appropriately (Acaps, 2012). Other challenges include objectively verifying the results of qualitative research, and identifying the appropriate techniques and applications for analysis (Acaps, 2012). The nature of qualitative research brings about ethical questions (Van den Broeck, 2015) and the researcher should devise measures to deal with ethical issues in order to eliminate any potential harm.

The analysis of the acquired data was done by way of content analysis, which is a suitable method for secondary data analysis. The approach was extraction and meaningful interpretation of the five policy attributes identified for the purpose of this study, namely, institutional arrangements, legislative mandate, layout and content, resources and funding, and feasibility. International and national policies on disaster management were analysed in terms of these aspects.

3.4 Desktop research

Desktop research is the examination of existing literature through review methodologies, and involves published reports and databases (Rickinson and May, 2009). Data sources reviewed for information in desktop research include previous studies (Cooperative Innovation Project, 2015). Desktop research supports data collection in four research dimensions, namely knowledge of the cooperative model, community need, social capacity and business capacity (Co-operative Innovation Project, 2015).

In most projects, the desktop research will seek hard statistical data which can be sourced from government, searching by themes such as population, agriculture, and energy. A range of official government sites can be freely accessed and allow free downloads. Desktop or desk based research can be supplemented by data from other sources, as reported by Ng (2015:198) “analysis of the planning context and the interpretivist analysis of the policy maps were complemented with other data sources, such as qualitative interviews with planners and cartographers”. International bodies’ publications, research reports and the general press are key sources for desktop research and include much background material. In the past, researchers relied on the clippings services of libraries and archive agencies but today work is made easier by online search facilities on newspaper sites.

Desktop research generally deals with secondary data already exists or was collected for different purposes by other researchers. Secondary data mostly requires desk or library research and can serve the researcher’s information needs to such an extent that it can be the key to solving the research problem without the researcher undertaking primary data collection. Desktop research is the collection of secondary data from internal sources, syndicated data, macro data, market research reports, the Internet, libraries, industry data, information from government agencies, and published reports. Collecting and processing secondary data through desktop research can be cheaper than the collection of primary data, but a thorough process needs to be followed (Shukla, 2008).

Secondary data or data that can be collected without fieldwork or field surveys has often already undergone at least one layer of assessment since being collected from the primary information source (Acaps, 2012). Published reports and statistics are important sources, gathered through searching libraries and the Internet. Speaking to someone from a particular institution or organization, or carrying out interviews with an expert is a desktop tool, and another method is that of bibliographic review. Data is sourced from journals, newspapers, directories, clippings, reports, government statistics, industry statistics, atlases, dictionaries, technical papers, books, and white papers.

Peel and Lloyd (2015) reference a literature review in relation to policy formulation and desk-based research, which includes reviewing a cross-selection of government documentation and policy guidance. A desktop approach is further followed in “examining a sample of ‘real-world’ development plan policies at different scales based on the topics previously identified by government” (Peel and Lloyd, 2015:430). Desktop research can also play a key role in the application of multiple research methods. For instance, in the context of a three-pronged approach desktop research served to position the case studies within broader socio-economic and political changes and to prepare for interviews and participation research (Van den Broeck, 2015). Similarly in Ng (2015) a three-pronged approach was developed where desktop research was used to trace the origin and evolution of projects against broader socioeconomic and political changes in Hong Kong, followed by interviews and verification of findings through participation.

The United Nations Conference on Trade and Development (UNCTAD) April 2008 Accord identified a need to strengthen service economies in developing countries and economies in transition. Also identified was untapped potential for developing countries to advance the development of service economy sectors and to establish regulatory and institutional frameworks and cooperative mechanisms to strengthen capacity and efficiency. In this context, a Desktop Service Policy Reviews (SPRs) study was used, aimed at assisting to improve regulatory and institutional frameworks in developing countries and economies in transition in response to increased demand for national services assessment. The desktop study provided a “comprehensive overview of the service economy of the country and in-depth analysis of the impacts of the regulatory, institutional and trade reforms undertaken to date”. Following a desktop approach, the SPR study identified and analysed the development and trade-related opportunities and challenges in each of the priority service sectors (UNCTAD 2014:7)

The Internet is one of the new methods of data collection and analysis following the advancement of information and communication technology. The Internet is a useful

source for literature and secondary data. Internet based data collection offers a solution that enables generation of large samples without the funding and logistic challenges related to a number of other research methods. Advantages of Internet-based research are that they allow the extension of scope and pursuit of projects and research questions that could not be pursued through other data collection methods. Challenges with internet data collection include source credibility, and the fact that data collection may not seem as legitimate as data collected in a community centre or a university laboratory.

This research project uses a qualitative desktop research method. The desk-based research in this study involves a literature review, the acquisition of policy documents, and processing data for analysis. Library and internet searches were used to access academic books, journals, policy documents, institutional reports, and newspaper reports. Road transport policy data as the subject of review were acquired through an internet search of road authorities in the three spheres of South African government, namely municipal (focusing on metropolitan municipalities), provincial, and national government. Disaster management policy data from the South African national government and other countries alike were acquired by way of an Internet search, the purpose of which was to compare and determine the level and efficiency of road transport policy. The above data, including data gleaned from the literature review, was merged and analysed in order to answer the research question.

Technology-based desktop research methods provided a viable alternative for doing a research study in the era of the Covid-19 pandemic. In this context, the computer became a critical instrument utilized for Internet search. Data collection for this research report was undertaken through the method of Internet desktop research, and the required secondary data in the form the reviewed literature and policy documents were successfully gathered.

3.5 Document analysis

A central characteristic of all qualitative methods is the importance of context and meaning, and that is inherent in document analysis as one of the qualitative research tools (Roller, 2019). Document analysis, also referred to as content analysis, “consists of analysing the contents of documentary materials such as books, magazines, newspapers and the contents of all other verbal materials which can be either spoken or printed” (Kothari, 2004:110). Content analysis is “the systematic reduction of content analysed with special attention to the context in which it was created, to identify themes and extract meaningful interpretations of the data” (Roller & Lavrakas, 2015 in Roller, 2019). In some literature, both qualitative research and document or content analysis are combined into the concept qualitative content analysis. Qualitative content analysis embraces all appropriate data sources, moving beyond text to include images, video, audio, graphics, and symbols (Roller, 2019). In document analysis, library materials, documents obtained from informants, and other sources will yield a large amount of information (Patton, Sawicki and Clark, 2016). Analysing qualitative data can be undertaken following a relatively unstructured and non-quantitative case-study approach (Patton, Sawicki and Clark, 2016).

Qualitative content analysis research consists of a first phase that is essentially creating or gathering data through codes developed from focus group, observational, media, or other content, while analysis of said gathered or created data forms the second phase (Roller, 2019). In both the gathering and analysis phases of qualitative content analysis, it is critical that there is a clearly defined research objective and that identifying the constructs to measure is uniformly undertaken. Following a qualitative research method, during the analysis phases the researcher matches “the constructs of interest to the study objectives, while remaining open to objective-related data that may fall outside the realm of the presumed constructs” (Roller, 2019, n.d.). Qualitative content analysis research can be used on both primary and secondary data. Primary qualitative content analysis takes place, for example, where a researcher analyses naturally occurring data sources such as news, historical and policy documents. Secondary qualitative content analysis entails analysis of data derived from other qualitative methods, such as focus group discussions (Roller, 2019).

One of the distinctive attributes of qualitative content analysis is that it distances the researcher from the research participants, as the researcher engages only with contents already obtained and stored, such as text from documents, videos and graphics. Distancing the researcher from the participants helps to limit potential bias, even though the researcher, as an instrument creating codes for content to be analysed, has the potential for researcher-as-instrument bias, a shared concern in all qualitative methods (*ibid.*). The nature of the qualitative content analysis approach can help attain some level of trustworthiness, confirmability, dependability, and transferability. The nature, acquisition and processing of data following a content analysis approach can also add credibility, validity, and reliability to the research findings (Roller, 2019).

Policy analysis involves primarily non-personal public documents, for which the content-analysis approach may prove useful. “In policy analysis, content analysis might involve identifying communication networks and preferences” (Patton, Sawicki and Clark, 2016:102), and the analyst would in such a context devise mutually exclusive and exhaustive categories and record the frequency of each occurrence in the documents. To better manage analysis of documents, the researcher needs to record ideas, record references, record names, and have a purpose. While conducting document analysis, the researcher also needs to place the documents in priority order, develop categories, record facts, and set deadlines (Patton, Sawicki and Clark, 2016).

Even having conducted thorough data collection and analysis, the failure to write a quality final document might undermine the integrity of the research findings and the value of the content analysis research approach. The researcher therefore needs to consider quality control in each phase of the research process, in data collection, analysis, reporting and outcomes. During the data collection phases, the scope and the actual data gathering should be credible as this will ensure that the data can be analysed. When conducting data analysis, it is important to ensure quality in the

processing and verification of the data, followed by quality reporting, which is transparent and brings about valuable and useful outcomes (Roller, 2019).

One of the challenges of document or content analysis is that, while documents are important sources of policy information, they also have many limitations similar to other sources such as management records and interview data. Materials placement in documents may be selective or influenced by a personal or institutional viewpoint or orientation on the subject matter; in some instances valuable or relevant information may intentionally or unintentionally not be included. Data must be used with caution, and it is therefore equally important for a document or content analysis researcher to compare documents in order to test one set of data against data from other sources (Patton, *et al.*, 2016).

This report investigates the impact of planning in mitigating the effect of floods on road transportation in South Africa. The research is a policy evaluation study, in particular policy on flood disaster management in the context of road transport. Flood disasters affect road services and infrastructure in the country, the researcher therefore is investigating whether the road transport authorities' policies in SA are suitable for managing flood disasters. The researcher looks at plans, strategies and legislative instruments to determine its suitability. Existing policy documents for road transport disaster management were collected from government and in this instance from road authorities at the level of metropolitan municipalities, the provincial and national government, including road entities. As a content analysis study, policy documents on disaster and flood disaster management were also collected from the National Disaster Management Centre and from other countries for purposes of comparison and of assessing the level of effectiveness of South African policies.

3.6 Limitations of the study

All research has limitations, which are dependent on the methods and facilitation of data collection, analysis, and presentation (Co-operative Innovation Project, 2015; Du Toit, 2015). A major concern for qualitative research and data is validity or

reliability due to the subjective nature of qualitative data, and the difficulty of applying conventional standards of reliability and validity (Goundar, 2012). The narrative and descriptive nature of qualitative methods requires a lengthy period of time for data collection, analysis and interpretation (Goundar, 2012). It is important for a researcher to avoid being overwhelmed by reading all documents in detail by carefully and quickly deciding and selecting relevant and important documents that will contribute to the analysis (Patton *et al.*, 2016).

Unavailability of data may also be limiting to the research project, including instances “where confidentiality concerns restrict the kinds of published data and information sources that are more readily available in larger centres” (Co-operative Innovation Project, 2015: 11). The Co-operative Innovation Project (2015) identifies four potential limitations in the context of data, namely information inaccuracies, potential for bias, representation in relation to needs and capacity, and quality and compilation of information. Use of secondary sources may provide general, vague and inaccurate information, information that is out of date, or published by a source that is not reputable (Du Toit, 2015).

Limitations encountered in this study include availability of data and accessing institutions through email for data collection purposes. Disaster and flood risk policy related data from road authorities was found in bits and pieces from different documents, while some authorities did not have usable information in this context. In cases where data has not been published or was unavailable on the Internet platform and only held by the respective authorities, it was difficult if not impossible to access, due to the uncertainties brought by Covid-19. Some materials, which the preliminary search showed to be in existence and possibly useful to the study, proved not to be retrievable or accessible from the available databases under the covid-19 conditions. However, despite the above challenges, the research design, still enabled reasonable acquisition of data and further processing thereof. This research project was undertaken during the Covid-19 pandemic and, with lockdowns and other restrictions limiting the available forms of data collection, the desktop method was ideal and has been very helpful in the data gathering process.

3.7 Ethical considerations of the study

Ethics refers to rules or principles of conduct held by an organization or group, the consideration of which in a research project is important. As is the case for following professions such as planning, the research process is guided by a code of ethics. To maintain high or strong ethical standards, the researcher should avoid behaviour such as bias towards a certain participant, procedure, or research results. In terms of the research code of ethics, it is expected of a researcher to behave properly throughout the process, ensuring research integrity. Research integrity carries special importance in qualitative research. Qualitative research designs and procedures are potentially more flexible than those for most other kinds of research. Research integrity can be achieved by disclosing the conditions that might influence how a study is conducted; similar to principles applicable to professions such as planning (Yin, 2011).

Planners and analysts are confronted with ethical issues which they have to address and resolve on a daily basis. Researchers may be able to resolve ethical issues on administrative decisions, bureaucratic procedures, and rules of behaviour, but there are more complex ethical issues relating to the moral implications of research methods, decision models, and evaluation of major policy alternatives. Planners and policy analysts therefore need to understand ethics in order to be able to make better choices about conceptual analytic frameworks, alternative actions and policies. Policy analysis researchers need to know how to practice analysis in an ethical manner, including addressing questions such as what is the right, what is good, whose values are to be pursued, whose goals are to be pursued, and to consider aspects such as the public good (Patton *et al.*, 2013).

Ethical issues are considered in relation to research participants, the researcher, and the organization or institution affected by the research project. Ethical considerations relating to research participants relate to collecting information, seeking consent, providing incentives, dealing with sensitive information, the possibility of causing harm to participants, and maintaining confidentiality. The researcher must be aware

of and address all the issues that are likely to affect the participants. Ethical issues relating to the researcher include avoiding bias, using inappropriate research methods, incorrect reporting, and inappropriate use of the information collected. For organizations or institutions affected by the research, ethical issues include the misuse of information and restrictions imposed by the sponsoring organization. The researcher has a responsibility to look at the ethical issues from the viewpoint of respondents and institutions, and to put in place detailed mechanisms to avoid any potential harm (Kumar, 2011).

Mechanisms for protecting participants, researchers and institutions from potential harm include seeking consent from research participants, and informing individuals or institutions regarding the consequences of participation before they consent. When using secondary data sources, the researcher is not involved nor interacts with participants or information sources, therefore, “it is absolutely certain that the researcher cannot have influenced the interactants”. Institutions and organizations as sources of data often have gatekeepers who negotiate the terms of access to data, playing a critical role in protecting the interests, well-being and anonymity of their clientele and the confidentiality of the data. Even in such a context, ethical considerations apply. When it does eventually become possible to access the data, the “question is if such data is ethically available for research purposes, [and] under what conditions” (Stommel, 2016:181).

The researcher took cognizance of ethical issues in this research process. From data collection to the results and outcome of the research study, no individual or public or private organization or institution will suffer any form harm or prejudice. The research methods, including the approach and tools were evaluated and selected considering of possible or likely ethical issues. The use of secondary data ensures that the researcher cannot have influenced the participants. The desktop research used in this study entails data collection with limited interaction with people, through accessing public or private records and institutional practices that is relatively free from ethical challenges compared to other methods. Even the minimal contact that was planned could not be pursued, that is, formal letters could not be sent to data

source institutions, as previously intended by the researcher due to the special circumstances presented by Covid-19. As an alternative, the data from disaster centres and road authorities, including their agencies, was acquired through desktop research. The research also followed university protocol, applied and received the ethics clearance certificate (See Annexure 1). Finally, the outcome of the research is expected to serve the public good, in particular through the benefit it seeks to derive for road users.

3.8 Conclusion

The chapter presented the qualitative research methodology used to gather data, and key aspects governing the admissibility and credibility of the research process. This research is a policy evaluation study, followed quality research methods approach to investigate the impact of planning in mitigating the effect of floods on road transportation in South Africa, using secondary data. Data collection was undertaken using the desktop method of data gathering, and data sourced from the Internet was processed using content analysis techniques. Limitations to the applied methods and ethical considerations were considered, and the credibility of the study is maintained.

The qualitative research method used in this project has served the intended purpose. The required secondary data was collected without any significant challenges even within the confinements of Covid-19 restrictions. The Internet search has been a helpful tool for desktop research in this project. A document analysis approach enabled the evaluation of data using the policy themes or aspects selected for the purpose of this project. Therefore, the research achieved its stated purpose. The results of the study will further explain the relevance and level of success of the research methods. The chapter will be followed by the data analysis process and presentation of the findings.

CHAPTER 4: ANALYSIS AND FINDINGS

4.1 Introduction

The previous chapter discussed the research method employed for this research, and in this chapter, the analysis of data and the study findings are discussed. Data analysis entails “a number of closely related operations which are performed with the purpose of summarising the collected data and organising these in such a manner that they answer the research question(s)” (Kothari, 2004:122). This policy evaluation study uses qualitative research methods, including the common technique of identifying main themes through analysing the contents of the information gathered (Kumar, 2011). Qualitative data analysis is governed by systematic and ongoing activity-based principles, the latter entailing flexibility of the research process to be responsive to the environment and contingencies allowing modifications and adjustments in terms of approach (Silverman, 2015).

According to Fetterman (cited in Vigiola, 2015), data analysis begins at the identification of the research problem and ends at the conclusion and recommendation stages of the study. In a qualitative policy evaluation study, three ways of doing content analysis can be used. These include the use of content analysis-based computer programs, integrating information into the developed write-up framework, and identifying main themes to guide the write-up. Data analysis in this chapter entails a discussion of the road transport policy framework and the country's disaster policies in terms of critical features for an effective and efficient policy for disaster. This chapter presents the findings of the study with regards to the international and South African policy context.

International disaster management policies considered for this study are at national or country level applicable to the lower sphere, namely to states or municipal equivalents. In the South African context, disaster management policies are initiated in the national sphere. The provincial and municipal spheres are guided by these policies in term of implementation or the development of related policies. Therefore, the approach is for different spheres to play a role in disaster management policy

development and implementation. South African road sector policies, presented later in this section, generally apply to all road authorities. An exception is the SANRAL Act, which is only indirectly applicable to provincial and municipal roads.

To serve as a yardstick and guideline for the evaluation of South African road transport disaster management policy, the disaster management policy context of three other countries are discussed in the first section of this chapter. International disaster management policies were drawn from three of the world's most advanced disaster management systems. The above policies are at the national or federal level, and therefore the South African national disaster policy framework is also presented to ensure comparability when conducting the evaluation. The South African road transport flood disaster risk management policy context will be presented in the last part of this section, describing the current status of the sector disaster management policy as per the data gathered.

A policy framework includes plans, strategies, regulations, and guidelines. These are evaluated in terms of the following aspects: road transport disaster management institutional arrangements, legislative mandate, layout and content, resources and particularly funding, and feasibility. Institutional arrangements refers to institutional design and delegation of authority, responsibility, and accountability for delivery or implementation, while legislative mandates or guidelines provide a framework and base for defining authorities, obligations, support, and which allows for the implementation of policies (Mattingly, 2002). The layout and contents of each policy determine the viability and ease of use, and the funding provision to the plan or policy to enables implementation (Mattingly, 2002). The implementation of policy entails execution of planned risk reduction actions (Mattingly, 2002). The second part of this chapter is a summary of findings making sense of what has been discovered through the chosen research method.

4.2 International and South African national disaster management policy frameworks

Disaster management plans, strategies and protocols to address disaster risks are guidelines and legislative requirements, as coordinated by national governments and international bodies such as the United Nations. The United Nations already established The United Nation Disaster Risk Reduction (UNDRR) under which the International Strategy for Disaster Risk Reduction (ISDRR) was developed, including the current Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 (United Nations, 2015). ISDRR and SFDRR are both global frameworks for the promotion of actions to reduce the impact of disasters, while UNDRR provides a platform for countries to learn from and support each other in dealing with disaster risk (United Nations, 2015).

South Africa is a signatory to UNDRR frameworks and currently implements disaster risk reduction in terms of ISDRR and SFDRR (United Nations, 2015). Some countries, including Japan, the USA, and India, have advanced disaster management systems, and as disaster prone countries their level of ability to cope with disaster occurrences provides lessons for many countries across the world (OECD, 2014). South Africa has seen its share of challenges and the first notable disaster management policy was developed in 2002, hence it is important to look into the nature of the current policy in the context of other countries. Presentation of international guidelines as well as national policy requirements enables evaluation of the South African road sector policy to determine whether it is on track or whether the policy is flawed.

In terms of international experience several levels of instruments – from plans to protocols – are available in the United States of America, India, and Japan, as selected for the purpose of this study. The plans are discussed in detail to determine the level of plans for flood disaster risk reduction of the South African road authorities, as according to McEntire and Mathis (2006) cross-cultural and international comparative perspective brings about better understanding. Requirements and guidelines for disaster management policy, including plans and

guidelines, are discussed in light of SA's national disaster management plans and the three countries' policies.

4.2.1 International context 1: USA disaster management planning

Disaster risk reduction and management for the United States, a federal republic of 50 states, will be discussed below, highlighting the Guide to Regional Transportation Planning for Disasters, Emergencies and Significant Events, and the US preparedness system. Both of these have been developed and are coordinated at federal level.

The Federal Guide to Regional Transportation Planning for Disasters, Emergencies, and Significant Events

The Louis Berger Group, a global professional firm, led the team that was tasked to develop the guide with principles and resources for facilitating regional transportation planning, coordination, and operations across all modes for disasters, emergencies, and significant events (Matherly *et al.*, 2013). A Guide to Regional Transportation Planning for Disasters, Emergencies, and Significant Events is a project of the National Cooperative Highway Research Program, developed by team of professionals including engineers, architect, planners, environmentalist, and construction managers. The purpose of the guide is to help transportation and non-transportation stakeholders, "such as emergency managers and first responders, better understand transportation's important role in planning for multijurisdictional disasters, emergencies, and major events" (*ibid.*: 1).

The guide sets out foundational planning principles and uses examples, case studies, tips, tools, and suggested strategies to illustrate their implementation (Matherly *et al.*, 2013). In terms of the guide, effective planning is comprehensive, cooperative, informative, coordinated, inclusive, exercised, flexible, and continuous. Planning principles connect the many disciplines such as climatologist and transport economist, levels of government, and private, non-profit, and public-sector agencies

that contribute to a good community plan. They provide a shared vocabulary for a collaborative effort that promises sound preparation, effective response, and rapid recovery (*ibid.*).

The US National Preparedness System

Preparedness is a shared responsibility between role players including communities and business led by government, and all parties should participate actively to achieve the national preparedness goal of:

“A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk” (US Department of Homeland Security, 2015:1).

The above national preparedness goal outlines five mission areas, namely prevention, protection, mitigation, response, and recovery. The mission areas are preceded by identifying and assessing risk, estimating capability requirements, building and sustaining capabilities, planning to deliver capabilities, validating capabilities, and reviewing and updating. Undertaking of different disaster risk management activities relies on planning and are built into the national preparedness system composed of National Risk and Capability Assessment, Core Capabilities and Mission Areas, the National Incident Management System, the National Planning System, and Emergency Planning Exercises (US Department of Homeland Security, 2015).

The United States of America (USA) as a federal republic develops disaster management policies at federal level including specific disaster risk contingency measures for each state to invoke when experiencing any disaster risk. Successful disaster risk management in the US context is derived from clearly crafted policies, including the National Preparedness System, and the Guide to Regional Transportation Planning for Disasters, Emergencies, and Significant Events. The USA is also able to provide support to a number of countries across the globe, with expertise and funding towards disaster relief. The US approach to the development

of disaster policies presents an opportunity for South Africa to explore developing disaster management policies at national level while also prioritising the transport function. The US Guide to Regional Transportation Planning for Disasters, Emergencies, and Significant Events presents a direct lesson for the road sector to develop policies to address disaster risks within its functional area.

4.2.2 International context 2: National Disaster Response Plan, India

India is vulnerable to various natural disasters including floods (Ministry of Agriculture, 2001). Given the frequency of natural disasters, there has been a need for an effective disaster management strategy to lessen disaster impact. The Prime Minister, Atal Bihari Vajpayee, approved the establishment of a High-Powered Committee (HPC) on Disaster Management in 1999 to strengthen “organizational structure of disaster management and reorienting existing organisational and administrative structures” (Ministry of Agriculture, 2001:1). The mandate of the HPC was to develop a disaster management plan and the National Disaster Response Plan was the outcome of extensive consultations and deliberations with all concerned ministries and departments (*ibid.*). In the development of a disaster management plan, the HPC have surveyed literature and best practice examples in order to gain an understanding of systems of response implemented across the world, and to identify the common elements of response to bring out a well thought-out and planned response mechanism (*ibid.*).

The Indian base plan provides a framework within which other agencies and departments can outline their own activities for disaster response (Ministry of Agriculture, 2001). Each department’s disaster management activities are supplemented by specific disaster plans to consider the peculiar conditions that might arise due to a specific disaster (Ministry of Agriculture, 2001). Government of India categorised functions into Emergency Support Functions (ESF’s) for focused approach, identifying lead departments and supporting departments, in terms of Crisis Management Framework and Standard Operating Procedures (SOPS) (*ibid.*). In terms of the framework, transport and roads department play a lead function in Emergency Support Functions (ESFs) No. 5 and 7, while also playing a support role

in at least 8 other ESFs, which includes emergency medical services, and search and rescue (*ibid.*). The transport department leads in EFS 5; provides transport for relief supplies, coordinates with other ESFs for the clearing of roads and providing other means of transport, and provide appropriate transport for easy access to damaged areas (*ibid.*). The public works and engineering department is responsible for EFS 7; clearing areas for relief camps and roads for easy access, seal areas that are likely to cause further damage, build temporary bridges and access ways for ease of access, and check the strength of existing structures (*ibid.*).

India as a disaster-prone area has an advanced disaster management system to mitigate the impact of disaster incidents. Strong institutional arrangements for the country's disaster arrangement start with the High-Powered Committee (HPC) on Disaster Management established by the sitting prime minister. India's HPC delivers on its mandate to develop disaster plans, guiding the approach to disaster management through ESFs. India's disaster management policy context positions roads and transport as one of the critical players in disaster risk management, with strong institutional arrangements and clear set guidelines to prioritise funding. The country's disaster risk management system can provide important lessons for South Africa, in particular the road transport sector, for dealing with disaster risk.

4.2.3 International context 3: the Japanese Disaster Management System

Occurrences of disaster incidents leading to loss of life and damage to property in Japan brought hard experience and a drive to invest in disaster preparedness, to share lessons and help other countries (JICA, 2018). Japan experiences earthquakes of a higher magnitude than any country in the world, and innumerable natural disasters, such as typhoons (JICA, 2018). With various disaster incidences occurring from time to time over a long history, the country has built awareness of the importance of disaster risk reduction and is proactive in terms of disaster risk reduction measures. These are further compounded into cultural norms for the society to minimize disaster-related damage (*ibid.*). Japan has made progress on "society's capabilities to respond to disasters and mitigate vulnerabilities to disasters by developing disaster management systems, promoting national land conservation,

improving weather forecasting technologies, and upgrading disaster information communications systems" (Japan Government Cabinet Office, 2015:2). The rate of disaster damage has shown a declining tendency following progress on the measures outlined above, especially on the country's disaster management system.

Japan's Disaster Management System addresses disaster prevention, mitigation and preparedness, emergency response, and recovery and reconstruction (Japan Government Cabinet Office, 2015). Roles and responsibilities are clearly defined among the national and local governments to execute disaster management (*ibid.*). In terms of the Japanese Disaster Management System, disaster management plans should be formulated at national government, prefectural or metropolitan level, and municipal level under the auspices of the prime minister, governor, and mayor respectively (*ibid.*).

The development of Japan's disaster management framework dates back to 1963 when the Basic Disaster Management Plan (amended in 1995) was formulated, with a contingency plan on earthquakes developed in 1979 in the form of the Tokai Earthquake Countermeasures Basic Plan (Japan Government Cabinet Office, 2015). The Disaster Management System includes the Basic Disaster Management Plan, Disaster Management Operation Plans, Local Disaster Management Plans, and Community Disaster Management Plans (*ibid.*). The Basic Disaster Management Plan is the highest level plan developed based on Disaster Countermeasures Basic Act and constitutes the basis for disaster management activities. Based on the Basic Disaster Management Plan, a Disaster Management Operation Plan is developed by each designated government organization and public corporation (*ibid.*). Furthermore, a Local Disaster Management Plan is developed by each Municipal Disaster Management Council subject to local circumstances and, lastly, Community Disaster Management Plans guide planning of community disaster management activities (*ibid.*).

From time to time, the Japanese government issues regulations to manage various disaster risks occurring in different parts of the country (Japan Government Cabinet Office, 2015). The Central Disaster Management Council, consisting of the Prime Minister as the chairperson, establishes basic disaster management policies and develops the Basic Disaster Management Plan while also promoting comprehensive disaster countermeasures. Apart from earthquakes, Japan is also prone to a variety of water and wind related disasters including flooding, landslides, tidal waves, and storm hazards, owing to meteorological conditions such as typhoons, geographical conditions, and settlements built on flood plains (*ibid.*).

Storm and flood countermeasures have been developed in the Japanese context to deal with the above disasters and related challenges. Furthermore, the countermeasures against large-scale floods formulated in 2008 is a move taken to minimize the damage anticipated from observed annual heavy downpours (Japan Government Cabinet Office, 2015). This has also led to the development of basic policies for Metropolitan Area Large-scale Water Hazards, and measures have been introduced to effect prompt evacuations (*ibid.*). The above countermeasures related to floods and other risks are supported by an effective communication system in the form of the Central Disaster Prevention Radio Network and early warning dissemination as part of a programme for Observation, Forecasting and Warning of Disaster Risks (*ibid.*).

The Japanese government is configured as three spheres with the prime minister in the national, governor in the prefectural, and mayor in the municipal sphere providing leadership with regard to disaster management. The disaster management system has been developed and implemented in terms of the Disaster Countermeasures Basic Act, and include a range of plans from the highest-level plan, namely the Basic Disaster Management Plan, to risk specific plans such as storm and flood countermeasures. Thanks to roles and responsibilities that are clearly set out, as well as funding per government entity, all spheres and sectors of government are able to manage disaster risks occurring in different parts of the country. Early warnings and communication tools are central to the country's disaster management

system. The Japanese disaster management system, and in particular the storm and flood countermeasures, presents a good lesson for South Africa and for each government entity to play its role to effect disaster risk management. The urban planning context is presented as per Article 44 of the plan, where city or village councils are required to formulate city/town/village disaster management plans designated for their areas (Japan Government Cabinet Office, 2015).

4.2.4 The South African disaster management policy context

The Disaster Management Act, Act 57 of 2002 provides the legal basis for policies, plans and programmes for dealing with disasters. This follows from section 41 (1) (b) of the Constitution, which stipulates that all spheres of government are required to “secure the well-being of the people of the republic” (Van Wyk and Boshof, 2003: 462). Disaster management is also listed as a functional area in Part A of Schedule 4 of the Constitution, implying that both the national and provincial spheres of government are required to develop and execute laws and have powers and responsibilities in relation to disaster management. A disaster management function was also assigned to local government through the promulgation of the Disaster Management Act (South Africa, 2002). A National Disaster Management Framework was developed as one of the instruments of the Disaster Management Act. The Disaster Management Act places a legal obligation on all organs of state in the three spheres namely national (Section 25), provincial (Sections 38 and 39), and municipal (Sections 52 and 53) government to develop, regularly review, update, coordinate, share and implement disaster management plans (*ibid.*).

Section 25 of the Disaster Management Act obligates, in the national sphere, the Department of Transport and its agency SANRAL to prepare disaster management plans, starting with disaster risk assessment for roads as a functional area (Sec 25 1 a) (South Africa, 2002). Provincial road authorities and road entities of each municipality are also required to develop disaster plans (*ibid.*). The National Disaster Management Framework of 2005 is the legal instrument to ensure consistency by guiding a uniform approach over a diversity of risks occurring in South Africa (South Africa, 2005). The provincial and municipal sphere also takes guidance from the

national disaster management framework for the development disaster management frameworks and plans (*ibid.*). The National Disaster Management Framework identifies four key performance areas (KPAs) supported by three enablers, and a list of guidelines to support the implementation of the framework in all three spheres of government (*ibid.*).

The National Disaster Management Centre, through the coordination of the National disaster Management Advisory Forum, has further issued guidelines on the development and structure of a disaster management plan (NDMC, 2017). The guideline, developed in terms of Section 19(a) of the DMA and Section 3.6 of the National Disaster Management Framework 2005 (NDMF), aims to provide a uniform structure and checklist to organs of state for preparing a disaster management plan (*ibid.*). The National Disaster Management Framework's key performance areas and enablers are extracted in relation to disaster management plans arranged into specific chapters, and in turn linked to the critical outcomes and action steps (*ibid.*). Users of the guideline should internalise and develop a sector specific disaster management plan suitable to their environment.

The National Disaster Management Centre further developed a risk specific contingency plans guideline, and also The National Seasonal Preparedness Plan for 2020/21 (NDMC, 2017; NDMC, 2020). The guideline for contingency plans was developed in terms of Sections 25, 38, 39, 52 and 53 of the Disaster Management Act read with Section 3.2.5.2, and key performance area 4 of the National Disaster Management Framework (South Africa, 2005). Contingency plans entail a forward planning process for an anticipated disastrous event, setting objectives, defining managerial and technical actions, and developing a potential response system to mitigate and respond effectively (*ibid.*). Four main components, namely risk assessment, preparedness, response, and action triggers make up the structure of contingency plans. The contingency plan should identify further subcomponents to be put in place to adequately prepare for and respond to a potential event (*ibid.*).

South Africa is affected by various disaster risks such as droughts, wildfires, sinkholes and floods, and the promulgation of the Disaster Management Act in 2002, followed by the National Disaster Management Framework in 2005, are responses to this reality. At medium risk level South Africa is ranked number 92, in terms of the 2020 World Risk Index, with medium exposure vulnerability and lack of coping and adaptive capabilities but high susceptibility (Behlert et al., 2020). An important preparedness initiative, namely contingency measures for the summer season based on weather predictions, was approved in September 2020, called the National Seasonal Preparedness Plan.

The National Seasonal Preparedness Plan for 2020/21 Summer Season follows the guidelines and national legislative prescripts on disaster management, making the country's disaster management policy framework progressive. The South African disaster management policy context as coordinated by the National Disaster Management Centre, provides the necessary guidelines for all sectors and entities required to undertake and partake in disaster management. The current National Disaster Management Framework can guide each sector or entity to develop a disaster management policy with strong institutional arrangements, guided by legislative, with good layout and content, and appropriate funding mechanisms, which is also implementable.

4.2.5 Highlights from International and SA National Disaster Management Frameworks

This section explored both national and international disaster management policy contexts, with the intention to demonstrate the avenues available for the road transport sector in terms of disaster management and flood risk management. The international lessons reveal the effectiveness of disaster management policy that is embedded in a well-organised approach, with strong institutional arrangements and guided by legislation as observed in the case of India and Japan. Disaster management, in the context of India and Japan is led and coordinated from the offices of the prime ministers. Plans and guidelines for disaster management

developed in a clear and concise manner may enable implementation, especially when countries deal with disaster eventualities.

International lessons also indicated funding as key enabler for disaster management and countries such as Japan and the USA ensure funding of the disaster management mandate and also offer financial support to other countries. South African policies on disaster management have been formulated taking into account the lessons learnt from other countries, but is dependent on the level of enforcement and implementation to ensure the success of the country's disaster management efforts. Led by the Ministry of Cooperative Governance, South African disaster management has to some extent considered strengthening disaster management institutional arrangements. Legislative prescripts and guidelines have been developed at the required level of planning, including funding for disaster management. Therefore, the international and national disaster management context makes a convincing case and hold possibilities for the road sector to develop policies that follows a well-organised approach to effect disaster management in the sector.

4.3 The policy framework for flood disaster risk management: Road authorities

The previous section under 4.2 discussed both the international disaster management policy context and the current South African disaster management policy framework. While the country's policy context derived lessons from other countries' disaster policies, it is important to understand whether the national disaster management policies guidelines are followed when developing sector disaster management policies. This part of the chapter focuses specifically on how national disaster policies framework are integrated or complied with by the road transport sector as per data drawn from legislative documents, strategic documents, and various plans, particularly disaster plans from road authorities from the three spheres of government.

Currently, the road authorities in the South African context have several policies relating to disaster risk management, most of which are not directly or specifically

related to disaster and flood disaster risk (See Table 1). At national and provincial level, the list includes the Technical Methods for Highways (TMH), Technical Recommendations for Highways (TRH), the Road Incident Management System, the Provincial Road Maintenance Grant and Road Asset Management Programme, and recently also the White Paper on Road Transport Policy. In metropolitan municipalities, also responsible for a roads function, various disaster plans including specific disaster type contingency plans or protocols exist. However, as far as flood risk mitigation is concerned, barring some level of expression in the City of Johannesburg's Road Agency (JRA), no specific plans were found. South African policies from road authorities in the national, provincial and municipal spheres are discussed below in relation to flood disaster risk management.

Policies	Road authorities applicability		
	National	Provincial	Municipal
National Land Transport Act			
SANRAL Act			
Road Policy			
Road Asset Management System			
Road Incident Management System			
Disaster Management Plan	Section 24 Plan	Section 38&39 Plan	
Flood Risk Management Plan			

Table 1: Road authority policies

Key:  Developed/Implemented  Development in progress/partial implementation  policy not developed  policy non-applicable

Table 1 represents the national, provincial, and municipal road authority policies for South Africa. The first column presents policies of road authorities in all spheres. The subsequent columns represent which policies are applicable to which sphere of governance. Different colours represent the level of compliance per road authority, in terms of development and implementation of each policy. Where a policy is not applicable the cell is shaded grey.

4.3.1 Disaster risk management policies: National and provincial roads

The national and provincial spheres in the South African governments as depicted by Table 1 follows the same mandate on their respective road transport functions, except for SANRAL Act. SANRAL Act regulation can still be traced on provincial borders as all national roads exist in within provincial borders, even though the SANRAL regulations and standards are not enforced on provincial roads. Both national and provincial road authorities currently do not have a disaster management plan, as revealed through this study. Disaster management on road transport, including flood disaster management, is undertaken through existing policies to be outlined in this section. Municipalities perform roads functions and as an entity also responsible for other functions will be discussed in the next section.

a) The SANRAL Act, 1998 and the National Land Transport Act, 2009

Significant laws are South African National Roads Agency Limited and National Roads Act, Act 7 of 1998 (which will be referred to in this study as the SANRAL Act) and National Land Transport Act, Act 5 of 2009 (which will be referred to as the NLTA). The latter is currently being amended and reference is also made to the 2019 National Land Transport Bill, and relevant to disaster management institutional arrangements is the amendment of NLTA Sections 11 and 12 (Republic of South Africa, 2009). Institutional arrangements fall under key performance area (KPA) 1 of the National Disaster Management Framework (NDMF) of 2005, which is the primary disaster management policy in South Africa. The NLTA amendment of Section 12 for inclusion under Section 8 (1) read with subsections 4, 5 & 6, bestows on provinces the authority to pass legislation or enter into agreement with one or more municipalities to provide for the joint performance, governance and funding of their respective powers and function (Department of Transport, 2009). The above amendment of Section 12 of the NLTA can also be explored for relevance to disaster risk management funding, enabler 3 of the NDMF (Republic of South Africa, 1998, Republic of South Africa, 2009).

The South African National Road Agency Limited and National Roads Act 1998 make provision for a national road agency to manage and control the country's national road system and take responsibility to develop, maintain, rehabilitate, regulate use and protect national roads (Republic of South Africa, 1998). SANRAL, without any specific policy or strategy on disaster or flood risk management, undertakes to preserve and remedy the effect of floods and other disasters through different maintenance activities (Republic of South Africa, 1998).

For infrastructure severely affected by floods such as bridge failures, road cuts and pavement defects, special maintenance is performed (Republic of South Africa, 1998). Routine maintenance is ideally applied pre-infrastructure distress, and offers preventative measures to prolong the life of infrastructure while also correcting existing distresses (Republic of South Africa, 1998). The structural capacity of the infrastructure can further be revived by rehabilitation, and adjustments can be made to increase the level of service, capacity, alignment, and bridges' width and length (*ibid.*).

Neither the SANRAL Act nor the National Land Transport Act provide for a legislative mandate in terms of disaster management, except for the arrangements that might need to be adopted and realigned for flood disaster risk management. Disaster management and flood disaster risk is not conceptualized in the two legislative documents and therefore the implication of the layout is irrelevant. With no flood disaster management content in either the SANRAL Act or the National Land Transport Act, flood disaster management implementation related activities are also not provided for.

b) The White Paper on Road Policy, 2018

The White Paper on Road Policy, 2018, was developed as the national policy framework to ensure that South Africa's roads are well managed and safe and include all modes of transport to achieve a sustainable approach to roads management. The policy is developed by the national Department of Transport

supported by provincial and municipal governments, and therefore should reflect all transport related issues affecting road authorities in the three spheres (Department of Transport, 2019). One of the policy objectives relating to disaster risk management is to determine financial options with regard to road infrastructure investments, road safety, law enforcement and enabling mechanisms to implement programmes and projects.

The policy seeks to address roles and responsibilities, and to improve institutional arrangements and coordination in all road authorities, whether national provincial or municipal (Department of Transport, 2019). Institutional arrangements, the management of road infrastructure, and technical capacity are key focus areas for infrastructure development. The policy further seeks to offer guidance in respect of sustainable funding mechanisms, and improve governance and administration to optimise efficiency in the country's road infrastructure provision, road traffic and safety management (Department of Transport, 2019). All road authorities are required to adopt and apply road asset management principles within the road sector and comply with the Committee of Transport Officials (COTO) technical norms, guidelines, and standards. Road authorities across all spheres of government are encouraged to apply the principles of universal design to roads infrastructure development, and develop a "green" road network, which conforms to the principles of sustainability (*ibid.*).

The road policy drive for sustainability in respect of road infrastructure development misses the element of risks such as flood disasters, which should be taken into cognisance and managed to ensure development. The policy is not disaster management focused, neither does it provide for either flood or any infrastructure development related disaster risk. While the funding arrangements are addressed, there is no mention of disaster management as one of the activities considered for funding or implementation. The implementation plan also does not relate to disaster management.

c) The Technical Methods for Highways (TMH)

South African road authorities follow the Codes of Standard Practice for design contained in the Technical Methods for Highways. These are prescribed for use in various road design and construction procedures. TMH manuals aim to produce uniform results across the country's road development, guiding preparations, design, construction material and use, signage, maintenance, and visual assessments for effective road network development and management (Committee of Transport Officials, 1998). Relevant to disaster risk management are the three standards of practice for the design of highway bridges and culverts under TMH 7, visual assessment of paved roads in TMH 9 and unpaved and unsealed roads in TMH 12 (COTO, 1998).

TMH 7 the code of practice for the design of highway bridges and culverts provides guidance for the design of bridges and culverts in consideration of floods in terms of the extent of flood forces, including the effect of debris (COTO, 1998). In terms of TMH 7, the process should be guided by compulsory sensibility studies and risk analysis, and the applicable partial load factors (*ibid.*). However, the discretion lies with the structural engineer in consultation with the responsible authority. TMH 9 and TMH 12 provide guidelines for the visual condition assessment of paved and unpaved road networks, respectively (*ibid.*). The assessments are used to determine the condition, material and rehabilitation needs of these roads, and guide priorities in accordance with available resources, including funding. Evaluation of the visual condition of roads is undertaken to determine the degree and extent of occurrence of surface cracks and failures, structure rating and potholes, and functional features of riding quality and skid resistance (*ibid.*).

TMH 9 and 12 further provide for surface and side drainage assessment to determine the effectiveness of clearing water (COTO, 1998). Surface drainage of a road has huge impact on the condition of the road, while side drain challenges such as overgrown blocked and non-existent side drains may lead to premature pavement failure and added distress during flooding (*ibid.*). Therefore, the overall drainage

assessment of the road is essential to guide preventative measures against water borne disaster risk such as floods (*ibid.*).

The Codes of Standard Practice of the Technical Methods for Highways are key to flood disaster risk discussion, as road infrastructure planning, design, development, operations, and maintenance happen within the context of disaster risks. TMH manuals provide guidelines that are preventative and serve a disaster risk reduction purpose for road infrastructure development. The TMH discussion does not answer the question about the legislative implications or institutional arrangements in respect of flood disasters, except to argue that the standards must be followed by all road authorities. Road authorities follow COTO approved and updated standards when implementing road development and maintenance projects.

d) The Road Incident Management System (RIMS), 1996

Road Incident Management System (RIMS) was introduced in 1996 by the National Department of Transport, as a tool in the form of a protocol for managing road incidences on national provincial and municipal roads (Department of Transport, 1996). RIMS is the coordinated and pre-planned use of human, mechanical and electronic resources to manage incidents and to restore traffic to normal operating conditions as soon as possible (Department of Transport, 1996). National, provincial, and municipal road authorities coordinate systems on their roads, to manage incidents. An incident as defined in RIMS as an occurrence of any extraordinary condition or event which results in a reduction of the capacity of the road and creates a hazard for road users for a sustained period (*ibid.*). As indicated above, incident management refers to the pre-planned and coordinated use of human, mechanical including electronic resources to manage incidents and restore traffic to normality (*ibid.*). The functioning of RIMS interacts with disaster management at various levels; every disaster starts as an incident until it is escalated through classification and declaration as a disaster. RIMS functions and activities seek and strive to improve integration with disaster management at all levels (*ibid.*).

An incident management guideline plan is developed per system to guide participants in ensuring quick and efficient use of manpower, equipment, and material to clear the scene of an incident to avoid the likelihood of secondary incidents (Department of Transport, 1996). The system also provides specific contact details, procedures and protocols, alternative routes, and area of jurisdiction (Department of Transport, 1996). Key role players are emergency services (EMS), centralised communication centre/s (CCCs), specialised services, essential services, and the affected parties (*ibid.*). The identified role players collectively partake in planning to implementation of RIMS chain of events from incident detection and location identification, services mobilisation and response, situation analysis, scene management and clearance, to follow-up (*ibid.*).

The Road Incident Management System (RIMS) is developed to cover every road in South Africa as coordinated through the municipal, provincial, and national governments including SANRAL; there is also some level of extension beyond the borders through the Cross Border Road Transport Agency. The RIMS configuration and protocol can provide an opportunity for road authorities to synchronise their respective systems towards the management of flood disaster incidents, but in its current state the policy does not extend to flood risk management.

e) The Road Asset Management System (RAMS), 2012

The South African Road Asset Management System's "Know your Network" is a tool for road sector planning and delivery, providing a database, storage, processing, and presentation of road data for infrastructure development and maintenance (COTO, 2013). Different categories of road infrastructure condition assessments are undertaken to build the database. The system guides roads sector prioritization, funding, and investments (COTO, 2013). Road transport flood disaster risk issues are not specifically provided for within the RAMS, but road asset management discussions include the management of road transport within the context of risk, with flooding being a notable risk (*ibid.*). Provinces and municipalities are required to develop Road Asset Management Plans (RAMPs), in line with their provincial or municipal priorities to guide annual resource allocation (*ibid.*).

The Western Cape RAMP is one such example, developed to ensure effective planning and requirements in terms of the level of service delivery, legislative compliance, and funding are met (Western Cape Department of Transport and Public Works, 2019). RAMP objectives relating to road disasters are to maintain road assets for safety and usability optimise asset preservation over the long term, prioritise road asset investments, improve road asset performance, and improve infrastructure capacity in the face of increasing demand (COTO, 2013). The Western Cape's priority list is also informed by the experience of incidents affecting road transportation. "The impact of extreme weather events that often caused floods have in the past seen significant destruction to road infrastructure, with the unpaved road network and drainage structures being most affected" (Western Cape Department of Transport and Public Works, 2019:73). The need for responsiveness of the RAMP is furthermore placed in the context of climate change. It states that "predictions on climate change indicate that there is a need to enhance the resilience of critical infrastructure to cope with the effects of climate change and this will put additional demands on funding resources" (*ibid.*).

The Road Asset Management System (RAMS) is a planning tool providing an inventory of roads infrastructure and their conditions. Road authorities are required to prioritise in relation to their available resources through their RAMPs. Both the system (RAMS) and plans (RAMPs) guidelines fall short of highlighting the disaster risk to road infrastructure, particularly the risk of floods. Flood risk is only reflected in the Western Cape RAMP as part of a list of infrastructures to be repaired and rehabilitated after flood damage occurred; the RAMP contains no identification of floods as a risk or propositions for risk mitigation and preparedness. Both the RAMS and RAMPs as road policies are currently not utilised as a resource by road authorities when dealing with flood disaster risk.

4.3.2 Disaster risk management policies of metropolitan municipalities

Municipalities are the third sphere of government in South African and are responsible for transport functions, mainly transport services and road infrastructure delivery and maintenance. Municipal roads, district roads, streets and rural roads

mainly owned and maintained by municipalities, also as classified in terms of Technical Recommendations for Highways (TRH) 26 and Road Infrastructure Strategic Framework of South Africa (RIFSAS) 2007 (COTO 2012). Both TRH26 and RIFSAS provide guidelines and responsibilities to municipalities and metropolitan municipalities. South Africa have 8 class A municipalities referred to as Metropolitan Municipalities, and disaster management policies of four metros have been evaluated. The four metro's with two of the top (Johannesburg and Cape Town), one medium (Tshwane) and one lower (Nelson Mandela Bay) on the category of major cities were selected for this study, will be analysed in relation to flood disaster management (Van Huyssteen, Meiklejohn, Coetzee, Goss, and Orange, 2010).

a) City of Cape Town (CoCT): Municipal Disaster Risk Management Plan, 2015

A disaster plan is developed to continually facilitate preventative, risk-reduction and preparedness for unforeseen events, and emergency response to incidents or disasters when they occur or threaten to occur (City of Cape Town, 2015). The purpose of the CoCT Municipal Disaster Risk Management Plan is to outline policy and procedures for pro-active hazard and risk assessment, followed by disaster prevention, risk reduction, preparedness and response, relief, and rehabilitation (City of Cape Town, 2015). Planned municipal disaster risk management, both proactive and responsive, is undertaken through multi-agency and multi-jurisdictional co-ordination (*ibid.*). The approach includes the establishment and implementation of a policy framework, establishment of a disaster management centre, compilation disaster risk management plans and procedures for the different entities comprising the municipality, and hazard- or risk-specific disaster risk management plans (*ibid.*).

In the context of a municipality, disaster management plans must cover the whole disaster risk management continuum and must address all actions before, during and after disasters. Compiled in a generic form, the plan refers to Standard Operating Procedures (SOP), legislation and best practice of the respective services or entities (City of Cape Town, 2015). The generic plans can be adapted to suit the type of hazard or disaster risk being dealt with. To cover all aspects of disaster risk

management, different services and entities' plans must be integrated with the relevant multi-disciplinary hazard or risk-specific disaster risk management plan (*ibid.*).

In terms of institutional arrangements, disaster risk management in the City of Cape Town will be linked with existing and current mandated and functional services and entities, with the Municipal Manager assuming the role of the Head of the Municipal Disaster Management Forum (City of Cape Town, 2015). Heads of units and entities in the municipalities are permanent members of the Forum to ensure all services are represented and functioning and those day-to-day activities are integrated to achieve disaster prevention, reduction, preparedness, and response for the municipality (*ibid.*). A guideline for the communication structures and the relationship between the various disaster risk management formations of the different spheres of government has also being determined (*ibid.*). The City furthermore has a Disaster Risk Management Centre (DRMC) which "will act as a repository and conduit for information concerning disasters, impending disasters and Disaster Risk Management in the municipal area" (*ibid.*: 11). Setting roles and responsibilities of the main stakeholders is critical but each stakeholder's "involvement must be to prevent the occurrence of emergencies or disasters that threaten life, property, the environment or economic activity" in the municipality (*ibid.*).

Among the instruments to ensure service coordination is the Commissioner for Transport, who ensures that disaster risk management plans are compiled and maintained as part of the strategy for and management of transport in Cape Town (City of Cape Town, 2015). The Commissioner for Transport oversees the Departments of Performance and Co-ordination, Planning, Contract Operations, Financial Management, Infrastructure, Maintenance, Network Management and Regulations (*ibid.*). Funding is an important element of a disaster plan and central to the coordination of services. Entities are responsible for funding and harmonising access to funding support for their disaster related services and activities. Funding enables comprehensive disaster risk, vulnerability, and manageability assessment, which is an essential activity of disaster management.

Comprehensive disaster risk assessment enables disaster risk prioritisation, and the 2009/10 CoCT municipal assessment ranks flooding disasters high on the list of overall disaster risks and relative priority ratings (City of Cape Town, 2015). In the City of Cape Town, disaster risks are set to be addressed in terms of priority through pre-disaster risk reduction and preparedness measures (including prevention and risk reduction strategies, disaster preparedness and standard operating procedures), disaster response and recovery (including disaster response and relief co-ordination, requests for provincial and national support following the declaration of a disaster) and recovery and rehabilitation operations (*ibid.*).

The CoCT Municipal Disaster Risk Management Plan fulfils the requirement of Sections 38 and 39 of the National Disaster Management Act of 2002, and also follows the guidelines of the National Disaster Management Framework of 2005. The CoCT's disaster plan also institutionalises road disaster related functions under a Commissioner for Transport. The plan clearly sets out institutional arrangements and clear communication channels to effect disaster management. A key feature of the CoCT Municipal Disaster Risk Management Plan is that it outlines the funding arrangements and the development of disaster risk management plans by each service coordination entity. Risk assessment is key for planning and implementation of disaster management, and the CoCT Municipality disaster plan provides for risk assessment – identifying floods as one of the common risk affecting the municipality. The CoCT Municipal Disaster Risk Management Plan generally presents a feasible measure for the management of disaster risk in the municipality.

b) The City of Johannesburg Metropolitan Municipality

The City of Johannesburg Metropolitan Municipality developed a disaster management plan and furthermore developed a Flood Management and Storm Water Plan.

Implemented through the City's road agency, the Johannesburg Road Agency (JRA), the Flood Management and Storm Water Plan has three elements entailing activities

to be undertaken before and during the rain, including preventative maintenance, maintenance activities during rains, and further flood management during rains targeting hotspot areas (Sandton Chronicle, 2014). The Flood Management and Storm Water Plan involves the proactive and reactive maintenance of pavements and inlets, identification of flooding hotspots, clearing of channels and culverts, clearing of low-lying bridges, and the review of flood line management plans (*ibid.*). The City reportedly identified and mapped high risk areas, and consequently developed mitigating plans, which include implementation tactics that proactively address hotspots areas. Through the Flood Management and Storm Water Plan, the JRA minimizes the flood related disaster risk by monitoring low level bridges and clearing debris, identifying bridges that are likely to be affected by floods and that are due for upgrade, and seeking measures for addressing possible measure for hotspots that might arise (*ibid.*).

The plan is coordinated by the City of Johannesburg's disaster management task team consisting of the JRA, Joburg Water, the Johannesburg Metropolitan Police Department (JMPD), the City's Emergency Management, as well as the Departments of Social Development, Housing, and Urban Development. The JRA established regional standby teams deployed as additional resources in the event of an emergency. The South African Weather Service (SAWS) provides weather information including warnings on the severity of rain and the potential to cause flooding, and the JRA immediately communicate information to the regions at risk. (Sandton Chronicle, 2014).

The City of Johannesburg has experiencing high rainfall patterns over years, which has significantly impacted on the road network system and supporting infrastructure (Sandton Chronicle, 2014). Early in 2014, for example, severe flooding in the city caused damage to the road infrastructure network including road surfaces, storm water drains, culverts and bridges, requiring an estimated amount of R60 m for repairs and rehabilitation. In response to the 2014 disaster, City of Johannesburg, through the Johannesburg Road Agency (JRA), managed to complete the repair

work on four bridges by November of the same year, with the remaining five bridges scheduled for completion by February 2015 (Sandton Chronicle, 2014).

The Flood Management and Storm Water Plan follow the guidelines developed by the City and those contained in the disaster management legislation, and are coordinated by the JRA with other key services playing supporting role. The plan has been institutionalised, with clear funding guidelines. Its feasibility for dealing with flood risk in the city has been by tested by previous flooding incidents in the city.

c) The City of Tshwane Metropolitan Municipality

City of Tshwane Metropolitan Municipality (CoT) developed a disaster management plan in 2011, as required in terms of Sections 52 and 53 of the Disaster Management Act of 2002. Developed to deal with disaster risk affecting the metropolitan area, the plan puts the primary focus on institutional arrangements for disaster risk management and developing contingency plans for responding to disaster risks as identified through a disaster risk assessment (City of Tshwane, 2011). The City of Tshwane Disaster Management Plan of 2011 requires the council of the metropolitan municipality to establish institutional capacity, in terms of Disaster Management Act, for implementing disaster risk management within the municipal sphere of government (City of Tshwane, 2011).

The municipality's plan contains Divisional Disaster Risk Management Focal Points that elaborate on the general and specific disaster risk management responsibilities of each division, in terms of four key performance areas and three enablers (City of Tshwane, 2011). The plan also provides for heads of Municipal Disaster Management Centres and individuals assigned responsibility for disaster risk management in municipal divisions to serve on the relevant Integrated Development Plan (IDP) structures, so as to ensure integration between development programmes and disaster risk management (*ibid.*). The City of Tshwane Municipality Disaster Plan furthermore presents an overview of the structure for disaster risk management planning which must be viewed in conjunction with the disaster risk management

framework. The planning framework components for disaster risk management include the integration of disaster risk assessment and developmental practices (*ibid.*). The planning framework is divided into two sections for facilitation of divisional planning responsibility, namely risk reduction planning and contingency planning (*ibid.*).

Through disaster reduction planning, the municipality's divisions or entities engage in vulnerability reduction planning and make provision for disaster risk management planning in their respective developmental projects (City of Tshwane, 2011). Contingency strategies and emergency procedures to be implemented in the event of a disaster must also be included in a disaster management plan (*ibid.*). Contingency strategies and plans are a forward planning process prepared for mitigation, prevention, and response in respect of all prioritised hazards, and will be employed by the municipality in extraordinary circumstances (*ibid.*). The final section of the CoT plan is a disaster risk profile identifying macro disaster risks and macro vulnerability, ranking flood disasters as priority number five and affecting all regions of the municipality. With all regions affected by floods, road transport in the municipality is also affected by the number one ranked disaster, namely dolomite resulting in the occurrence of sinkholes (*ibid.*).

Without being specific to a disaster risk, the CoT plan highlights measures to deal with disaster risks likely to affect the municipality starting with the identification of risks and planning of disaster risk reduction projects in line with the disaster risk priorities (City of Tshwane, 2011). Adoption of a carefully considered process to enable the prioritisation of disaster risk management activities follows; with flooding considered one of the wide-scale risks due to its potential to affect the municipal area as a whole, which therefore should be prioritised for prevention or limiting of its impact. Flooding is further included on the list of high and medium impact events requiring intervention and mobilization of resources and infrastructure (*ibid.*).

In terms of the City of Tshwane Metropolitan Municipality Disaster Management Plan, a critical tool in the form of the Disaster Management Information System (DMIS) has been initiated to enable hazard identification, vulnerability assessments, risk assessments, disaster risk reduction as well as planning for an incident (City of Tshwane, 2011). All standard operation procedures, legislation, policies, and bylaw documentation are incorporated in the system for ease of use and reference. The plan concludes with important elements, namely, the emergency communication system to ensure reliable communication in case of disaster emergencies, and an implementation strategy for the successful implementation of the plan (*ibid.*).

City of Tshwane Metropolitan Municipality complied with the Disaster Management Act of 2005 by developing a disaster management plan in accordance with Section 52 and 53 thereof, also following the applicable guidelines. The plan sets out institutional arrangements for the City to deal with disaster risk, also setting out focal points which will solidify disaster management institutional capacity. The plan seeks integration between development programmes and disaster risk management, outlining the approach for the respective management portfolios to plan their projects integrating disaster risk reduction. Integration of development programmes with disaster risk management also addresses the underlying issue of funding disaster management programmes. The City's disaster plan stipulates contingency plans that need to be developed and implemented to follow the comprehensive disaster risk assessment conducted by the City. Flood disaster is included in the list of high and medium impact events, and all necessary measures required to be undertaken in case of road transport disaster are covered in the plan.

d) Nelson Mandela Bay Municipality

Nelson Mandela Bay Municipality (NMBM) boasts a total road length of about 4 104km (Nelson Mandela Bay Municipality, 2010). Of the 4104 km of roads, 35 km are national roads, provincial trunk roads account for 81 km, provincial rural main roads for 264 km, provincial district roads for 196 km, provincial minor roads for 240 km, provincial urban main and metropolitan significant roads for 417 km, and minor surfaced and unsurfaced roads for 2 871km (*ibid.*). Road transport is the

municipality's primary mode of access, and the occurrence of flood disaster incidents is of concern for the municipality (*ibid.*). In NMBM flood disaster is rated as a class 1 hazard type and has previously impaired road transport system and requires level 1 prioritisation in terms of disaster management. Floods are the highest rated risk in the municipality, and it is further acknowledged that flooding can damage communication systems and roads and disrupt disaster response and recovery efforts. The destruction of road infrastructure and services by flood disasters is a concern and therefore requires prioritisation (*ibid.*).

Nelson Mandela Bay Municipality developed a policy framework on disaster management in the form of the Disaster Risk Management Policy Framework for Nelson Mandela Bay Metropolitan Municipality (Nelson Mandela Municipality, n.d.). The policy requires all council services to participate in disaster management issues and to ensure adequate risk and hazard assessment of projects; this will play a key role in planning and evaluation of development projects (Nelson Mandela Municipality, n.d.).

The policy also pronounced the establishment of a Disaster Management Centre as an institution under which disaster management plans and programmes will be developed and implemented in accordance with community-identified needs and through community participation (Nelson Mandela Municipality, n.d.). The Municipal Disaster Management Centre generates reports on policy matters and, where necessary, proposes legislative amendments and maintains a centralised resource data bank including vulnerability assessments, and hazard and risk analysis data (*ibid.*).

The disaster management policy framework provides for an advisory service to broader social, economic, business, health and educational institutions falling under the municipality's jurisdiction, and facilitates the necessary input from other services where this is required (*ibid.*). The policy also provides for undertaking capacity development in terms of training and research and ensures reasonable human resource capacity including recruitment of volunteers for disaster management exigencies. The policy further guides the development of a Disaster Management

Coordinating Committee and outlines the terms of reference for the Committee, with the appointment of high level officials able to take decisions on behalf of the business units of the municipality and chaired by the municipal manager (*ibid.*).

The Nelson Mandela Bay Municipality disaster management policy advocates for a risk reduction strategy aligned to the International Strategy for Disaster Risk Reduction (ISDRR) with four objectives (Nelson Mandela Municipality, 2010). The four ISDRR objectives are increasing public awareness, obtaining commitment from public authorities, stimulating partnership and networking, and improving scientific knowledge of causes and effects of disasters. Also key to the plan are the eight planning requirements to be applied by municipal organs planning for disaster risk reduction initiatives, which include a well-informed and consultative decision making process with clear goals and targets (*ibid.*).

The Nelson Mandela Bay Municipality disaster management policy provides a link to the IDP, emphasising the service and infrastructure delivery to be linked with disaster risk management (Nelson Mandela Municipality, 2010). A logical framework has been developed to guide measures to reduce the vulnerability of disaster-prone areas to flood disasters through maintenance of roads and storm water infrastructure as a key activity (*ibid.*). The development of a flood contingency plan by the NMBM is a proactive step for dealing with disasters as they occur in the municipality (*ibid.*).

The Nelson Mandela Bay Municipality disaster planning context has been developed in consideration of the municipality being both highly road transport dependent and vulnerable to disasters and particularly to floods. The Disaster Risk Management Policy Framework for the Nelson Mandela Bay Metropolitan Municipality addresses legislative compliance and enforces the responsibility of the municipal entity for disaster management. Institutional arrangements are outlined, with all council services required to mainstream disaster risk management; the mainstreaming also includes funding requirements for disaster risk activities. Flood disaster risk management is undertaken through a contingency plan expected to be immediately

invoked in case of any incident in the municipality including incidents affecting road transport infrastructure and services.

4.4 Summary of findings

Findings are important as they affirm the study results and answers research questions before the researcher draws conclusions and makes recommendations. The research findings of this study follows on the previous section of the chapter highlighting key content requirements of policy documents in the light of policies and practices in the national and international disaster management context. This section starts with a consolidation of the road transport policy context as previously described in an attempting to determine which elements of disaster management and flood risk mitigation are covered, if at all, and the extent to which this is done. The discussion considers the requirements and guidelines from the national and international disaster management context to assess road transport policy in terms of policy attributes, developed in terms of NDMAF 2005 Key Performance Areas (KPA's). Policy attributes are institutional arrangements, legislative mandate, layout and content, resources and funding, and feasibility.

4.4.1 Institutional arrangements

In South Africa, the National Disaster Management Framework comprises four key performance areas (KPAs) and three enablers; institutional arrangements are KPA 1 and represent a critical step for each institution undertaking disaster management. International examples in this study present formidable institutional arrangements to effect disaster management. Disaster management in India has the country's highest office, namely that of the Prime Minister, responsible for the establishment of the High-Powered Commission (HPO). In the Japanese disaster management system, it is required that disaster management plans be formulated at national, metropolitan, and municipal level, with involvement of the prime minister, governor and mayor. Indian and Japanese planning contexts were found to be good international examples of how institutional arrangements are salient to risk reduction, and expedited responses and reconstruction.

In South Africa, in the provincial and national sphere, the 2019 National Land Transport Bill and the White Paper on Road Policy refer to institutional arrangements but not in the disaster management context. Municipalities have prepared plans following accordance with the 2005 NDMF addressing KPA1, institutional arrangements, with management and unit heads taking responsibility and accountability for disaster management planning and activities. Units within municipalities are coordinated through Municipal Disaster Management Centres as focal points. In the City of Johannesburg, the Johannesburg Roads Agency (JRA) provides focused road transport development and road disaster management plans. Institutional arrangements specific to disaster management for provincial and national road authorities are either not established or not documented. Only municipal authorities provide for disaster risk management institutional arrangements that follow the national and international disaster management guidelines.

4.4.2 Legislative mandate

Programmes which derive their mandate from legislative instruments enjoy enforceability which is critical in public project implementation (United Nations 2015). Governments of India, Japan and USA have enhanced their disaster management systems through strengthened legal frameworks (United Nations 2015). In South Africa, disaster management is a legal mandate in terms of the National Disaster Management Act, also supported by the Constitution of 1996. The International Strategy for Disaster Risk Reduction (ISDDR) is a critical disaster management instrument guiding all countries of the world in the development of measures to deal with types of disasters affecting their citizens. In South Africa, disaster management is a concurrent function and road transport disaster management should be executed by all road authorities, as required and mandated in terms of the Disaster Management Act of 2002.

The municipal sphere in South Africa complies with the legislative requirements for disaster management, as municipal disaster management plans have been

developed by all the metropolitan municipalities. In contrast, policies of national and provincial road authorities do not directly respond or comply with the requirements in terms of the NDMA and the Constitution for disaster management. A number of policy instruments are available, such as the SANRAL Act and Road Policy (White Paper), but prescripts such as Sections 25, 38 and 39 of the NDMA and Section 41 of the Constitution are not provided for in the current sector policy.

4.4.3 Layout and content of the Disaster Management Plan

The occurrence of disasters requires continuous processes and actions to effect prevention or reduction, relieve the severity, ensure emergency preparedness and response, and facilitate repair and rehabilitation. A well-organized road transport policy setting out clear procedures for dealing with flood disaster risk swiftly and effectively is important. The National Disaster Management Centre through its advisory body has already developed guidelines for sectors and entities of government to develop disaster management plans and contingency plans. The US National Preparedness Goal outlines five mission areas from prevention to recovery, while also undertaking risk assessment and continuously addressing institutional capacity issues related to disaster management. The Japanese Disaster Management System includes identified roles and responsibilities for executing disaster management, and includes clearly stated guidelines for response and prompt evacuation. The Indian base plan provides a framework for entities to outline their disaster management activities with roles and responsibilities defined as per the different Emergency Support Functions (ESFs).

The data collected for this study shows that metropolitan municipal authorities that are also responsible for road transport functions attempt to develop their plans in terms of the legislative guidelines, also in terms of the layout and content required to effect disaster management. The disaster plan guidelines itself is a succinct 10-chapter guide explaining what needs to be captured, promising to result in user friendly disaster management sector plans if applied. Neither provincial nor national road authorities nor their agencies attempted to follow the guidelines and produce the legislatively required documents, with only fragmented information often

indirectly related to disaster management to be found in their various policy documents.

4.4.4 Funding arrangements

Disaster management funding arrangements are a critical enabler for all phases of the disaster management cycle and should be integrated into disaster management policies; research shows that investing in disaster risk reduction is a key element of sustainable development finance (Watson, Caravani, Mitchell, Kellett and Peters, 2015). The USA, Japan and India have advanced disaster risk management systems that enable setting aside funds for disaster risk management activities and have developed programmes to extend humanitarian aid to other countries (OECD, 2014). South Africa is among the countries that integrate disaster risk reduction into development planning within a public expenditure management structure (Watson *et al.*, 2015).

Disaster management is the responsibility of each organ of state, similarly funding for flood risk mitigation in road transportation is the responsibility of the respective road authority, in terms of the South African Constitution and National Disaster Management Act. Section 56 of the National Disaster Management Act stipulates that the cost of repairing public infrastructure is borne by the organ of state responsible for the maintenance of the infrastructure. SANRAL has no dedicated flood risk or any road disaster funding but undertakes to preserve and remedy the effect of floods and other distresses through routine and special maintenance arrangements. For provincial roads, there are no guidelines or funding arrangements for road flooding distress, and funding in terms of the National Land Transport Bill also does not cover road transport disaster management. The White Paper on Road Policy seeks to address a sustainable road funding mechanism, but currently none of the road authorities have dedicated funding arrangements to address flood risk or road disaster management issues.

4.4.5 Feasibility of the Disaster Management Plan

The success of any policy depends on its prospects for implementation. Implementation guidelines for public disaster management policy should therefore be developed taking into consideration the emergency and dynamic nature of disaster incidents. As already discussed above, key factors conducive to effective policy implementation required for an efficient public policy (Gasper, 2006) include institutional, legislative, contextual, and funding arrangements. In some policy development contexts, implementation plans, or in some cases action plans, are included as part of the policy framework, and in the South African National Disaster Management Plan Guidelines, Chapter 3 to Chapter 8 should be regarded as a to-do list for disaster management activities.

Data collected and analysed for this study reveal that the three countries, India, Japan and USA are implementing disaster management measures in terms of their different plans, and as a result are experiencing a decline in the damage associated with disasters. Metropolitan road authorities were found to have documented actions to deal with disaster risk challenges. This included a specific focus on flood disaster risk management with respect to road infrastructure by the Johannesburg Roads Agency. SANRAL has put in place measures to relieve distress caused to the road infrastructure by flooding, but the effort seems not to be inclusive in terms of pre-during-post flood risk management aspects. The research identified the fact that no disaster management plans have been developed in terms of the national guidelines by national and provincial road authorities as a shortcoming that needs to be addressed.

4.5 Conclusion

Disaster management is a concurrent function in South Africa similar to the case in countries such as India, Japan and the USA with advanced disaster management systems that are referred to in this study for the purpose of comparison. In the South African policy context, the disaster management function is driven from the national

sphere of government with strong institutional arrangements for disaster management derived from government's highest authority. Institutional arrangements in terms of South African national policy for disaster risk management are similar to that of the three other countries, with the presidency or prime ministers' offices overseeing and holding accountable all role players responsible for disaster management activities. Legislative instruments have also been developed to ensure disaster management; this is significant, as mandates with legislative obligations and guidelines assist the disaster risk management endeavour. The South African National Disaster Management Framework and the disaster management policies presented in this chapter generally provide a guide for the layout and contents of plans for effecting disaster risk reduction. Funding and feasibility of implementation of disaster management activities are also highlighted in the policies.

The South African policy context takes lessons from and shows some similarities in terms of approaches to that of the three other countries referenced in the study, but in the case of the road transport sector critical policy elements are somewhat lacking as highlighted in this chapter. For the purposes of this study, road transport flood disaster policies were drawn from road authorities at national, provincial, and municipal (metropolitan) level. The policies gathered were not flood disaster risk specific, as very little to no road transport disaster risk specific policies from road authorities were found. Metropolitan municipalities developed disaster management plans following the guidelines provided by the available legislative instruments, establishing institutions for disaster management. The layout and contents of municipal policies generally follow the national guidelines, and with funding provided accordingly implementation is also undertaken. Both national and provincial road authorities, to date, have no disaster management policy for road transport, but rely on several policies. Policies currently used do not meet the legislative obligation created in terms of the Disaster Management Act of 2002. Therefore, disaster management practitioners will have to rely on several policies in order to deal with the effect of flood disaster incidents on road transport.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This research is a policy evaluation study, assessing current South African road transport policy on flood disaster risk management. Road authorities in the national, provincial and municipal sphere are responsible for road infrastructure development, and connectivity and accessibility to services. The literature review has revealed that disasters and particularly flood disaster risks pose serious challenges to road infrastructure and services, as they occur. In South Africa, flood disasters are the most frequently occurring natural disasters followed by droughts and fires, and cause the largest natural disaster losses. Between 2011 and 2021 South Africa experienced floods incidences every year in at least more than one province, frequently higher than any other natural disaster risk type. Tropical Storm Eloise which affected 8 provinces of South Africa and caused damages to an estimated cost of \$10 million, which includes Mozambique, Malawi, Mozambique, Swaziland and Zimbabwe. Unfortunately number of factors including climate change and human activities are expected to aggravate and increase the frequency of flood incidences.

Affected road authorities may be overwhelmed by the effects of flooding, and encounter difficulties to restore access and mobility, damage to infrastructure may also be extensive, requiring additional resources and funding for repair and reconstruction. The literature showed that disasters are unpredictable and therefore planning is critical for every sector to build resilience and preparedness in order to reduce the impact, as part of disaster management. Planning in disaster management is a process drawing on various policy instruments, and road transport authorities are required to have policies to guide the management of various disaster risks, including that of flood disasters.

The transport function is a concurrent function of the three spheres, and roads authorities in the national, provincial and municipal sphere are required to deal with

disaster risk affecting mobility and access. Road categories are also derived from the authority owning and maintaining different infrastructure networks; for instance, municipal roads are the responsibility of the respective municipality. Nevertheless, access and mobility are not confined to one municipality and neither is disaster risks confined to any border; therefore flood disaster management on the road transport network concern road authorities in the municipal, provincial and national sphere. Notably, the Department of Transport in the national sphere is required to lead the development of integrated, efficient transport systems by creating a framework of sustainable policies, including disaster risk management policies.

5.2 Conclusions drawn from the study

The purpose of this study was to evaluate road transport policy on flood disaster management, gathering current and available policy instruments to answer the question of whether the current policy is effective in disaster risk reduction. This research study used qualitative research methods, aimed at determining whether measures in the form of policies put forth to deal with flood disaster risk are effective. As a policy evaluation study, the collection and examination of available road transport and disaster risk management policy was successfully executed. Through a desktop research methodology, secondary data was sourced in the form of existing disaster management policies from road authorities across the three spheres of government in South Africa.

Parameters were set in this study over disaster related policy development from identified sources, to avoid instances of data not being readily available over the conditions and limited time of the study. Road transport flood disaster risk management, in as far as it exists within the national context, was the subject of evaluation, South African national disaster management policies were therefore sourced. Furthermore, in providing a baseline for disaster management policy evaluation, secondary data was sourced from three countries known to have the most advanced disaster management systems in the world. Determining whether a policy was good through this research was based on the incorporation of five key disaster management aspects; the data collected gave an overview of the status of

road transport disaster management policy in South Africa. For the purpose of the desktop evaluation of road transport disaster policies within the South African national disaster management policy framework, the selected international examples provided the required baseline.

Progress in terms of South African disaster management policy development and implementation progress in the road transport sector was determined according to the five policy attributes, while the international contexts serve as attributes to measure against. The five policy attributes identified for this study, used in conjunction with the national or federal policies of the identified countries provided this research with a distinctive and objective measure to assess the South African road transport sector disaster management policy context.

Using the research methods as summarised above, the approach to disaster management by road authorities was found not to be based on a single policy concept, neither was there any specific road transport sector policy provision. No guidelines, plans or legislative provisions guiding road sector disaster management in South Africa have been developed, except for the JRA's Flood Management and Stormwater Plan and SANRAL's commitment to remedying the effects of floods. Municipalities responsible for road functions within their jurisdiction are the only entities that have developed disaster management plans, which are notably the current base policy provision for disaster management. Municipal disaster management plans understandably also deal with other functions of the municipalities, but roads are critical assets and flood disasters have also been identified as one of the priority risks in all the municipal disaster risk assessments. National and provincial road authorities draw from several policy provisions to deal with disaster eventualities, and therefore no specific planning and preventative measures are highlighted in relation to flood disaster management.

Institutional arrangements for disaster management relate to key performance area 1 of the National Disaster Management Framework of 2005 and also follow international guidelines, but road authorities do not have policies that align with these prescripts. The Disaster Management Act of 2002 provides the regulatory framework and obligations consistent with countries with advanced disaster management systems, however, the country's provincial and national road authorities are yet to synchronise with the Act and integrate disaster management into their mandate. Disaster eventualities are unpredictable, requiring disaster management systems and protocols to be clear in order to allow prompt action for mitigation, response and recovery; yet no clear protocols and policy provision have been developed by road authorities. The road authorities' piecemeal provisions do not meet the requirements in respect of clear layout and content to guide disaster risk management. No financial or any other resource arrangements have been made for disaster risks affecting road transport. Without predesigned, clear policy provision with allocated resources, the feasibility of policies for dealing with road disaster risks may not be attained as the national and international disaster management guidelines point to funded clear protocols as prerequisite for success.

The current road transport policy may not be efficient in mitigating flood disaster risk. South Africa's current road transport disaster risk management arrangements do not provide an enabling context for an effective policy framework relating to flood disaster risk management guidelines and legislative requirements. Despite the perceived inefficiency, the current policy provides the base for developing a dedicated policy instrument to better manage flood disaster risk as required by legislation. For instance, the White Paper on Road Policy highlights institutional and funding arrangements towards road development and a safe road environment, while the RAMS and RIMS provide for road network and road incidents management respectively. Both the RAMS asset management and RIMS incident management systems are relevant and critical elements in the disaster management policy development context. The research methods used in this study were effective in gaining an understanding of whether planning makes an impact in mitigating flood disaster risks for road transportation. This policy evaluation study, surveying disaster management policy in South Africa comparatively in relation to that of other

countries, indicates the probability of disaster risk reduction if disaster plans are developed and implemented as base disaster management policies.

5.3 Answering the research questions

The first chapter of this report reflects on the importance of the study in attempting to highlight the role of policy development and effective implementation towards disaster risk reduction. Flood disaster was also highlighted as one of the disaster type impacting negatively on road transport services and infrastructure. South Africa relies mainly on road transport for basic and primary access and mobility, and the occurrence of flood disaster affect both access to basic services and delivery of goods (Pregmolato *et al.*, 2017). Road transport is regarded as one of the critical infrastructure in disaster management, and effective policy context on flood disaster reduction is key to reduce the severity of disaster impact (Luskova, 2018; Pregmolato *et al.*, 2017). This section reflects on the effectiveness of the current disaster policy in the road transport sector by answering question/s on flood disaster policy context of South African road authorities.

5.3.1 Subsidiary research questions

Sub-question 1: What is the current level of disaster management policy in the South African road sector?

Road authorities at national and provincial sphere have several policy instruments that relate to disaster issues but these are not structured as guidelines and also do not provide for the sector to comply with legislation as far as policy to deal with road disaster, and flood risk in particular, is concerned.

Sub-question 2: What effect does current policy implementation context have on flood disaster management?

Key elements of road transport required for disaster risk management are fragmented over several policy instruments. In this context, effective flood disaster mitigation is currently unattainable.

Sub-question 3: What is the correlation between planning and flood disaster management?

Disaster Risk Reduction Planning in a disaster management context is a legislative requirement in terms of national laws and global disaster management strategies, and international experience has also revealed an improved level of relief from disaster distress when planning is in place, which points to the interconnectedness of planning and flood disaster management. Road authorities, including SANRAL and the JRA, have some level of road flooding management planning in place.

Sub-question 4: What other failures and successes can be drawn from policy frameworks of other sectors or other countries?

National and provincial road authorities have not developed dedicated disaster management policies, and as a result may be compelled to refer to several policy instruments at the same time, even in a state of emergency. A National Disaster Management Framework has been developed and adopted by metropolitan municipalities and is impacting positively on the national disaster management protocol. The study findings showed that countries developing and implementing disaster plans including contingency plans and protocols are better able to provide relief against disaster and flood risk.

5.3.2 Main research question

How effective is the current policy framework in mitigating the impact of flood disasters affecting South African roads?

The current road policy framework on flood disaster risk includes guidelines, strategies, plans, and acts guiding a number of activities related to road transportation. These varying policy instruments are not meant to specifically deal with floods or any road disaster risk management, making the application and implementation thereof in a disaster management context challenging. Road authorities in the municipal sphere rely on disaster plans developed to deal with all disaster types affecting different service functions of the municipality to better deal

with all disaster risks including that of flooding on roads. While the municipal road authority policies generally show responsiveness and effectiveness in dealing with disaster risks, the level of effectiveness of provincial and national road authorities in dealing with flood disaster risk is low as assessed in terms of critical attributes.

The developed municipal plans are in compliance with Sections 52 and 53 of the Disaster Management Act, Act 57 of 2002, while disaster management policy guidelines at national and provincial road authorities are not compliant with legislative requirements. Apart from achieving legislative compliance, existing municipal plans provide a context of correlation between planning and effective flood disaster risk management. South African disaster planning guidelines and the disaster planning guidelines of the three other countries studied support disaster management plans as base policies and critical for disaster risk management. For the road transport sector to be efficient in terms of flood disaster risk management depends on the level of disaster plans and planning for disaster management. The current road transport sector policy context does not follow national and international disaster management guidelines, and effectiveness on flood disaster risk may not be attained. Efficacy of provincial and national road authorities in the development and implementation of disaster management plans can be attained by adopting best practices from national and international disaster management planning guidelines. Road disaster management plans needs to be developed in terms of the national and international disaster planning guidelines, particularly with strong institutional arrangement, and also follow legislative mandate with funding provision and feasibility for implementation.

5.4 Policy development recommendations

1. From a survey of the current level of disaster management planning, it is clear that the road transport sector has to develop disaster management policies which specifically deal with disaster risk affecting road transport services and infrastructure. All the road authorities and entities should develop policy instruments to fulfil the constitutional obligation of safe and reliable transport

services for the country, and disaster management in terms of the Disaster Management Act of 2002.

2. The starting point should be the development of a base disaster management plan, referred to as Section 25 plans for the national and Section 38 and 39 plans for the provincial spheres. Developed disaster plans and other disaster management policy instruments require effective implementation by each sector to deal with disasters risks, such as floods. Therefore, road authorities across the three spheres including all road agencies should institutionalize disaster management within their entities, in order to develop effective disaster management systems for road disaster risk management.
3. Disaster plans are a legislative requirement in the disaster management context and it was found that entities in different countries prioritized disaster plans to better deal with disaster risks. Metropolitan municipalities and two of the country's existing road agencies have already identified flood disaster risk as a priority disaster risk to be addressed by road authorities. The development of policy instruments in the form of a strategy or plan for dealing with flood disaster risk is critical and should be developed and implemented by all road authorities.
4. A disaster management plan can serve as a base disaster management policy as per the national and international lessons identified through this study; road authorities should benchmark against existing guidelines in the national and international context. Furthermore, following lessons learnt in respect of best approaches, the road transport sector should make available resources, including funding arrangements, to implement policy guidelines for disaster management. Resources are critical for the sector to successfully mitigate and reduce the impact of flood disaster risk on road transportation.

5.5 Recommendations for further study

1. Further research is recommended including an empirical study to determine the level of impact of road transport policy on flood disaster risk management, and the extent to which planning may influence the road transport disaster management context.
2. While the impact of flood disasters on road transportation was the focus in this study, an assessment study of all disaster types and the extent to which they

impact on road transportation for prioritization and informed disaster risk management is recommended as a future study topic.

3. An impact study on the human lives lost, damage and loss of personal properties as a result of road flooding disasters, will add insight into the effects of flood disaster management in terms of the road network on the lives of individuals.
4. Also recommended is a study to investigate the socio-economic impact of road disasters on human livelihoods, the cost of delays in the transportation of goods and services, and the cost of repairing damaged road infrastructure.
5. This study has highlighted planning as a critical variable in the disaster management context; further investigation into the relevance and integration of disaster planning in the road project management cycle is recommended.

Road transport infrastructure is a critical asset essential for access and mobility. Furthermore, the government of South Africa relies on the road transport network for planning and delivery of basic services and economic growth. However, as the investments made into road network development remains under threat from natural disasters, further research is required to determine the external variables that may exacerbate the nature and frequency of flooding incidents that damages road infrastructure, approaches to settlement establishment and planning being among these variables.

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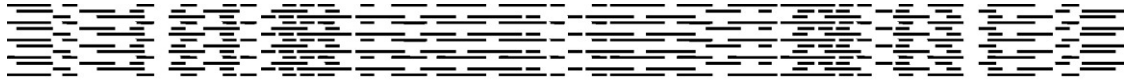
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SCHOOL OF ARCHITECTURE AND PLANNING HUMAN RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE PROTOCOL NUMBER: SOAP053/06/2020

PROJECT TITLE: Impact of planning in mitigating the effect of floods on road transportation

INVESTIGATOR/S: Chuene, Solly (Student No: 520909)

SCHOOL: Architecture and Planning

DEGREE PROGRAMME: Master of Science and Development Planning (MSCDP)

DATE CONSIDERED: 27 November 2020

EXPIRY DATE: 27 November 2021

DECISION OF THE COMMITTEE: Approved

CHAIRPERSON

(Dr Brian Boshoff)

DATE: 2.12.20

cc: Supervisor/s:

Aly Karam

DECLARATION OF INVESTIGATORS

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to endure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

Signature

Date

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