Severe Weather Compound Disaster: June 2007 Cut-off Lows and Their Consequences in the West Coast, South Africa

Financed by
the Provincial Disaster Management Centre

Compiled by
Disaster Mitigation for Sustainable Livelihoods Programme,
University of Cape Town

Executive Summary

The West Coast floods were the result of a cut-off low lasting from the 6th to the 11th of June, and a mid-latitude cyclone which persisted from the 25th to 26th of June. The combination of these two extreme weather events had devastating effects upon the West Coast District Municipal area. While deaths and displacement associated with the severe storms remained limited, the direct economic losses from the two events amounted to R128 million.

This report consolidates the findings of research undertaken following the 'cut-off low events' of June 2007, as commissioned by the National Disaster Management Centre, and departments of Local Government and Housing, as well as Public Works and Transport of the Western Cape Provincial Government.

Overview of the rainfall events and impacts

The first flooding incident was characterised by a cold front which passed through the Western Cape between the 6th and 11th June 2007, and resulted in heavy rain and flooding in Saldhana Bay, Cederberg, Matzikama, Bergrivier and Swartland Local Municipal areas, as well as the West Coast District Municipal area. This extreme weather event was caused by a cut-off low pressure system. Very cold and wet conditions were experienced which resulted in prolonged, heavy rainfall over the West Coast. The second event was caused by a mid-latitude cyclone, supported by a deep upper-air trough, which passed over the cape between the 25th and the 26th of June. The cold front associated with the system extended unusually far north, and its effects were felt as far away as the southern parts of Namibia. Rainfall rates of over 50 mm/day were recorded on the 25 June, less than the earlier event, but still of sufficient magnitude to cause extensive flooding. The municipalities most affected by the second event were those around the Swartland, Hexrivier, Witzenberg and the Cederberg Mountains.

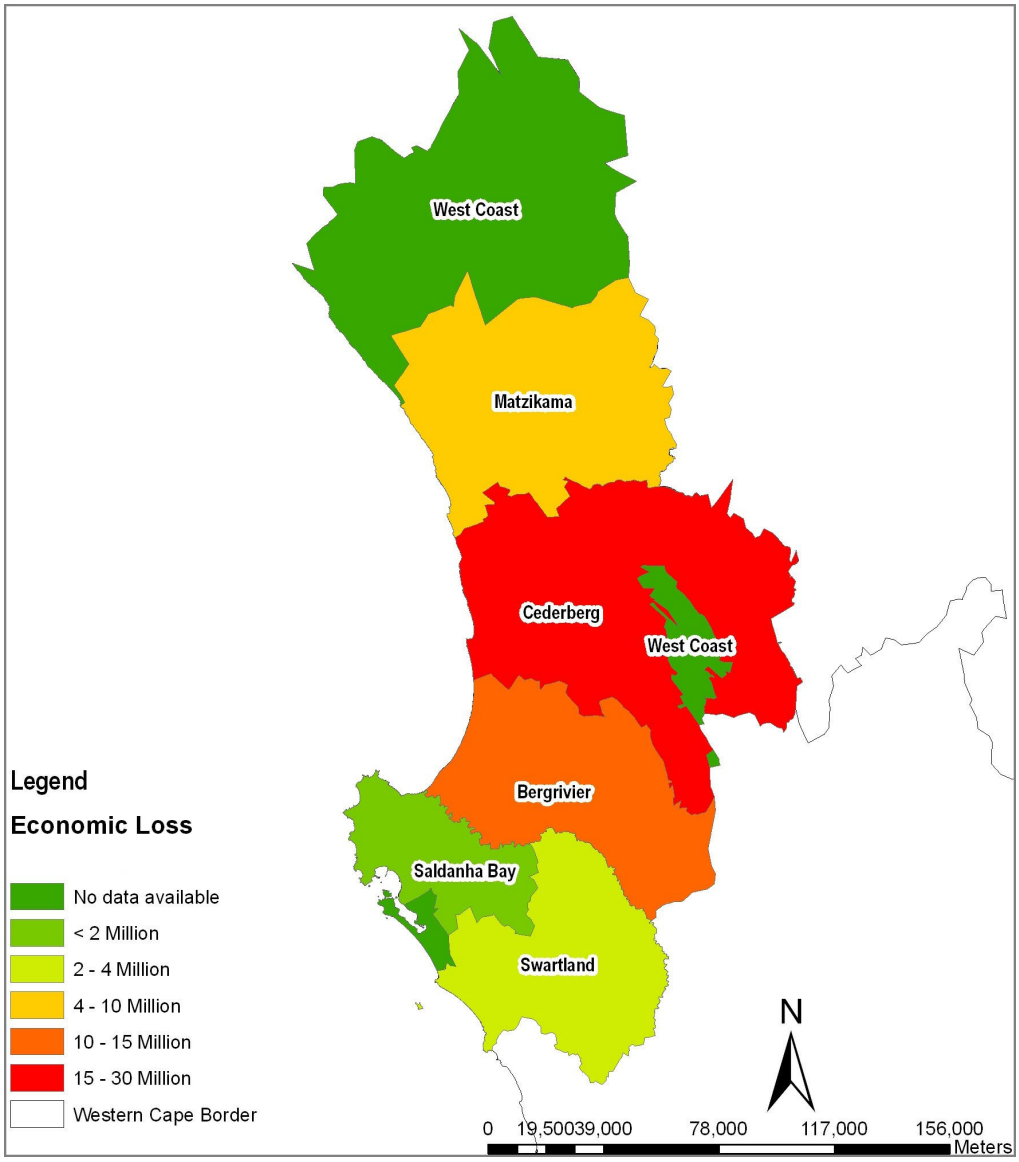
The worst affected sites were in low-lying areas where the storm water drainage systems could not cope with the exceptional downpours. All the Department of Water Affairs and Forestry's (DWAF) dams, such as the Clanwilliam Dam, overflowed during the events, but none of these dams were in structural danger. Many roads were damaged and subsequently closed throughout the affected areas.

Municipalities, with the assistance of emergency services, assisted in rescuing and evacuating people affected by the flooding. The emergency medical services conducted several rescue operations, and reported a rise in motor-vehicle accidents over the period. Three people were killed and several injured in weather-related accidents. In largest accident, a goods train carrying coal derailed just outside Moorreesburg, seriously injuring one person and lightly injuring three others. The municipality and other organisations also provided hundreds of people with temporary shelter, drinking water, food, blankets and clothes. Most of these people were from informal settlements, low-cost housing communities and farm areas. Most of the people affected returned to their homes within a few hours.

Total losses, taking into account both flooding events as reported by the various municipalities, as well as provincial and national departments, including state-owned enterprises, amount to R 128 million resulting from 203 impact incidents.

According to impact data compiled, provincial government departments incurred an estimated R 38 million in direct losses (Table 4.3.3). Of all the departments, the

provincial departments of Agriculture and Transport and Roads sustained approximately 98% of the economic losses associated with the sector, totalling R 37 million.



Overview of economic losses in local Municipality

Summary of main conclusions

Rising disaster losses have been significantly driven by rapid urban growth and expansion

Many of the losses attributed to the extreme weather event were driven by rapid urban growth that has seriously undermined the protective capacities of the natural environment. This is measurably evidenced by the upward trend in weather and run-off-associated infrastructure losses since 2003, suggesting that the 'triple bottom-line' for sustainable regional growth and development may already be compromised.

The district's rapid urban expansion and population growth have not been matched by strategic investments in the redesign or maintenance of critical infrastructure. This is especially indicated by losses to roads and storm-water systems.
Disaster and climate risk management are prerequisites for sustainable integrated development in the West Coast District

Disaster and climate risk management are critical prerequisites for sustainable growth in the West Coast Municipality due to its repeated exposure to both extreme weather and endangering wild-fires. In addition, this recurring pattern illustrates how poorly managed developmental risks have been transformed and transferred onto essential services such as disaster management, emergency services and those responsible for critical provincial and municipal infrastructure.

In this context, there is a pressing need to integrate risk management considerations into the region's spatial and integrated development planning, along with the accompanying financial and human resource allocations.

Reducing the vulnerability of disaster-prone areas, communities and households should be prioritised

The Disaster Management Act (Act 57 of 2002) underscores the need to reduce the vulnerability of disaster-prone areas, communities and households. This would be best achieved by undertaking comprehensive community risk assessments to identify those most at risk, followed by participative community-based disaster risk management planning. In addition, such processes would also assist in identifying the individuals and groups most vulnerable to extreme weather, with a view to prioritising response activities during future events. They would also strengthen participative governance relationships between at-risk communities and local authorities.

Formal low-income homes are made more vulnerable to extreme weather due to a lack of 'weather-proofing' and 'run-off-proofing'

Many of the most at-risk, low-income settlements affected in the June events were situated below road level, and were exposed to endangering run-off due to limited storm water drainage capacity. In addition, poor construction standards increased exposure to heavy rain, run-off and subsidence.

The vulnerability of low-income dwellings to extreme weather events represents an unaffordable pressure on already resource-constrained households. There are currently no provisions or specifications for 'weather-proofing' or 'flood-proofing' low-income dwellings in areas exposed to heavy rain and run-off conditions. However, such measures are crucial in order to protect the assets and health of households living in high risk areas. Housing developments for all economic groups, but especially for lower income groups, should actively incorporate design criteria to avert risks driven by severe weather and surface run-off.

Post-disaster reconstruction provides opportunities to reduce the vulnerability of infrastructure to extreme weather events

The technical demands and administrative complexity of emergency reconstruction were apparent following the June events. Given the tight implementation time-frames imposed, it is to the credit of the technical staff concerned that repairs were completed on time.

The findings of this and previous assessments show an inverse relationship between per capita investment in municipal repair/maintenance and flood/run-off-related losses during heavy rainfall events. This highlights the protective value of investing in maintenance and repair and motivates for increased municipal and provincial expenditure in infrastructural maintenance and upgrading. It also suggests the need for further cost-benefit research to determine the minimum per capita budgetary maintenance/repair allocations and/or investments required to upgrade infrastructure to risk-averse levels.

Despite costly recurrent impacts it is still difficult to generate a spatial agricultural loss profile for the West Coast

The agricultural sector repeatedly sustains the highest losses associated with weather extremes, but agricultural risk management within the province is significantly limited by the absence of geo-referenced loss data. In this context, the Provincial Department of Agriculture is urged to incorporate Surveyor General numbers on its disaster loss reporting forms.

Post-disaster impact reporting and documentation processes require urgent streamlining

Loss estimation research following disaster events is a powerful research method for answering questions such as 'what failed?', 'where did it fail?' and 'why did it fail?' Such research complements more traditional inductive risk assessment processes by highlighting the specific susceptibility of key services and characterising these with respect to external exposure to heavy rain and run-off.

However, onerous reporting requirements have the potential to divert the energies of technical personnel from implementation to administration and reporting. This suggests the need to balance the drive for better data against the numerous demands placed on frontline technical personnel. Reporting processes should be streamlined and harmonised in order to standardise data collection. This will allow for more comprehensive analysis that relevant to multiple activities, such as mobilising funding and post-event risk analysis.

It is important that impact assessment, recovery and reconstruction guidelines are developed consultatively and are accompanied by an orientation process for key provincial and municipal stake-holders on how they are to be applied.

Recommendations for Provincial and National Departments

Introduction

Provincial recommendations are organised by sector or department, and cross-referenced to the appropriate section in the report in the right-hand margin.

Ref.	Provincial Department	Recommendation
5.2.1	Agriculture	All agricultural losses should be accompanied by SG number. The Provincial Department of Agriculture should incorporate S.G. numbers in to its disaster loss reporting forms

5.2.2	DWAF	Areas and infrastructure adjacent to and downstream from rivers where gauging stations have repeatedly failed should be identified and mapped as 'flood-risk exposed' for planning purposes
5.2.3	Education	Attention should be given to assessing and improving the rain and wind resistance of roofs in school buildings, especially primary schools
5.2.4	Housing	Formal housing should: not be sited in flood or run-off exposed locations without robust storm-water capacity and foundations low-income dwellings should be constructed to meet minimum design criteria for extreme weather events, including severe storms, heavy rains and strong winds
5.2.5	PDMC	In cooperation with the NDMC and other key role-players, the PDMC should: engage with National and Provincial Treasury to explore financial provisions for restoring critical infrastructure beyond replacement standards to risk-averse levels engage with the South African Institute of Engineers to establish a mechanism for mobilising skilled engineers after extreme-weather processes and other disasters for post-event assessment and reconstruction engage with risk-prone municipalities and relevant provincial departments about practical strategies for reducing climate risk impacts on vulnerable infrastructure establish standard impact reporting procedures for municipalities and government departments prepare simple technical, administrative and financial guidelines that streamline impact reporting formats and the management of emergency reconstruction. This includes ensuring that all municipal and provincial (especially infrastructural) losses are geo-referenced using a GPS ensure that a dedicated person is appointed to track the impact of extreme weather in each municipality and ensure that data are submitted with a detailed report of each impact
5.2.6	Roads	The failure of provincial roads in the West Coast should be averted through urgent investments in upgrading and risk-proofing vulnerable sections critical to the regional economy, along with upward adjustments in repair and maintenance budgets
5.2.7	Social Development	An unambiguous provincial protocol for social vulnerability assessment of at-risk households should be developed and applied after each extreme weather event

Recommendations for District and Local Municipalities

Introduction

Municipal recommendations are organised by sector or department, and cross-referenced to the appropriate section in the report in the right-hand margin.

Ref.	Thematic Area	Recommendation
5.3.1	Civil and Technical Services	Municipal maintenance and repair should be prioritised and funded as front-line climate and disaster risk management services for municipalities exposed to extreme weather Reducing and managing endangering run-off should be prioritised, as should harvesting run-off to strengthen adaptive capacity during drought. This includes: protecting remaining natural flood attenuation capacity wherever possible to minimise excess run-off investing more vigorously in robust storm water, bridge and road infrastructure to avoid repeat failures investigating and/or rigorously applying municipal incentives and deterrents to reduce agricultural, commercial and residential run-off investigating and/or rigorously applying incentives and deterrents to encourage rainwater and run-off harvesting that minimise the impact of future droughts
5.3.2	Development Planning	Future urban expansion on the West Coast should actively incorporate risk reduction considerations into spatial development and integrated development planning processes Integrated climate adaptation and disaster risk research should be undertaken to determine the relationship between urban development and hydro-geological risks in the district, especially in areas where there is evidence of recurrent impacts. Areas and infrastructure adjacent to and downstream from rivers where gauging stations have repeatedly failed should be identified and mapped as 'flood-risk exposed' for planning purposes Risk reduction considerations should be integrated into all local planning and regulatory processes. These include: tightening land-use regulations to avoid further damage to protective environmental services incorporating risk assessment for flooding, run-off, slope failure and subsidence into all future environmental impact assessments

		For weather exposed infrastructure, it is recommended that the authorities: investigate existing design criteria for critical infrastructure, especially roads and storm water to determine their usefulness and susceptibility to extreme rainfall events 'rethink' investment, environmental, engineering and human resource strategies for risk-averse infrastructure develop decision-making models that evaluate the relative strengths of different proactive investment strategies for upgrading and maintaining critical road and other infrastructure to offset future losses from expected extreme weather investigate the viability of risk insurance options as potential risk transfer mechanisms to ease financial pressure on weather-exposed municipalities Integrated development planning should be used as an opportunity to reduce, not increase the exposure of poor households to endangering surface run-off, rain and subsidence damage
5.3.3	Disaster Management	With specific respect to disaster and climate risk assessment: Integrated climate adaptation and disaster risk research should be undertaken to determine the relationship between urban development and hydro-geological risks, especially in areas where there is evidence of recurrent impacts Areas and infrastructure adjacent to and downstream from rivers where gauging stations have repeatedly failed should be identified and mapped for planning purposes Suburbs and settlements that required emergency assistance due to the extreme weather, flooding and surface run-off should be identified and mapped as risk-prone for risk management planning. With specific respect to risk reduction planning: A Disaster Management Advisory Forum should be urgently established and identify a skilled and committed multi-stakeholder task team to identify strategies for mitigating extreme weather-associated risks Spatial loss and impact information from extreme weather events should be incorporated into integrated

		planning processes, to highlight at-risk sites and settlements Existing disaster management capacity should be urgently increased to manage the wide-ranging demands of post-event recovery, as well as risk reduction planning and preparedness and response Comprehensive community-based risk assessments should be conducted in at-risk communities. These should feed into participative community-based disaster risk management planning processes Creative, locally relevant, robust and sustainable risk reduction measures should be identified and communicated among residents of at-risk settlements With specific respect to preparedness and response: Contingency planning for at-risk communities and settlements should be undertaken consultatively, well in advance of a weather alert Formalised systems should be established for communicating and confirming understanding of warning information among government and non-governmental role-players Warning information, as well as response and relief updates, should be communicated in multiple, context-specific and language-appropriate formats Warnings should be communicated in appropriate formats to households and settlements known to be exposed to extreme weather, surface run-off and flood risk Institutional arrangements with respect to the JOCs and mini-JOCS should be formalised and agreed on by critical stake-holders well in advance of extreme weather events An effective and inclusive contingency plan should be in place for response and relief that ensures timely and equitable assistance to high-risk settlements With specific respect to post-disaster reporting: An initial assessment of affected infrastructure should be taken directly after a weather event. This should be revisited a month later Only infrastructure for which the municipality is directly

		responsible should be recorded. All other infrastructure should be referred to the sectors or departments responsible for the specific infrastructure All municipal impacts should be recorded, even if funding is not needed, with a view to identifying extreme weather 'hot spots' for improved risk management There should be uniformity across all municipalities and sectors for calculating and presenting damage costs. These should be accurate and not presented as estimates
5.3.4	Urban Planning	Climate and disaster risk management should be integrated into urban planning and budgeting processes. This includes: incorporating technically robust disaster risk assessments in the planning phase of all major developments in weather-exposed locations upgrading critical bridge, road and storm water infrastructure to risk-averse levels Sewage treatment plants sited near to rivers at risk of flash flooding should be identified and flood-proofed

Recommendations for South African Weather Services

Introduction

Recommendations for SAWS are reflected in the left-hand column with explanations given in the right-hand column in the table below.

Ref.	Thematic Area	Recommendation
5.4.1	Warning content	Warnings should be differentiated, stating different levels of anticipated extreme weather risk. Extreme weather warnings should, where possible, provide expected values for rainfall and wind speed. Weather warnings should include descriptions of likely localised impacts.
5.4.2	Timing of warnings	Warnings need to provide end-users with time to respond. Extreme weather warnings should be issued at least a day in advance, earlier wherever possible.

5.4.3	Dissemination	Weather warnings should be communicated directly by telephone to key provincial officials and municipal managers in the areas likely to be affected. While the SMS system is a very effective and rapid means of communication, phone calls are less easily disregarded and provide opportunity for questions of clarification

Acknowledgements

The Disaster Mitigation for Sustainable Livelihoods Programme would like to formally acknowledge the many individuals who contributed time, insights and information in the course of this review. In this context, DiMP appreciates that many of those who provided information faced multiple demands during the research process – including post-event relief and reconstruction, as well as other reporting responsibilities. While it is not possible to list all those who gave their time, information and insights in the course of this review, we would particularly like to acknowledge the following individuals.

With specific respect to detailed loss information provided from provincial departments, municipalities and other governmental and private sector entities, we would like to sincerely thank Louise Zikmann, At Botha, Lars Stake, Tania Bergh, Jacques Wentzel, Philip Humphreys, Leon Sprong, Dale Morgan, Colin Cyster, Bertrand van Zyl, H.G Esterhuysen, David Tshobotlwane, Dalene Vraagom, Jan Steyn, Viwe Balfour, Johan Meij, Siwe Mabula, Ronelle Pieters and Elvin Pedro.

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List of acronyms

DEAT	Department of Environmental Affairs and Tourism
DiMP	Disaster Mitigation for Sustainable Lievlihoods Programme
DWAF	Department of Water Affaires and Forestry
EMS	Emergency Medical Services
EIA	Environmental impact assessment
GMT	Greenwich Mean Time
JOC	Joint Operation Centre
GIS	Geographical Information System
GPS	Global Positioning System
NDMC	National Disaster Management Centre
NGO	Non-governmental organisation
PDMC	Provincial Disaster Management Centre
SAA	South Atlantic Anticyclone
SAPS	South African Police Services
SAWS	South African Weather Service
SANRAL	South African National Roads Authority Limited
SMS	Short message service
SG	Surveyor General numbers
UCT	University of Cape Town

Part 1: Background, Conceptual Framework and Methodology

1.1 A brief overview of the June events

The disastrous flooding that took place in June 2007 was as a result of two cut-off low weather systems, which had devastating effects on the West Coast region and many surrounding areas. The worst affected areas were the towns of Moorreesberg, Hopefield, Vredenburg and Citrusdal all located in the southern parts of the region.

The first flooding incident was characterised by a cold front which passed through the Western Cape between the 6th and 11th June 2007, and resulted in heavy rain and flooding in Saldhana Bay, Cederberg, Matzikama, Bergrivier and Swartland Local Municipal areas, as well as the West Coast District Municipal area. This extreme weather event was caused by a cut-off low pressure system. Very cold and wet conditions were experienced which resulted in prolonged, heavy rainfall over the West Coast. The second event was caused by a mid-latitude cyclone, supported by a deep upper-air trough, which passed over the cape between the 25th and the 26th of June. The cold front associated with the system extended unusually far north, and its effects were felt as far away as the southern parts of Namibia. Rainfall rates of over 50 mm/day were recorded on the 25 June, less than the earlier event, but still of sufficient magnitude to cause extensive flooding. The municipalities most affected by the second event were those around the Swartland, Hexrivier, Witzenberg and the Cederberg Mountains.

The worst affected sites were in low-lying areas where the storm water drainage systems could not cope with the exceptional downpours. All the Department of Water Affairs and Forestry's (DWAF) dams, such as the Clanwilliam Dam, overflowed during the events, but none of these dams were in structural danger. Many roads were damaged and subsequently closed throughout the affected areas.

Municipalities, with the assistance of emergency services, assisted in rescuing and evacuating people affected by the flooding. The emergency medical services conducted several rescue operations, and reported a rise in motor-vehicle accidents over the period. Three people were killed and several injured in weather-related accidents. In largest accident, a goods train carrying coal derailed just outside Moorreesburg, seriously injuring one person and lightly injuring three others. The municipality and other organisations also provided hundreds of people with temporary shelter, drinking water, food, blankets and clothes. Most of these people were from informal settlements, low-cost housing communities and farm areas. Most of the people affected returned to their homes within a few hours.

1.2 Conceptual Framework for this Study

In the past, severe weather events such as cut-off lows would have been understood as 'natural disasters', or 'Acts of God'. International best practice now recognises that disasters result from the interplay between natural or other threats – hazards - and conditions of socio-economic, environmental or infrastructural vulnerability. Normally, a hazard is viewed as an external phenomenon with the potential to cause harm, while vulnerability refers to the internal characteristics of the household, community or area exposed to the hazard that increase the likelihood of loss. In this context, it is no longer correct to state that a storm 'caused' a flood, but rather to state that the storm 'triggered' the flood.

A disaster is said to occur when a vulnerable household, community, city, province, business, ecosystem or physical structure is subjected to a hazard which it cannot withstand, or from which it cannot recover without external assistance. In this conceptualisation, any specific level of disaster risk faced by a household, community or area is shaped by both hazard and vulnerability conditions, and can be broadly understood as the probability of losses which a household, community or municipality cannot resist or recover from without outside help.

In the case of June disasters, the originating hazards were the weather systems (both singly and together), which brought heavy rain, strong coastal winds and cold temperatures. The systems interacted with aged and structurally inadequate storm water infrastructure, which was unable to cope adequately with the heavy run-off conditions, triggering 'knock-on' structural failures in roads, houses and other infrastructure.

This report examines the nature of the June extreme events, the authorities' response to the events, the key sites of vulnerability and the cost of the events.

1.3 Ethical Considerations

In order to ensure the confidentiality of the information provided by a wide range of resource people and institutions, individuals consulted in the course of this study will not be referred to by name, but rather by their official designation, or as representatives of specific organisations.

UCT/DiMP acknowledges that the research team conducted most of its field research in the immediate aftermath of the extreme weather events, when local residents and government officials in the affected areas were under severe stress, particularly where there was limited skilled human capacity. In this context, the team has, wherever possible, balanced the need for a fair reflection of the disaster's impact, with a realistic appreciation of the numerous priorities, constraints and challenges faced by those responding the events.

1.4 Limitations of the Research

Although every attempt has been made to capture correctly the events surrounding the June 2007 cut-off lows, it was impossible to consult with all those affected. Similarly, given that the events affected four district municipalities across a wide range of sectors, it was not possible to document in great detail the implications of the storms for a specific geographic area or sector. The research was also constrained by unevenness in the recording and documenting storm-related damage, as well as the lack of streamlined processes for recording impacts and losses. Such constraints were particularly pronounced in reproducing the institutional links that either enabled or limited an effective response. This may have resulted in unintended misinterpretation of the information collected.

1.5 Structure of this Report

This report is divided into five parts. Following this introduction:

Part 2 provides an overview of the biophysical aspects of the disaster event, specifically the meteorology, flood hydrology and land-use characteristics that contributed to its severity.

Part 3 examines the authorities' response to the events, including the addresses the institutional arrangements, and local government's institutional capacities for risk reduction, emergency management and recovery and rehabilitation.
Part 4 focuses on the direct economic impacts of the events
Part 5 focuses on conclusions and recommendations.

The appendices provide examples of data collecting instruments and summary tables, as well as a list of people contacted.

Part 2: The June 2007 Cut-off Lows: Extreme Weather

This section examines the biophysical characteristics of the August 2006 cut-off lows, and is divided into three parts: the historical rainfall patterns of the area, a meteorological report for the time period and a synoptic discussion of the events.

2.1 Historical Rainfall Climatology

The west coast's rainy season generally spans May to August, with rainfall levels peaking in June. Most rainfall is brought by mid-latitude cyclones, which are common during these months. Historical data shows considerable spatial variability in average monthly rainfall in the region. Average June rainfall for the last 76 years (Figure 2.1.1) show values close to 90 mm/month in the southern parts of the affected region (Darling station), but tends to decrease toward the north, with Vanrhynsdorp receiving 30 mm/month. The mountainous regions inland from the coastal plain receive higher rainfall due to their orography, as illustrated by the Citrusdal weather station, which receives an average 70 mm/month.

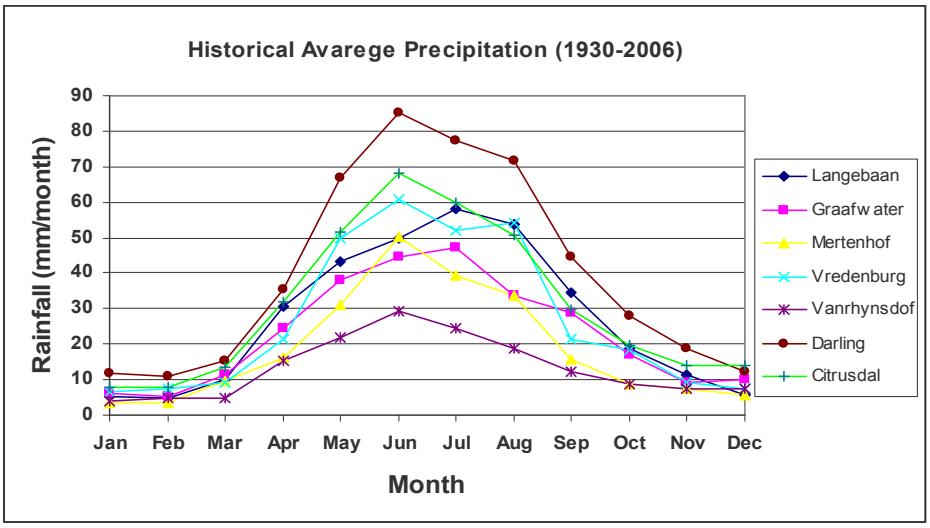


Figure 2.1.1: Monthly rainfall climatologies for stations in the affected region.

Figure 2.1.2 shows June rainfall totals dating to 1900 and 1925 for selected stations. A number of years where June rainfall exceeded 200 mm/month have been recorded at Darling station: 1920, 1943 and 1995, with 1920 being the highest (~240mm). Elandsfontein station, located in the Cedarberg, experienced June rainfall greater than 200 mm/month in 1921, 1927 and 1942, and the total rainfall for June 1962 is one of the highest recorded in the region, exceeding 300mm/month.

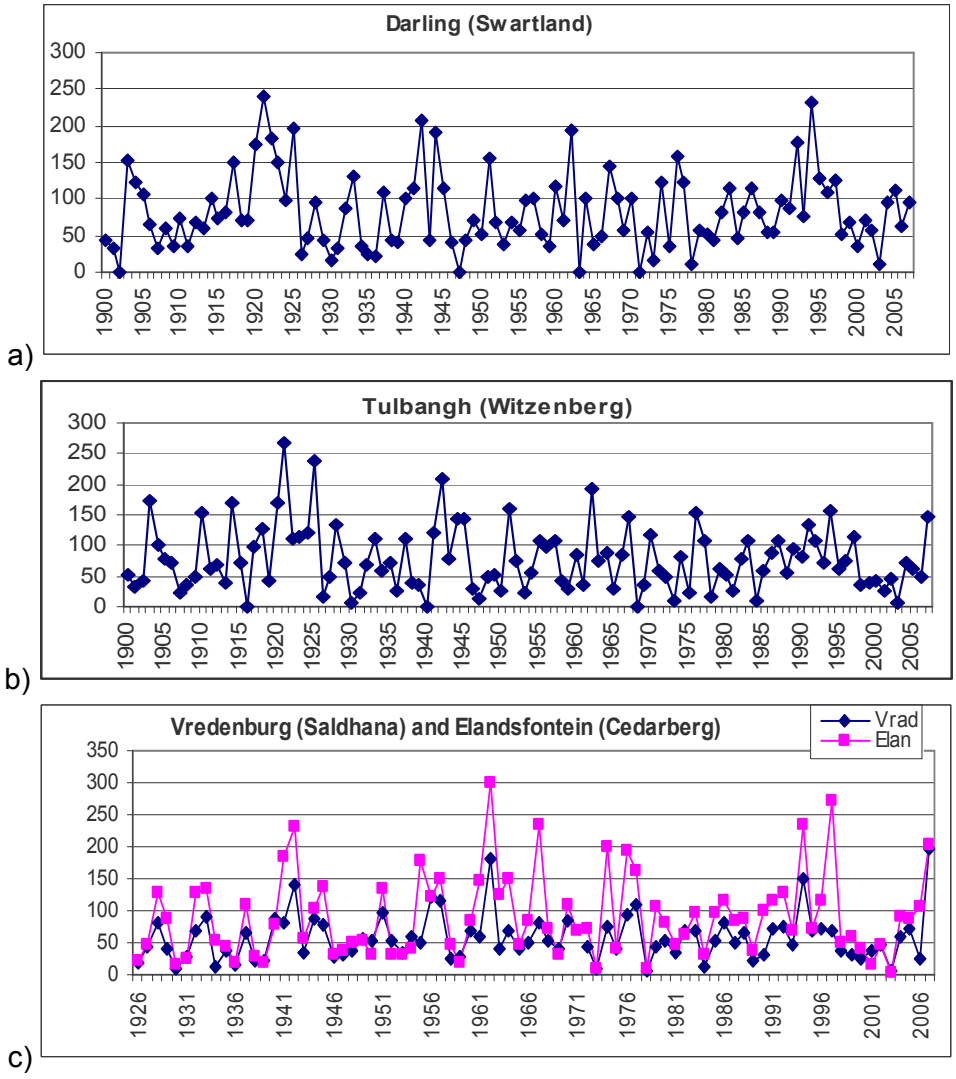


Figure 2.1.2: Historical precipitation totals for June at the a) Darling, b) Tulbach and c) Vredenburg and Elandsfontein stations.

2.2 Meteorological Report

Two major events occurred within a space of 14 days, with some stations recording as much as 150mm of rainfall in a day. The first event occurred between the 6th and 11th of June. The areas affected included the Saldhana Bay, Cedarberg, Matzikama, Bergrivier, West Coast and Swartland municipal areas. Continuous moderate precipitation prior to this period was also recorded in most municipalities, which worsened the flooding. The second event lasted two days, the 25th and 26th of June. The municipalities most affected by the second event were those around the Swartland, Hexrivier, Witzenberg and the Cederberg Mountains. The Southern parts of the region were worst affected by both events, particularly the towns of Moorreesberg, Hopefield, Vredenburg and Citrusdal. As shown in Figure 2.2.1, these are among the most densely populated areas in this region.

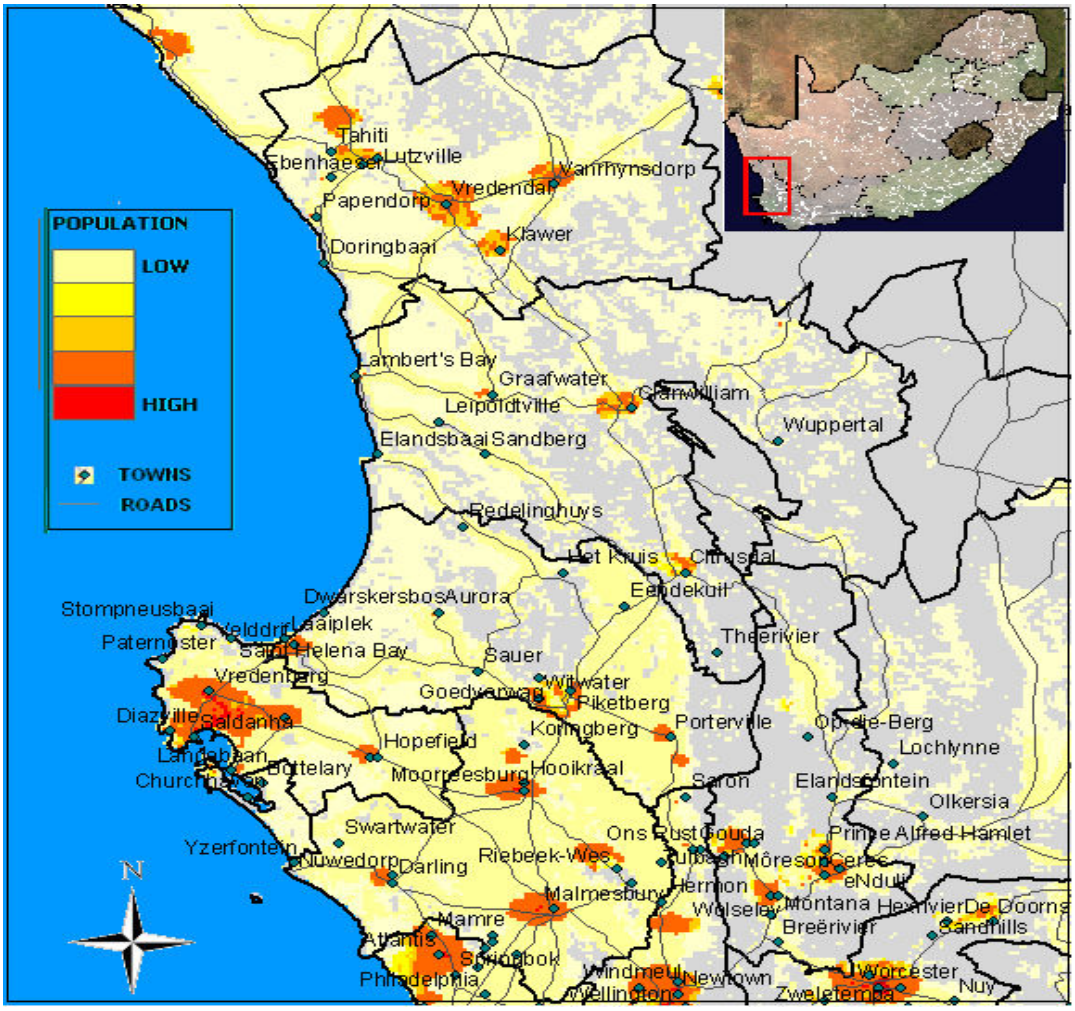


Figure 2.2.1: The geographical region affected by the west coast floods. Shading shows population density.

The heavy rainfall recorded on the 6th and 7th of June was caused by a cut-off low which caused the localised convergence of moisture and uplift over the affected region, which resulted in cloud cover and intense precipitation. The cut-off low remained over the area on the 8th and 9th of June; a frontal system developed, resulting in additional rainfall. On the 10th and 11th of June, the cut-off low dissipated, but the surface low pressure and associated frontal rainfall moved slowly eastwards.

Details of the daily rainfall during the first event are shown in Figure 2.2.2.These spatial maps are based on records from multiple stations within the region. The heaviest precipitation occurred on the 6th of June, when areas around the central Bergriver municipality received rainfall in excess of 130 mm within one day. During the same day, the stations in the Swartland and Saldhana Bay, recorded maximum rainfall levels of 120 mm and 110 mm respectively, while the Cedarberg received 57 mm. The rainfall persisted for the following five days, at lower, but still exceptional levels. Rainfall in the Saldanha Bay and Swartland districts was typically less than 10 mm/day, whereas Bergriver and Cedarberg received more than 20 mm/day.

The second event, on the 25th and 26th of June was caused by a mid-latitude cyclone supported by a deep upper-air trough. The cold front associated with the system extended unusually far north and influenced the southern parts of Namibia.

Heavy rainfalls were experienced on the 25th of June, which resulted in widespread flooding across parts of the Swartland, Hexrivier, Witzenberg and the Cederberg mountains. Stations in the Witzenberg municipality received over 40 mm. Rainfall levels were much lower on the 26th of June, although some isolated stations did experience heavy downpours. See figure 2.2.3.

The total accumulated rainfall for each of the two events is shown in Figure 2.2.4a. The highest rainfall levels recorded during the first event were between 280-318 mm, and were concentrated over the central Bergriver municipality. Some stations in the Cedarberg also recorded rainfall exceeding 230 mm, among them those near Citrusdal, which was one of the areas worst hit by the flooding. For the second event, rainfall was highest in the Witzenberg area, totalling in excess of 50 mm in two days. The second event was clearly much smaller in magnitude than the first. Figure 2.2.4b shows the total rainfall for the month of June, along with difference from the mean of the last 10 years. This indicates that the two extreme events resulted in monthly rainfall levels as much as 200 mm greater than the recent historical average.

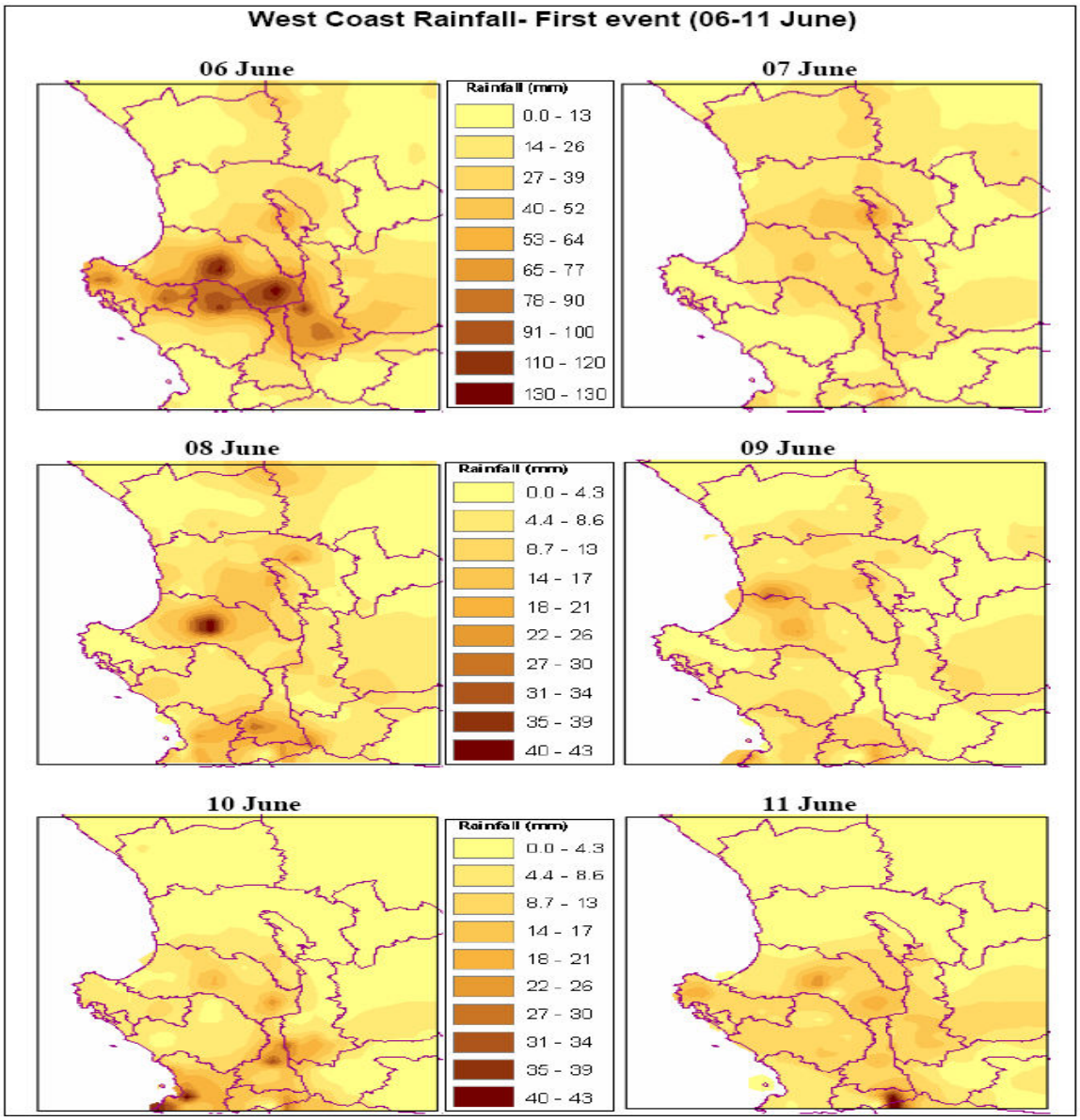


Figure 2.2.2: Daily rainfall from station records for the first event.

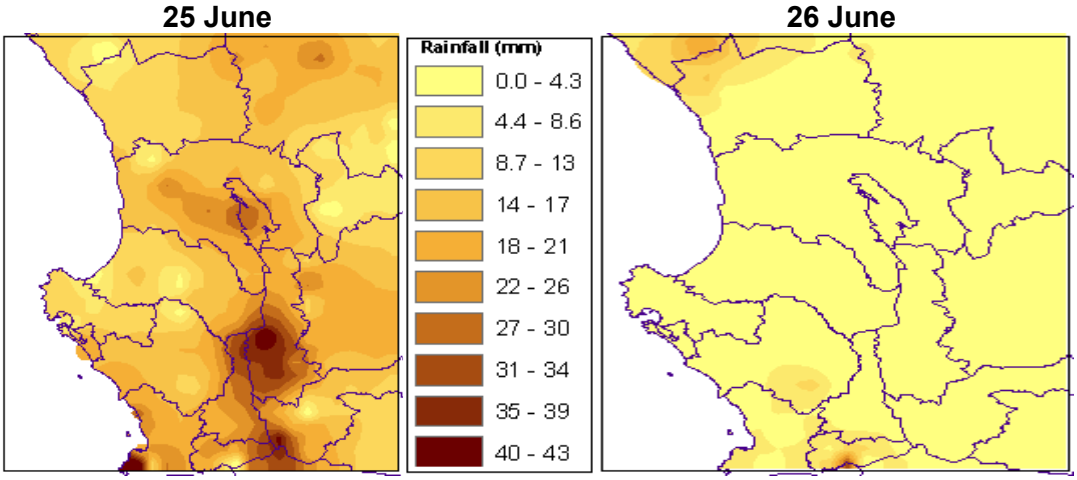
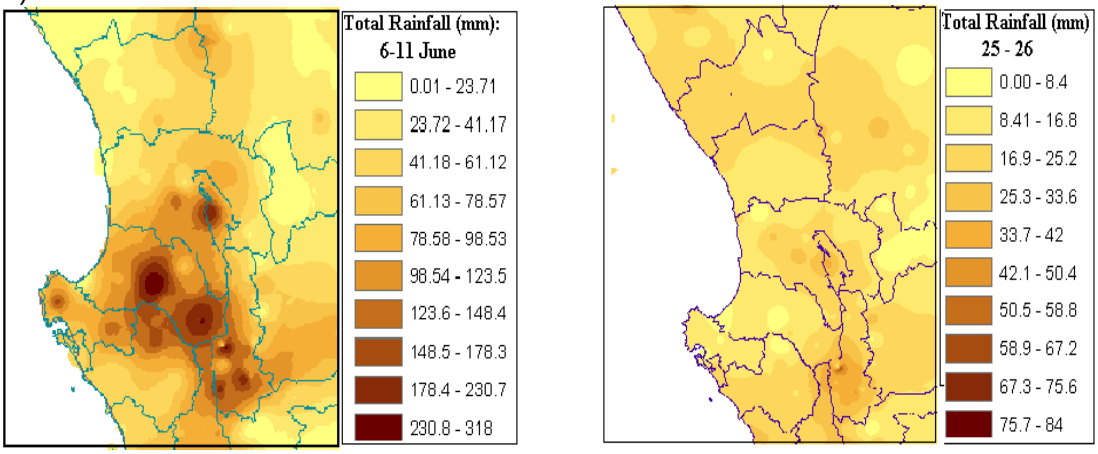


Figure 2.2.3: Daily rainfall from station records for the second event.

a) Accumulated rainfall



b) June total rainfall (2007) June rainfall anomaly

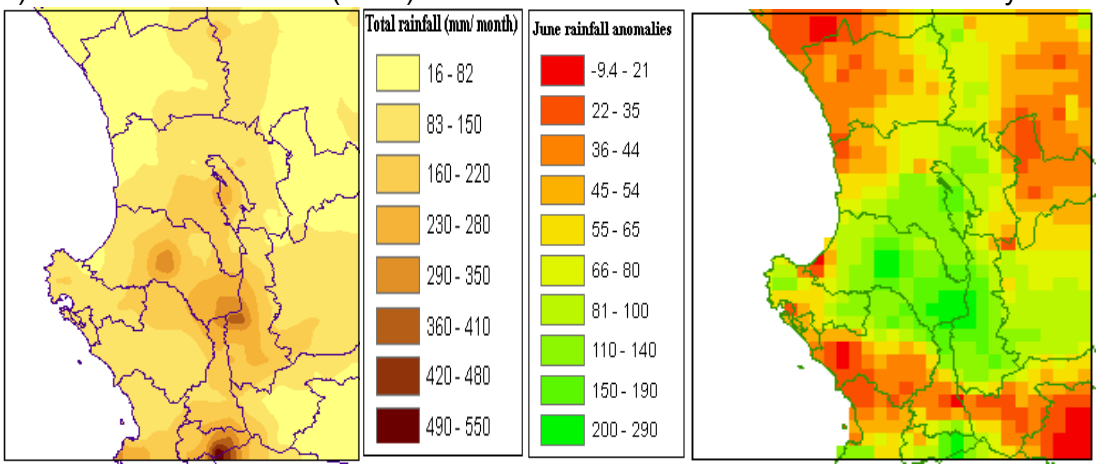


Figure 2.2.4: a) accumulated rainfall for each event and b) total rainfall for June 2007, and difference from 1996-2006 mean.

2.3 Synoptic discussion

2.3.1 Event 1: 6th to the 11th June 2007

On the 6th of June, a well-developed cut-off low was positioned with its centre south of Cape Agulhas. This is shown in the 500 hPa geopotential height field (Figure 2.3.1a, contours). It was accompanied by an upper-air ridge extending over the South Indian Ocean, south of Madagascar, which acted to block the eastward propagation of the cut-off low. At the surface, low pressures (less than 1012 hPa) extended over the west and south coasts of South Africa (Figure 2.3.1a, shading). Surface wind fields over the Western Cape indicated northerly and north-easterly winds over the region at 00:00 Greenwich Mean Time (GMT), becoming westerly and south-westerly by 12:00 (Figure 2.3.1b). Cloud cover (Figure 2.3.1c) extended over most of the Western Cape, but the cloud tops were relatively low (medium grey shades in IR image), apart from some localized areas where the cloud tops were higher (light grey to white shades). A wide cloud band extending from the eastern escarpment to south of Cape Town corresponded to the south-eastern edge of the cut-off low. This is indicative of large-scale transport of moisture from the sub-tropics to mid-latitudes, which is likely to be associated with the convergence of moisture within the cut-off itself.

On the 7th of June (Figure 2.3.2), the centre of the low remained stationary, but the blocking ridge began to weaken. A second cell of low pressure developed to the east of the low's centre. Moderate north-westerly winds continued to blow over the region and heavy cloud cover extended over the western parts of the country at 12:00. The situation remained the same into the 8 June (Figure 2.3.3), but wind speeds increased along the west coast and a well-developed front was positioned over the south-western Cape at 12:00.

By 12:00 on 9th of June (Figure 2.3.4), the low had dissipated, but the surface low positioned to the south of the country deepened (< 1000 hPa), bringing fresh to strong north-easterly winds and low frontal cloud to the Cape Peninsula and West Coast. By 12:00 on the 10th of June (Figure 2.3.5) the surface low had moved eastwards, but a large amount of cloud remained over the Western Cape.

By 12:00 on the 11th of June, the frontal system had moved into the South Indian Ocean (Figure 2.3.6) and the South Atlantic Anticyclone (SAA) had ridged south of the continent, bringing light to moderate south-easterly winds to the West Coast region. Low cloud cover remained over much of the Western Cape.

Event 2: 25th to the 27th of June 2007

At 00:00 on the 25th of June, an upper air trough lay over the west of the country, accompanied by a surface low pressure (Figure 2.3.7a). This brought strong northerly winds to the coastal regions between Cape Agulhas and Cape Columbine (Figure 2.3.7b). At 12:00, the upper-air trough was positioned over the West Coast, while the surface low developed a deep centre (< 992 hPa) situated to the south of the continent. The cold front associated with this mid-latitude cyclone is clearly shown in the IR satellite image for 12:00, with cloud extending along the west coast into Namibia (Figure 2.3.7c). The frontal zone was also characterized by a pronounced change in wind strength and direction, with light to moderate north westerly winds on its leading edge, backing to become strong southerly behind the front.

On the 26 June (Figure 2.3.8), an upper air ridge over the South Indian Ocean inhibited the eastward propagation of the trough, but by 12:00 a relatively weak cut-off low developed over the eastern parts of the country. This, accompanied by a ridging SAA, brought southerly and south easterly winds to the south-western Cape coast. The scattered cloud cover and cold conditions following the front were associated with localised rain squalls.

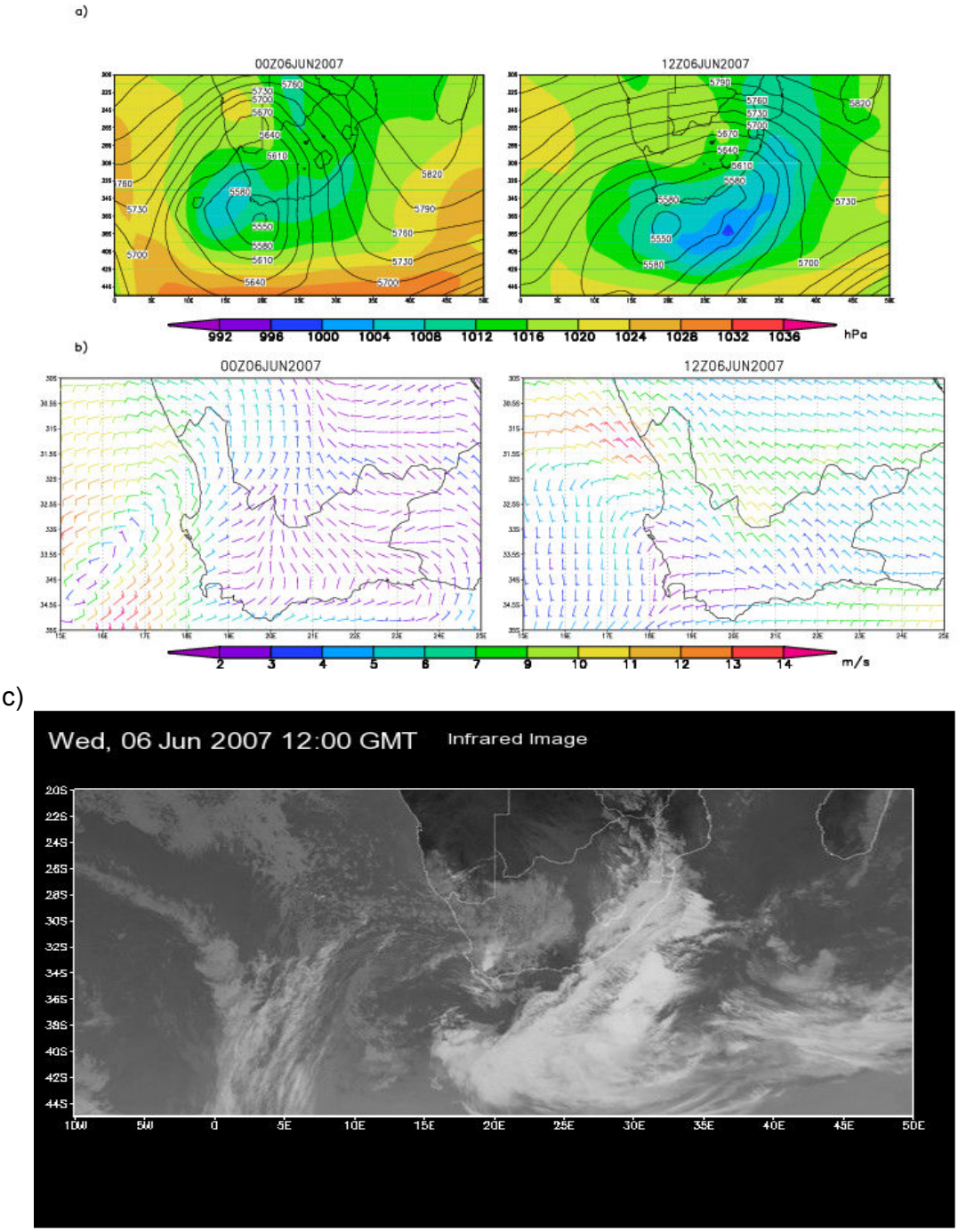


Figure 2.3.1: 6th of June 2007: a) GFS sea-level pressure (shading) and the height of the 500 hPa pressure level (contours) b) GFS surface winds and c) Meteosat 9 infrared satellite images. Times are given in GMT.

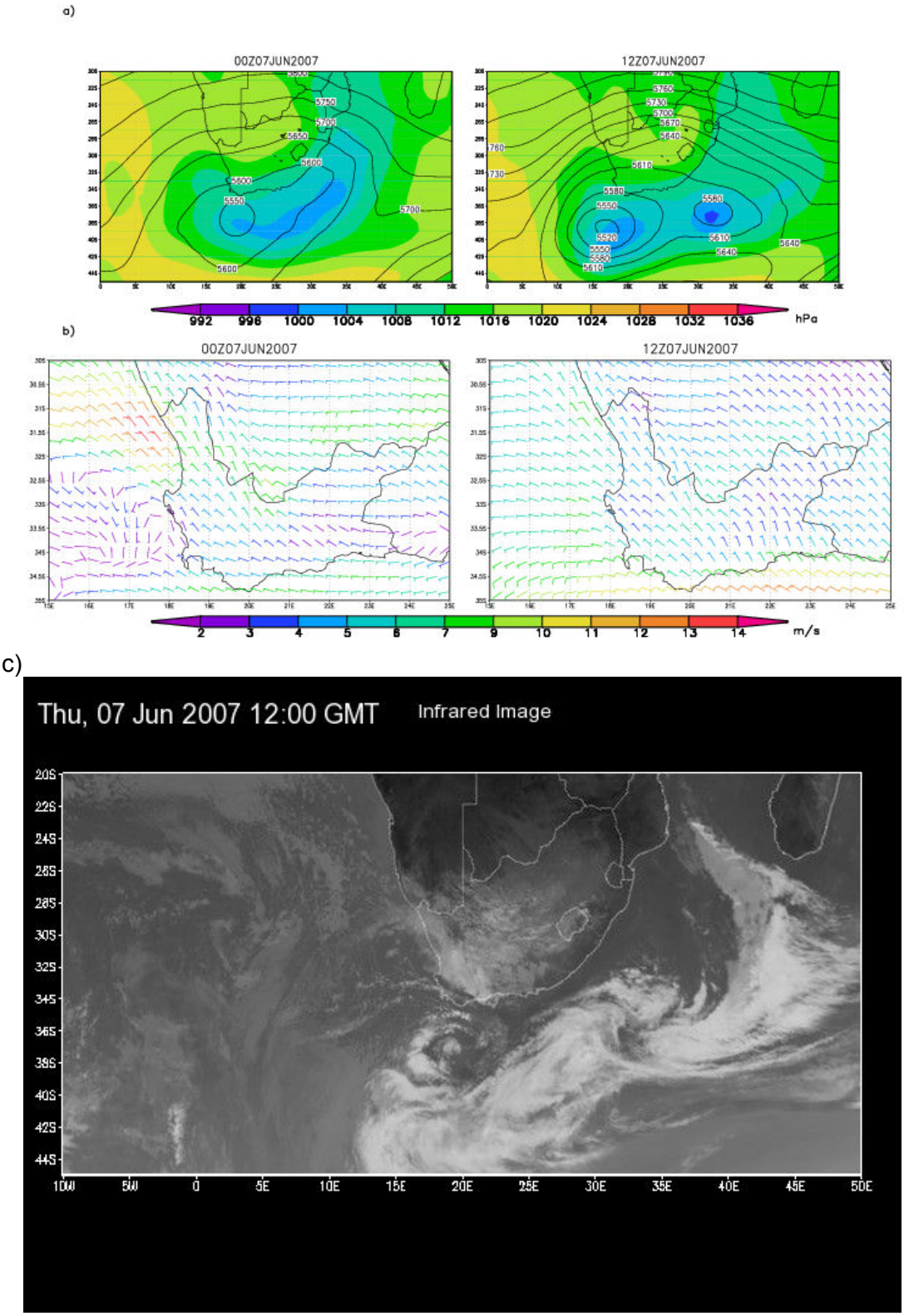


Figure 2.3.2: As per Figure 2.3.1, but for 7 Jun 2007.

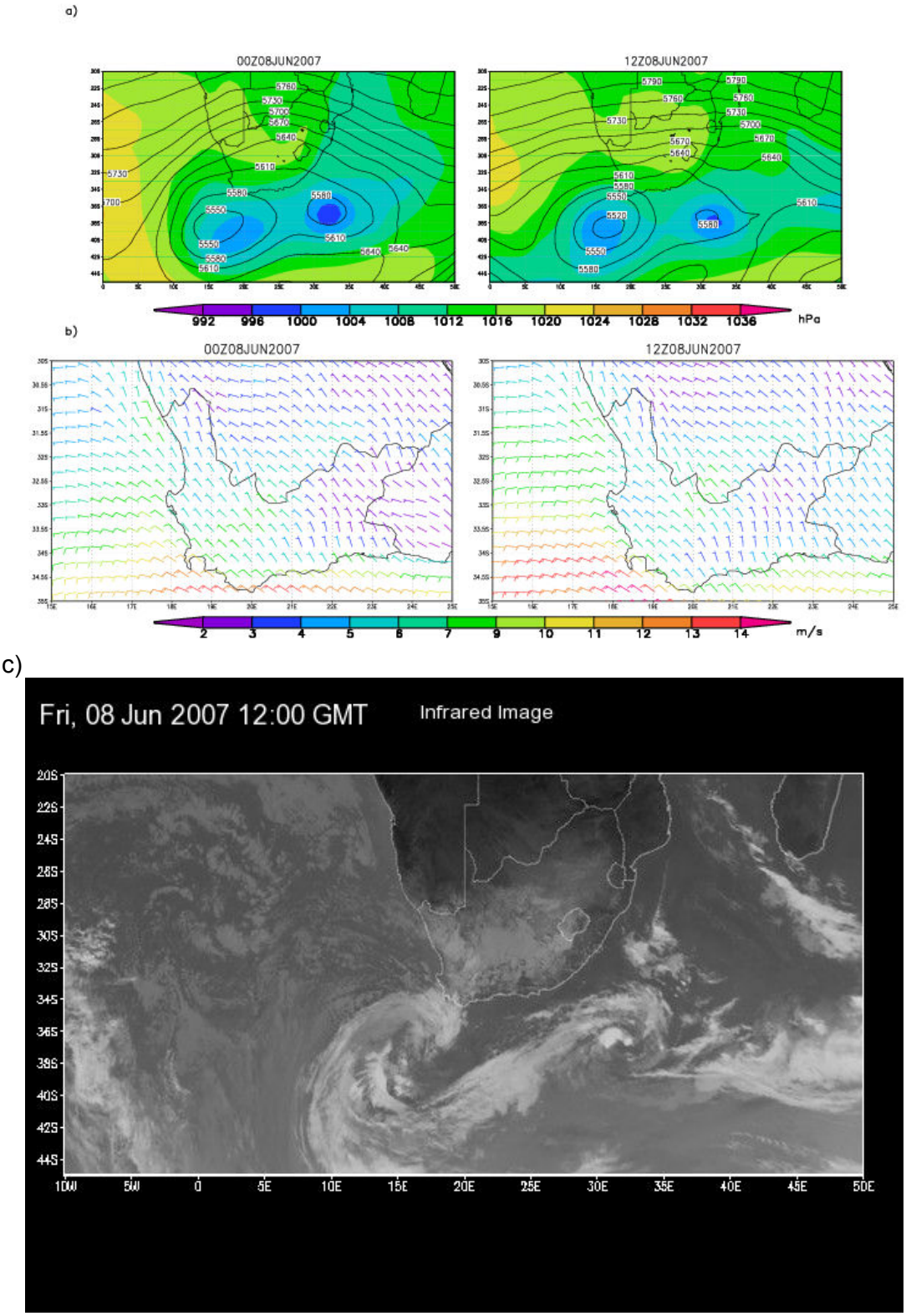
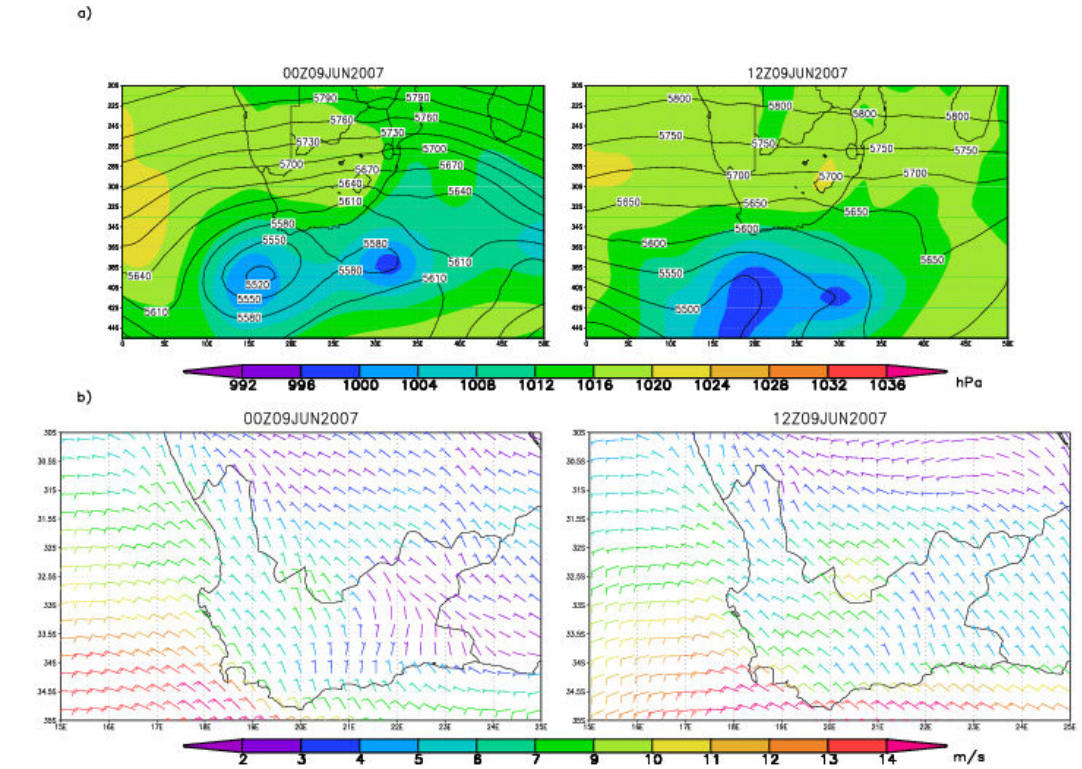


Figure 2.3.3: As per Figure 2.3.1, but for 8 Jun 2007.



c)

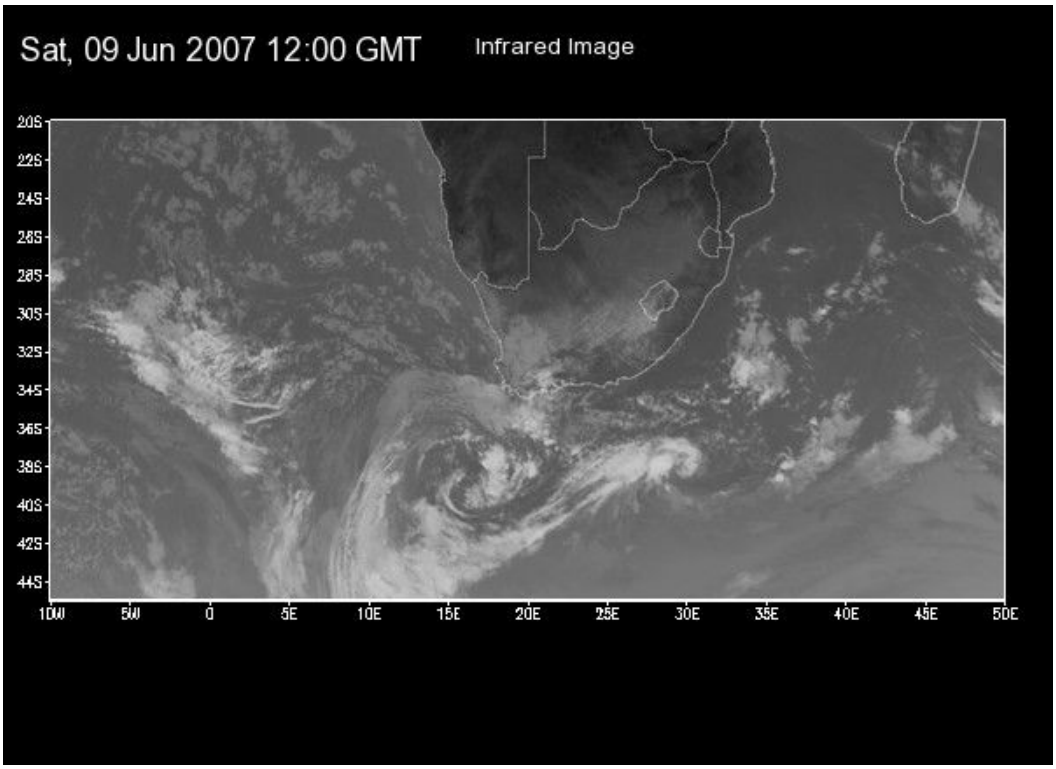


Figure 2.3.4: 9th of June, as per Figure 2.3.1.

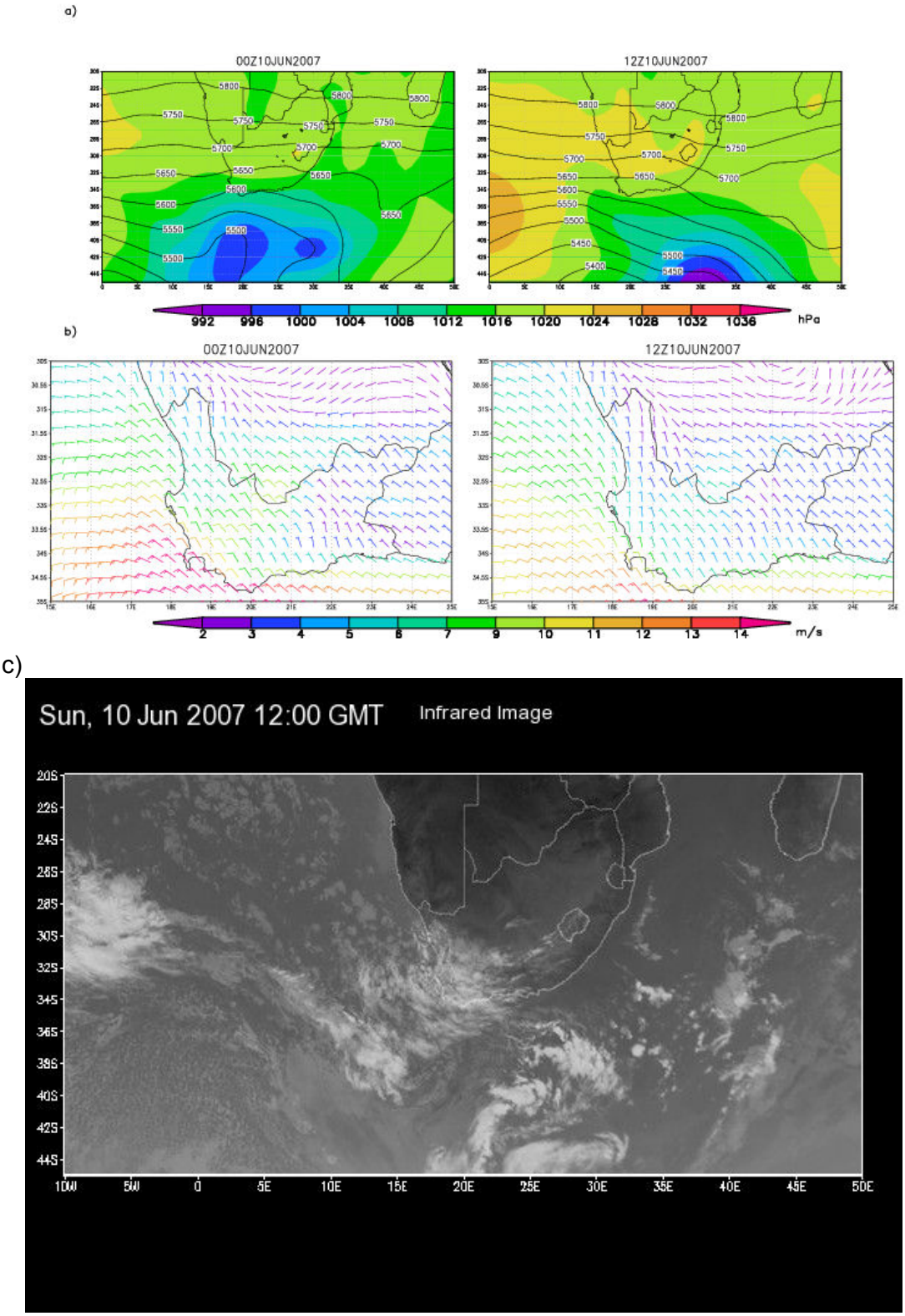


Figure 2.3.5: 10th of June 2007, as per Figure 2.3.1.

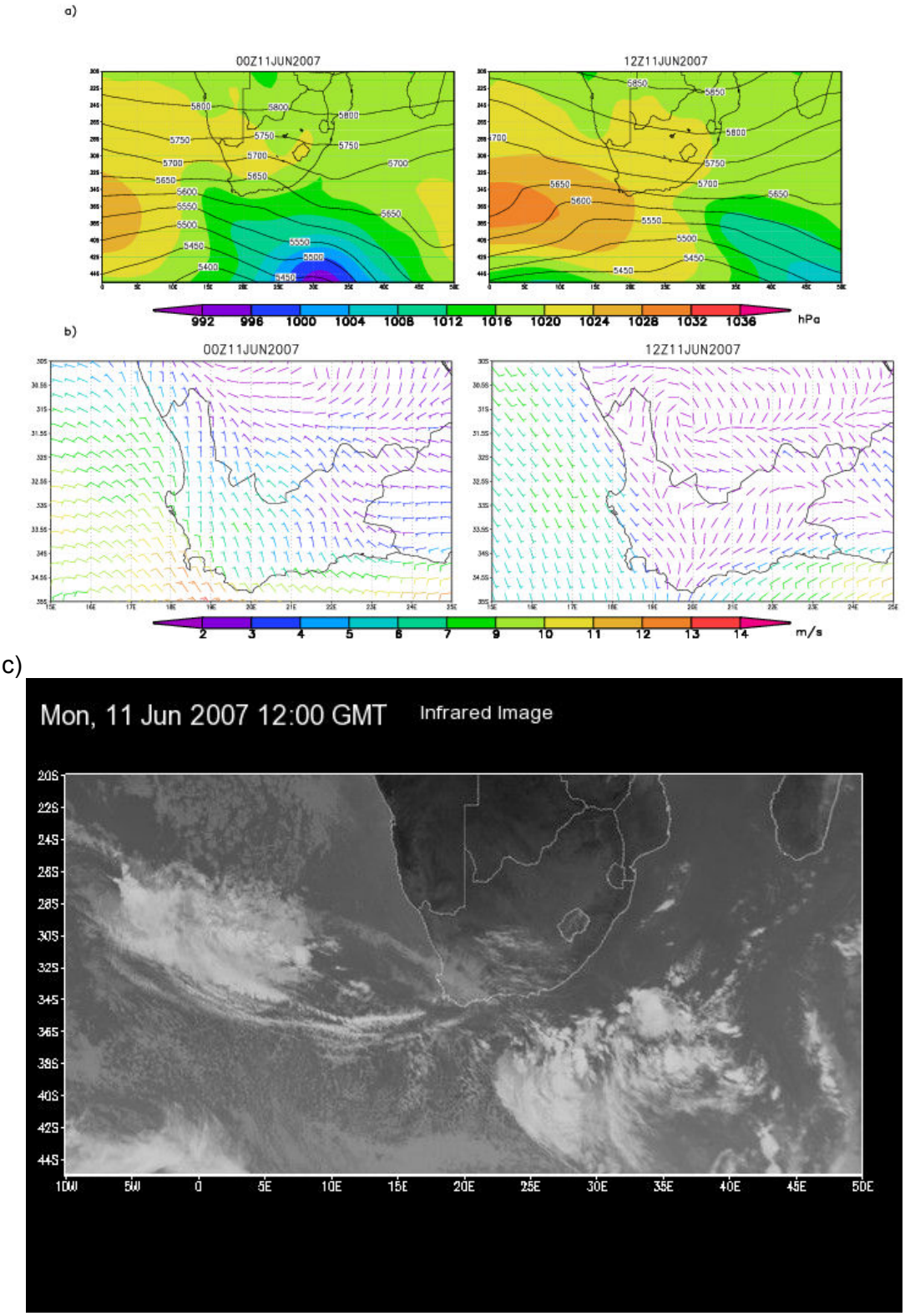


Figure 2.3.6: 11 June 2007, as per Figure 2.3.1

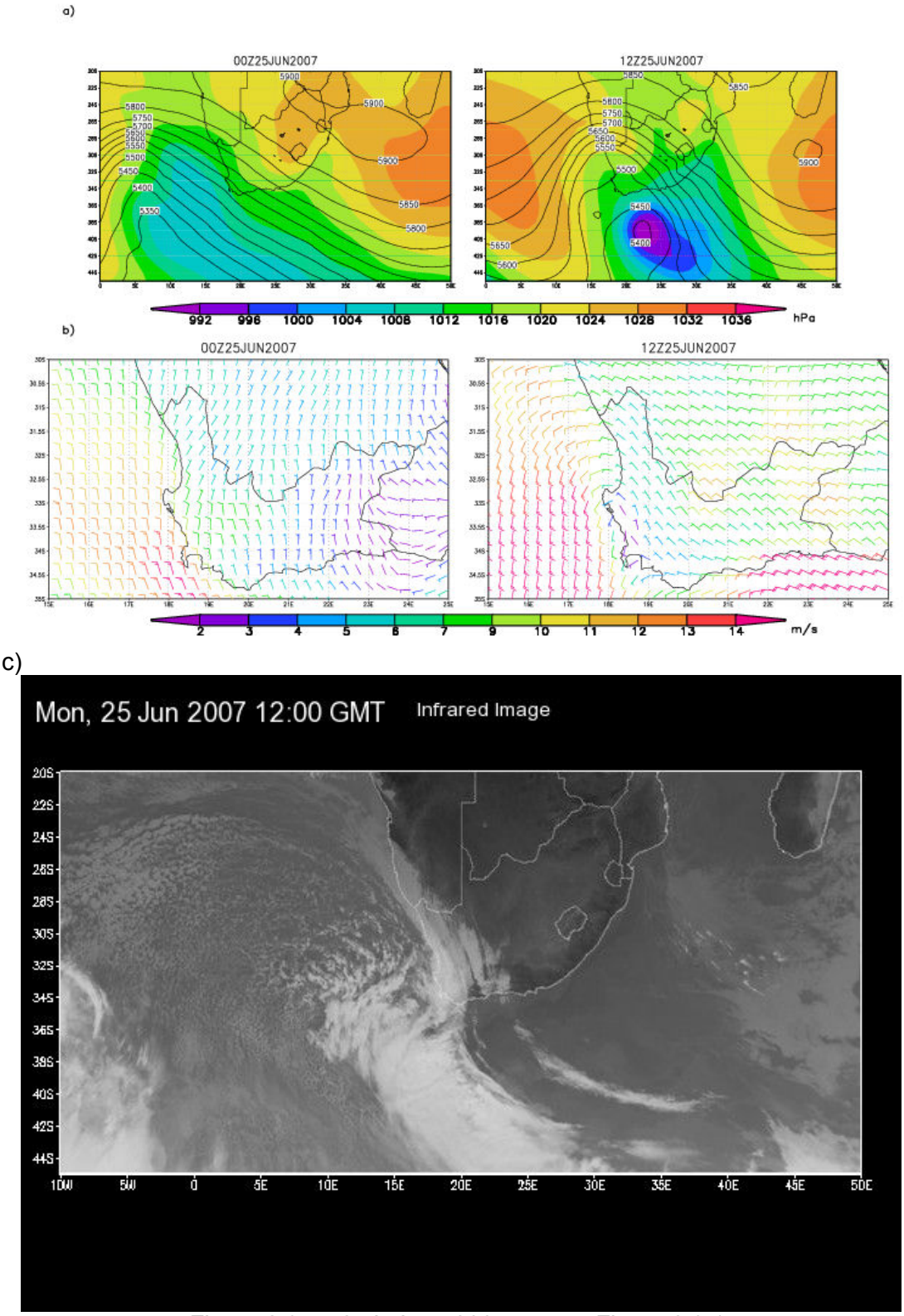


Figure 2.3.7: 25th June 2007, as per Figure 2.3.1.

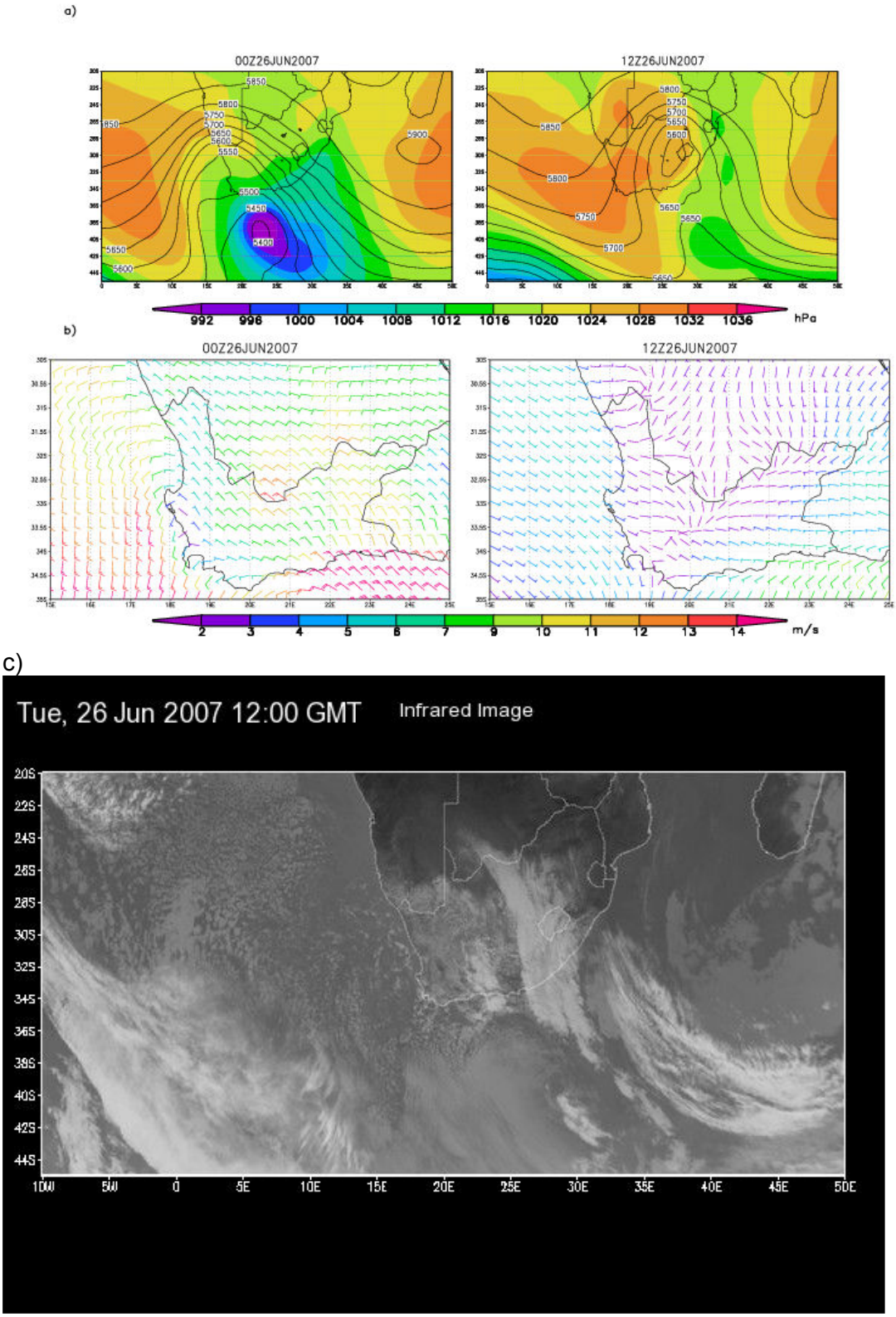


Figure 2.3.8: 26th June, as per Figure 2.3.1.

Part 3: Institutional Response, Risk Reduction and Recovery

Data on the institutional response to the June events, as well as risk reduction prior to the storms and recovery interventions after the events was collected primarily through a two-day debriefing session with role-players in Ganzekraal in late July 2007. This section provides and overview of the debrief processes, details the findings of the research and makes recommendations on how risk reduction, response and recovery can be strengthened in the future.

3.1 Overview of the Ganzekraal Debriefing

The Western Cape provincial disaster debriefing was held at Ganzekraal Resort from the 26th to the 27th of July 2007. Presentations and panel discussions on the 26th of July involved the relevant municipalities, provincial departments, national departments, parastatals and the South African Weather Service (SAWS). The proceedings on the 27th of July focused on debriefing role-players on the June events. The workshop was facilitated by the University of Cape Town's Disaster Management for Sustainable Livelihoods Programme (DiMP). The objective of the meeting was to focus on the management of the June events and the lessons learned. The Provincial Disaster Management Centre (PDMC) opened proceedings by welcoming and thanking the participants for attending the two day debriefing meeting. The Mayor, Mr J. Botha gave the key note address.

3.1.1 Summary of Presentations

The objective of the presentations was to share information on the actions taken by various spheres of government in response to the events, as well as the losses incurred by different sectors. The feedback section was divided into several response areas:

SAWS

A meteorologist from SAWS discussed how the cut-off low moved across the region and how much rain fell in specific areas during the events.

Municipalities

A representative from each local municipality in the West Coast region provided an account of their response, the difficulties they experienced, what they thought would make their response better in the future, and the most critical damages incurred in their area. They also provided information on how many food parcels and blankets were handed out and the factors that made this process difficult. The district municipal manager congratulated his colleagues for their response, and noted that while they were not completely prepared for a disaster of this magnitude, they did well under the circumstances. He emphasised the need for municipalities to develop preparedness plans in the wake of the disaster.

The Department of Housing

Colin Cyster provided information on the province's budget allocation for emergency housing to house the victims of the disaster. He said money was available, but that priority would be given to those worst affected. He indicated that a needs assessment was underway.

The Department of Environmental Affairs and Tourism (DEAT)

The DEAT asked that role-players consult DEAT when drawing up environmental impact assessments (EIAs). It was noted that DEAT was happy to help departments do EIAs, but that departments needed to officially request their assistance.

The Department of Agriculture

This presentation stressed the importance of mitigation efforts in the agricultural sector, as farmers were amongst the most affected by the events. Financial assistance was requested from the private sector to fund weather stations on key farms as part of a better early warning system. The presentation also highlighted the need to improve cell phone reception on some farms, as warnings often do not reach farmers due to lack of cell phone reception when Telkom lines are damaged by poor weather.

The South African National Roads Authority Limited (SANRAL)

Kobus van der Walt identified all the damaged sectors on the N7 highway, as well as preliminary estimates of the economic losses incurred by SANRAL.

Spoornet

The maintenance manager identified the damages incurred by Spoornet, and called for better and more efficient early warning systems. He gave workshop participants a toll free number they could call to report damage.

3.1.2 Summary of Wrap-up Session

The feedback session was concluded with a presentation on the 'big picture' disaster risk context in the Western Cape.

The presentation identified the pressing need to acknowledge and accommodate risk reduction in infrastructural development. This was illustrated by showing the economic costs of repairing inadequate infrastructure in the aftermath of the extreme weather events experienced by Eden municipality and its surrounding areas over the last decade. The presentation demonstrated that the costs increased exponentially with each event, and underscored the importance of integrated planning that includes an awareness of climate change.

The Process and Limitations of the Debriefing Session

On the second day, participants were divided into three groups, each containing a representative from every level of government. Each group was facilitated by a DiMP staff member, and was given the following set of questions to guide their discussions:

When did you receive the early warning (specify time of day if possible), from whom and in what medium?
What did you do with the warning?
Who did you contact?
Did you have a strategy to deal with the early warning? If so, how did you implement it? Did you have to adapt the strategy?
What made you realise that this was a significant event (for example, you saw a street starting to flood)?
What did you do when you realised this?
What was the immediate or first response required and when it required?

What was the sequence of events during the response?
What were your limitations in terms of secondary concerns (for example, evacuation versus traffic control)?
What was your biggest challenge during the event?
What was your biggest challenge after the event?

The aims of the debriefing session were twofold: to allow DiMP to place all the activities undertaken on a timeline and to identify the institutional arrangements within and between the various spheres of government. Unfortunately, heavy rain forced most disaster management and municipal personnel to leave the meeting, in order to attend to affected households and prepare for potential evacuations, reducing the number of people participating in the exercise. The time for the exercise also had to be shortened to allow PDMC staff to return to Cape Town in order to assist households affected in the Metro.

The exercise covered primarily the first event, as participants found it difficult to separate out the first and second events.

3.2 Timeline for the First Event

1st June:

SAWS issued an short message service (SMS) advisory warning alerting authorities to a forecast weather event
The National Disaster Management Centre (NDMC) and PDMC were advised of the warning

5th June:

SAWS issued a high level warning via SMS alerting authorities to an imminent weather event
The NDMC and PDMC received the warning. The NDMC contacted the PDMC to verify the situation and ensure that there were measures in place to respond
B-Municipalities received warning. Warnings were generally not taken seriously

6th June: Matzikama Municipality

9:00 warnings issued
9:30 meeting held with role-players at the Vredendal Community Hall

7th June: Swartland Municipality

6:00 municipal Police became aware of flooding
7:00 road closures began
8:00 extra units from Malmesbury and Darling were mobilised
9:00 both flood damage and community needs assessed
9:15 Spoornet received the warning. Their response plan included: disseminating the warning; patrolling the area that would be affected; and deciding whether train lines should be closed, and if so, which ones
10:00 JOC established (PDMC and DWAF were present)
11:00 assistance given to affected communities according to needs assessment
12:00 road and street cleaning process begins

16:00 re-opening of roads begins
17:00 blankets and food parcels handed out
18:00 last roads opened
23:00 Olifants River begins to flood (Vredendal)

8th June:

03:00 Lutzville flooding begins
MEC of Local Government and Housing visited West Coast area

13th June:

Assessment sessions facilitated by West Coast authorities and the PDMC

14th June:

Delegation led by Premier visited area

3.3 Findings on Early Warning and Information Dissemination

3.3.1 Early warning processes

The SAWS is responsible for producing forecasts and issuing severe weather warnings to the public, the media, as well as government departments. Forecasters determine the probability of weather events and assess their possible impacts. The SAWS tends to focus on the potentially most damaging weather events, including rain and snowfall, very cold temperatures, strong winds and large ocean swells. When the likelihood of poor weather is high, the SAWS head office in Pretoria and the local weather office concerned - in the case of the two events discussed, the Cape Town Weather Office - issue warnings. The SAWS sends alerts to both provincial and municipal disaster risk management, via SMS, who disseminate the information to other stakeholders. The SAWS used to send out messages to disaster management and other line functions, however this complicated lines of communication and resulted in some role-players not receiving information, and the system has been streamlined over the past two years. Warnings are also posted on the SAWS website and information is made available via the SAWS telephonic forecast service.

The PDMC received a warning from SAWS a week before the extreme weather event. This warning was received via telephone calls and email. The West Coast District was alerted on the 5th of June, and the Cederberg Municipality was notified only on the 7th of June. The PDMC disseminated the information to Disaster Management officials and other stakeholders in the affected districts and the Cape Town Metro to warn them of the expected storm. This was done via SMS and email, followed by a phone call to ensure that the warning had been received. The preparedness and recovery sub-directorates responded, and assisted the West Coast District Municipality established and managed a JOC.

3.3.2 Findings

The management of this event reflected a multi-sectoral and multi-disciplinary approach to the coordination of the floods. In addition to the JOC established by the

West Coast District Municipality, JOCs were established in local municipalities within the distirct. The following role-players were involved and co-operated in the operations of the JOC's: the Emergency Medical Services (EMS), Provincial Traffic, Provincial departments of Local Government and Housing, Social Development, Transport and Public Works, Agriculture, DEAT, DWAF, the SAWS, SAPS, Spoornet, as well as various NGO's.

There was general agreement that, given the west coast's authorities had never before dealt with an event of this magnitude, both the warning and response processes had been relatively effective. However areas for improvement were identified. These included:

Limitations regarding the use of SMS to disseminate information: the early warning system depended on sending and receiving SMS's. As profiled repeatedly since the 2003 cut-off low event affecting Montagu, this frequently results in poor risk communication, compromising both institutional preparedness and multi-stakeholder engagement – especially for civil society and for marginal weather-exposed communities. Participants also indicated that the SMS system was 'often faulty' and didn't 'work'. Moreover, 'generic' SMS messages did not provide sufficiently specific information for different geographic areas
Lack of confirmation: stakeholders reported that there was no systematic mechanism to confirm receipt of warnings and no personal contact between stakeholders. This undermined accountability for follow-up action across and between spheres.
Desensitisation to warnings: individuals and departments reported that they were desensitised to SMS weather warnings, as they frequently receive warnings about bad weather that does not materialise. Participants suggested that the SAWS needs to play a greater role in identifying potential disaster areas. They requested that SAWS combine warnings with the identification of 'hot-spots', in order to better target responses and resources, particularly the responsiveness of B-Municipalities to weather warnings.

Capacity limitations: limited human capacity at municipal offices results in both fewer messages being received and sent on to other role-players.

The research found that stakeholders such as farmers received no warning information, with implications for the measures taken to protect their crops and livestock. Given the potential severity of the losses in this sector, it is important that farmers be included in future warning processes. Strong links have already been established between the SAWS and the Elsenberg Department of Agriculture; similar relationships between the SAWS (and disaster management) and municipalities should be developed and deepened elsewhere in the region.

3.4 Recommendations Regarding Early Warning

Extreme weather warnings should differentiate between anticipated levels of risk

Warnings should ideally be differentiated, stating different levels of anticipated extreme weather risk. In relation to these and previous weather events, key responders note that they receive "so many warnings", that unless they are told specifically to respond to them, they disregard them. However, if they are informed that a high priority, "level-three" warning had been issued, they would have known to take urgent action.

Extreme weather warnings should where possible provide expected values for rainfall and wind-speed

Linked to the previous point, none of the warnings issued mentioned any potential values of rainfall or wind speed. If end-users are informed that more than 50mm of rainfall is expected, or that wind speeds may exceed 60km/hr they might be more likely to take enact preparedness measures. Wherever possible, the forecast values available to the weather service should be included in warnings, along with a severity rating system.

Extreme weather warnings should be issued at least a day in advance

Most of the advisories warned against events that were to occur the following day, while virtually all the warnings were issued on the morning the weather hit, limiting the time available to take precautionary measures. Advisories and warnings should be disseminated as early as possible in order to allow end-users time to take action.

Weather warnings should be communicated directly by telephone to key officials

For events above a certain level of risk, the SAWS should speak directly to key provincial officials and municipal managers in the areas likely to be affected. The SMS system is a very effective and quick means of communication, but phone calls are harder to ignore and provide a opportunities for recipients to ask questions.

All district municipalities should establish formalised systems for communicating and confirming warning information

There is also a need for a formalised communication and confirmation system to ensure that information is received by those who need it. Messages need to be conveyed in multiple, context appropriate forms, such as radio and television. This formalised system should also ensure an effective flow of information, between:

- government role-players (within and across spheres);
- JOCs and NGO responders; and
- JOCs and the affected communities/settlements.

3.5 Findings on Response and Relief

At the onset of the event, the West Coast District established a JOC and called west coast Disaster Management for assistance. The need for social relief was quickly identified and arrangements were made by west coast Disaster Management. The Department of Health responded by placing all personnel on standby, and mobilised medical equipment stores. As the cluster co-ordinator for social relief, the Provincial Department of Social Services assisted with the identification of affected areas, and assisted with the co-ordination of relief activities and the distribution of the food, blankets and accessories in the region. They also referred affected households to local authorities for temporary accommodation and requested the evacuation of affected families from high-risk areas.

A major finding emerging from the discussions was that Most B-municipalities did not have a response plan, which respondents attributed to a lack of resources to develop a strategy. There was no clear disaster management communication and response

strategy in place in the Swartland Municipality, for example. Key role players only became aware of the flooding after the fact. Furthermore, no response teams or coordinating structures had been established before in the area; in the absence of tested working relationships, a relatively haphazard group of role-players became involved in the response. The police and traffic control were first to react to the flooding in Moorreesburg, for example, for whom traffic control and road closures rather than assistance and relief where the most immediate concern.

Related to this, a key issue in some areas is that Disaster Management personnel are frequently busy on the ground during an extreme weather event, and are unable to perform a coordinating function. It is crucial that coordinating structures be established during events to streamline the flow of information and manage frontline activities. Point people should be identified at the local and ward level with him whom disaster management can liaise. There should be a prioritisation of activities. Information on recovery processes should also be fed back to the JOC. Representatives from Spoornet noted that they would like to form part of JOCs, as their planning is based on the information they receive from the JOC.

A second major challenge for the PDMC before and during the event was getting local municipal managers involved; only the Swartland Municipality engaged with the PDMC. The capacity to respond was also limited capacity within both local and district municipalities. Disaster Management also often faced challenges in helping municipal personnel understand their roles and functions with respect to needs assessment, the verification of damages and the provision of relief. Obtaining information on the impact of the storm from the various departments was often difficult.

Even where departments could and did assist, on-the-ground relief efforts were sometimes hampered by political dynamics. In some cases, food parcels and blankets were used as political leverage by politicians and did not reach those in need fast enough.

As with early warning, communications also sometimes proved inadequate. Not all areas could be reached due to poor telephony. Representatives from Bergriver gave the example of one area, Goedverwagt, where there is no cell phone reception, making it difficult to either warn people of impending weather or to establish what was happening there. Some areas were also impacted so severely that they were cut off from relief efforts.

3.6 Recommendations on Response and Relief

General levels of preparedness need to be improved

Municipalities without contingency plans need to develop response plans. Where there are plans, these need to be improved to include the formalisation of warning dissemination to critical stake-holders; clear definition of the staffing, roles and responsibilities of district-level and local-level JOCs; and the establishment of robust mechanisms that ensure the seamless flow of information between critical stakeholders (including government role-players, farmers, the private sector, media and disaster-affected settlements).

Participants argued that mapping all the rivers in the region would support planning and response by both the authorities and the SAWS. It was noted that a risk assessment was underway, which included such a mapping component.

Institutional arrangements with respect to the JOCs and mini-JOCS should be formalised and agreed-on by critical stake-holders

It is important that the JOCs have sufficient capacity to gather, process and respond to all relevant information. It is also crucial that they have formalised, practiced protocols to ensure proper communication between local and regional JOCs. These arrangements depend on the formalisation of a permanent JOC membership; the same people should represent their departments on the JOC at all times. JOCs also need the equipment to ensure a streamlined, continuous information flow between critical role-players, such as two-way radios. Measures should be put in place to ensure that information is consistent, relevant, maintained and updated.

Contingency planning for at-risk communities and settlements should be undertaken consultatively well in advance of weather alerts

Contingency planning for at-risk communities and settlements should be undertaken consultatively, long before a weather alert – in the case of the West Coast, before the onset of the winter rainfall. Such contingency planning should include procedures for activating responses, as well as specific evacuation arrangements. The authorities need to raise awareness in affected communities about the existence and content of the plans. This could be partly achieved through greater engagement with local schools on extreme weather events, risk levels, the components of community plans, evacuation procedures and local responsibilities.

3.7 Findings on Risk Reduction Constraints

The debriefing session also sought to identify the key institutional and other constraints compromising the risk-management capacities of local government in areas exposed to extreme weather. This exercise identified four main constraints: insufficient capacity to undertake risk-reduction, under-investment in infrastructure, insufficient emphasis to risk reduction in the rehabilitation of infrastructure and insufficient attention to risk-reduction in new housing developments.

3.7.1 Municipal disaster management capacity

Disaster risk management is a critical priority for sustainable growth in the West Coast region, due to its exposure to extreme weather events. There is a pressing need to augment existing disaster management capacity, which is currently severely overstretched and unable to manage the wide-ranging demands of both post-event recovery and multi-sectoral risk-reduction planning.

Efforts to augment the capacity of local government to reduce disaster risk need to take cognisance of the need to integrate social vulnerability, infrastructural and environmental risk-reduction considerations into the district's spatial development and integrated development plans, as well as those in associated municipalities. One way of both building capacity and better integrating risk reduction into developmental planning would be to establish a Disaster Management Advisory Forum, as outlined in the Disaster Management Act, and as required in the National Disaster Management Framework.

3.7.2 Under-investment in infrastructure: Focus on roads and storm water

Significant losses to road and municipal infrastructure were once again sustained during the June extreme weather event, underlining the high risk profile of critical infrastructure in the West Coast Municipality. Many of the losses can be attributed to:

Failed or obstructed storm water drains: compromised drainage infrastructure resulted in increased surface run-off volumes, both of which are the outcome of the region's rapid and poorly planned urban growth.
Past under-investment in maintenance and upgrading: inadequate maintenance and upgrading of road and storm water infrastructure has also increased the risk of structural failure. The consequences of this under-investment are compounded by large amounts of solid waste and debris in storm water channels and water courses.

3.7.3 Insufficient emphasis to risk reduction in the rehabilitation: Focus on roads and storm water

In post-event reconstruction, there are several critical constraints that prevent damaged or destroyed infrastructure from being rehabilitated in ways that reduce its vulnerability to future events. These include funding specifications that require rapid repairs within the annual fiscal cycle and aim at achieving 'replacement' not 'risk-averse' standards. Such constraints preclude the incorporation of redesign, re-siting, or other technical measures that would increase cost and project implementation times.

Sustainable, 'risk-averse' infrastructure is a critical priority for the West Coast Municipality, and is a prerequisite for continued business confidence and investment. The current loss patterns – particularly if losses occur every two to three years – are simply not affordable and undermine prospects for sustained municipal growth and investment. In this context, there is an urgent need to augment existing public sector technical and engineering skills within these weather-exposed municipalities. Current skilled capacity is severely overstretched; scarce personnel must simultaneously manage routine maintenance and repair aged public infrastructure, which cannot withstand repeated, heavy rain and run-off events.

3.7.4 Low-cost housing development

Significant risk-generating conditions are evident in a number of low-cost formal housing developments within the district. There is also evidence of inadequate integrated planning, with a number of low-income housing developments sited below road level, exposing dwellings to endangering run-off due to limited storm water drainage capacity. In addition, as the construction of low-cost houses is outsourced to private contractors, the quality of the structures is reportedly compromised due to the use of cheap building materials and poor construction standards, which have increased exposure to heavy rain, run-off and subsidence and their consequences.

3.8 Recommendations on Risk Reduction Constraints

The severe consequences of extreme weather in the West Coast illustrate how poorly managed development risks are transformed and transferred in the provision essential services, including disaster management, emergency services and critical provincial and municipal infrastructure.

Disaster and climate risk management should be strategically integrated and funded priorities for the West Coast

There is a need to integrate risk management considerations into the region's development spatial and integrated development planning. Such processes should be accompanied with adequate financial and human resource allocations. Other specific actions include:

- Establishing and activating a district Disaster Management Advisory Forum. This should consist of a skilled and committed multi-stakeholder task team and focus on strategies for mitigating extreme weather-associated risks.

- Incorporating spatial loss and impact information from recent extreme weather events into integrated planning processes, in order to identify those sites and settlements with heightened environmental, infrastructural and social vulnerability to extreme weather.

- Augmenting existing disaster management capacity.

-

Municipalities within the West Coast Municipality should integrate risk management considerations in to all local planning and regulatory processes

Many of the losses attributed to the extreme weather within the West Coast area have been significantly driven by rapid and poorly planned urban growth. This has often seriously undermined the protective capacities of the natural environment. An effort should be made to:

- tighten land-use regulations to avoid further damage to these protective environmental services;

- incorporate risk assessment for flood, run-off, slope failure and subsidence into all future environmental impact assessments within the district; and

- revisit existing design criteria for critical infrastructure, especially roads and storm water infrastructure, to determine their effectiveness and ability to withstand extreme rainfall events.

Measures should be explored transversally and vertically to better 'risk-proof' critical municipal and provincial infrastructure.

Repeated structural failures, and their associated costs, underline the serious vulnerability of essential municipal and provincial infrastructure in the West Coast to current heavy rainfall events. There s an urgent need to rethink investment, environmental, engineering and human resource strategies in order to support the development of risk-averse infrastructure, particularly where this is critical to regional economic and social development. In particular, there is a need for:

- The development of decision models that evaluate the relative strengths of different proactive approaches to upgrading (re-siting, redesigning, reconstructing) and maintaining critical road and other infrastructure to offset future weather-related losses.

- Focused discussions between risk-prone municipalities and provincial departments, including the Department of Public Works and Transport, Local Government and Housing, especially MIG, and Climate Change/Adaptation representatives, on practical strategies for reducing climate risk impacts on vulnerable infrastructure.

- Investigation of available climate risk insurance options and the potential for risk transfer mechanisms to ease financial pressure on weather-exposed municipalities.

Consideration should be given to weather- and runoff-proofing homes in low-income developments

Currently, there are no provisions or specifications for 'weather-proofing' or 'flood-proofing' low-income homes in areas exposed to heavy rain and run-off conditions. However, recognising that the objective of social housing is to address the housing needs of the most socially vulnerable, weather-proofing is vital in order to protect the assets, as well as the health of household members.

3.9 Post event reconstruction and recovery

The processes of recovery and reconstruction often focus on the physical rehabilitation of infrastructure and the restoration of disrupted services. However, the effectiveness of recovery and reconstruction is also significantly influenced affected by timely access to adequate funding – especially for critical infrastructure. This can be administratively complicated, as the provision of funding must comply with the often complex requirements imposed by existing financial cycles and established national and provincial funding mechanisms.

This section specifically focuses on the institutional dimensions of the funding and expenditure processes associated with the June 2007 events.

Part 4: Counting the Costs

Post-disaster (***or*** *'ex post'*) investigations of loss patterns provide excellent insights into the internal susceptibility of specific sectors and administrative jurisdictions to extreme weather shocks. They critically guide disaster risk assessments for future events by representing the realised risks associated with extreme weather systems, as well as the 'progressions of risk' that drive specific loss processes in infrastructure and agriculture. In addition, they provide quantitative and spatial data that can better inform decision-making on investments in mitigation and preparedness for extreme weather events. This is particularly relevant to future cost-benefit analyses with respect to infrastructure and services that experience repeat and costly losses. Moreover, ex post research consolidates loss information across sectors and administrative jurisdictions, providing a far more robust understanding of the transboundary or 'knock-on' effects of poorly managed risk. And last, such studies enhance understanding for the management of future climate risks by highlighting those sectors and areas more able to cope with climate variability, as well as those with significantly compromised capacity to resist and recover from extreme weather. This is of direct relevance to climate adaptation in the Western Cape where exposure to an increased frequency of extreme weather processes is anticipated.

This chapter is organised into the following sections:

- Section 4.1 presents the data collection, consolidation and analysis methods applied in the loss-estimation process.

- Section 4.2 outlines the more significant ethical concerns and constraints faced in the course of the impact assessment.

- Section 4.3 provides a detailed description of reported economic losses incurred as a result of the June 2007 extreme weather events. These are presented in tables, graphs and pie charts, and, where spatial data permit, are mapped.

- Section 4.4 provides conclusions and recommendations

4.1 Methodology

The June 2007 cut-off lows post-event analysis represents the sixth extreme weather event that DiMP has reviewed since 2003. Earlier reviews of the Montagu Floods (2003), August 2004 Severe Storm (Cape Town 2004), South Coast Floods (December 2004), April 2005 Cut-off Low (Bredasdorp, 2005), and the August 2006 extreme weather event have underlined the significant difficulties in consolidating loss information from multiple sources to generate an integrated loss profile.

In each case, the process has been time-consuming and highly labour-intensive, requiring specialist capabilities in quantitative and spatial data collection, management and analysis, as well as excellent interpersonal skills, due to the diversity of individual and institutional role-players involved.

4.1.1 Identification of key categories of loss and their spatial extent

The effective assessment of losses, generated by wide-area transboundary events, is best preceded by a broad 'scoping exercise' to determine the general character of

impacts, the areas affected and potential human resources and information sources for more detailed reports. This was undertaken from the 10th to the 13th of July 2007 and focused on:

- reviewing local media for initial disaster reports;
- assessing the spatial extent, temperature, rainfall and wind features of the weather system; and
- identifying human resources and other information sources.

Newspapers and Internet sources accessed for initial reports on the disaster are reflected in Figure 4.1.1. These gave an initial indication of where damages were sustained and the severity of the damage.

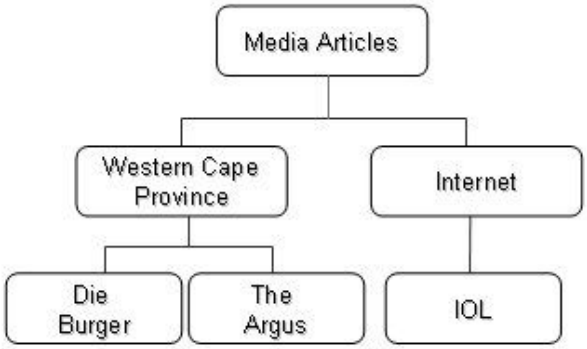


Figure 4.1.1 News media reviewed for information on disaster impacts

4.1.2 Data collection

Data was gathered from presentations given by officials from affected departments and municipalities on the events, as well as the discussions from the debriefing exercise the UCT team facilitated at Ganzekraal on the 26th and 27th of July 2007.

The PDMC forwarded impact documentation received by affected departments and municipalities to the UCT team. The UCT team contacted provincial departments, municipalities and parastatals to source and verify impact data. A uniform template was faxed and emailed to contacts within each of the departments. Figure 4.1.2 illustrates all the departments and municipalities contacted. Data was not received from all the departments contacted, and in some cases, the UCT team was force to rely on impact data forwarded from the PDMC, as well as the information gathered during the debrief meeting.

A UCT team member visited affected farms to source agriculture data.

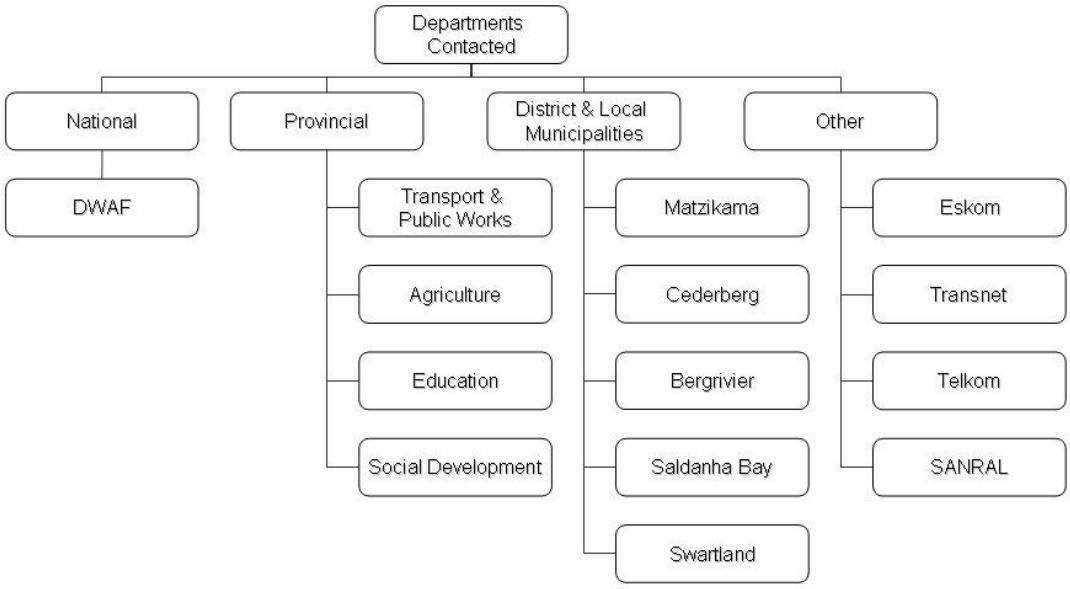


Figure 4.1.2 Departments, municipalities and parastatals contacted

4.1.3 Data consolidation and analysis

Impact data collected from government departments, municipalities, and parastatals were consolidated into a centralised database and then analysed. Information was streamlined into tables, graphs and charts. Every discrete impact recorded is reflected in tables with the economic loss presented in South African Rand (ZAR).

Quantitative data received from Provincial Roads branch of the departments Transport and Public Works and Education were cross-referenced with UCT's own spatial database to create shapefiles, which were used to generate impact maps. The following impact information was successfully mapped:

- provincial road impacts;
- damage to primary schools;
- DWAF impact sites; and
- economic losses sustained by each municipality.

4.2 Ethical Considerations and Constraints

4.2.1 Ethical considerations

There were a number of confidentiality issues related to data sourced from parastatal organisations. This resulted in relatively 'coarse' totals being presented in the findings reported for these agencies.

An important consideration was balancing DiMP's need for data from primary sources against the heavy implementation demands faced by technical staff in the municipal and other government departments contacted. This highlights an urgent need to streamline the data collection methods and forms for future post-impact

studies, to minimise the reporting burden on those tasked with field implementation. Specific technical considerations include the following:

- When data was received from the primary source as well as the PDMC, the UCT team gave preference to the data received from the primary source.

- Economic loss information for housing is included in municipal losses and not reported by the housing department.

- The relocation cost of the Cederberg sewage treatment plant – R 25 million - has been included in the impact cost for Cederberg municipality.

- Bergriver municipality recorded agricultural losses, but because no break down of losses was submitted, it is impossible to know whether these duplicate losses recorded by the Department of Agriculture.

4.2.2 Constraints

As there were two weather events in June, differentiating between the first and second events was difficult, as loss information was consolidated across both events. This, by necessity, resulted in the information being consolidated and analysed as one weather event, which lasted one month.

The losses calculated for data received from each primary source did not always match the initial loss estimates provided by the PDMC. As DiMP only incorporated data that could be verified, this resulted in discrepancies between the loss estimates reported here and those initially submitted by the PDMC (refer Table 4.3.1.1 for those entities who were unable to verify their initial loss information, identified by *).

Detailed loss and spatial data were not always available. This limited the degree to which loss tables and maps could be generated. Not all data requested from the primary source was received, which means that DiMP could not verify all losses received from the PDMC.

4.3 Impact Findings

4.3.1 Overview of total recorded economic losses

An ‘impact’ for the purposes of this study refers to a ‘discrete measurable negative outcome that is directly associated with the June 2007 extreme weather events. A negative impact may be human (i.e. injury, illness or death), infrastructural, agricultural or environmental and may also be estimated economically.’

Total losses, taking into account both flooding events as reported by the various municipalities, as well as provincial and national departments, including state-owned enterprises, amount to R 128 million resulting from 203 impact incidents (Table 4.3.1.1 and Figure 4.3.1.2).

Table 4.3.1.1: Total reported economic losses

By Organisation/ Administration	No. of recorded Impacts	Economic Losses [ZAR}	Economic Losses [%]
National Government Dept.			
DWAF	8	1,050,000.00	0.82%
Subtotal	8	1,050,000.00	0.82%
Provincial Government Dept.			
Agriculture	41	27,855,830.00	21.71%
Education	7	515,350.00	0.40%
Provincial Roads	42	9,343,565.00	7.28%
Social Development		411,000.00	0.32%
Subtotal	90	38,125,745.00	29.72%
District and Local Municipalites			
West Coast District Municipality		0	0.00%
Matzikama	8	4,490,000.00	3.50%
Cedeberg	10	26,163,100.00	20.39%
Bergriver	42	14,748,826.00	11.50%
Saldanha Bay	14	1,460,000.00	1.14%
Swartland	20	3,202,111.62	2.50%
Subtotal	94	50,064,037.62	39.02%
Other Sector			
* Eskom	0	3,800,000.00	2.96%
Transnet Freight Rail(Spoornet)	6	35,000,000.00	27.28%
SANRAL	5	124,146.28	0.10%
* Telkom	0	138,923.00	0.11%
Subtotal	11	39,063,069.28	30.45%
Total	203	128,302,851.90	100.00%

* Data were requested but not received

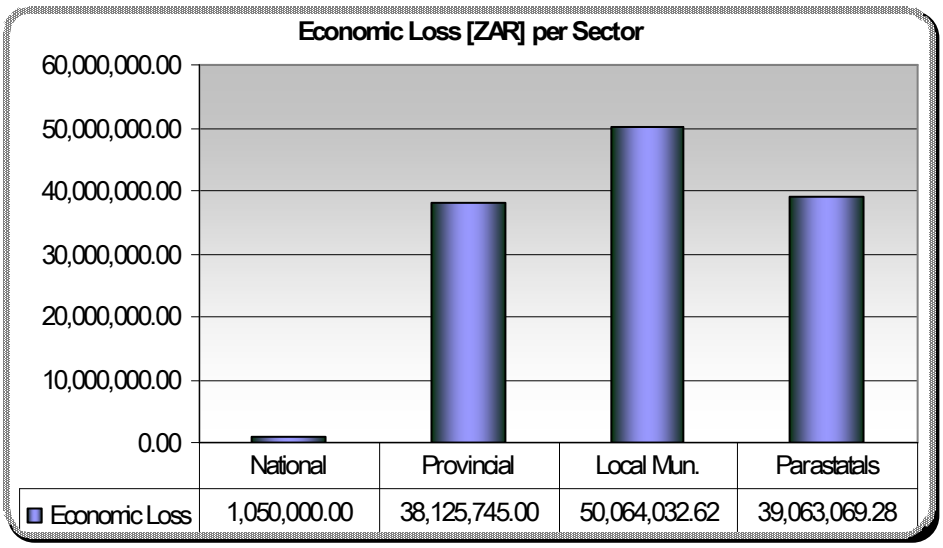


Figure 4.3.1.1: Economic Loss [in ZAR] per Sector

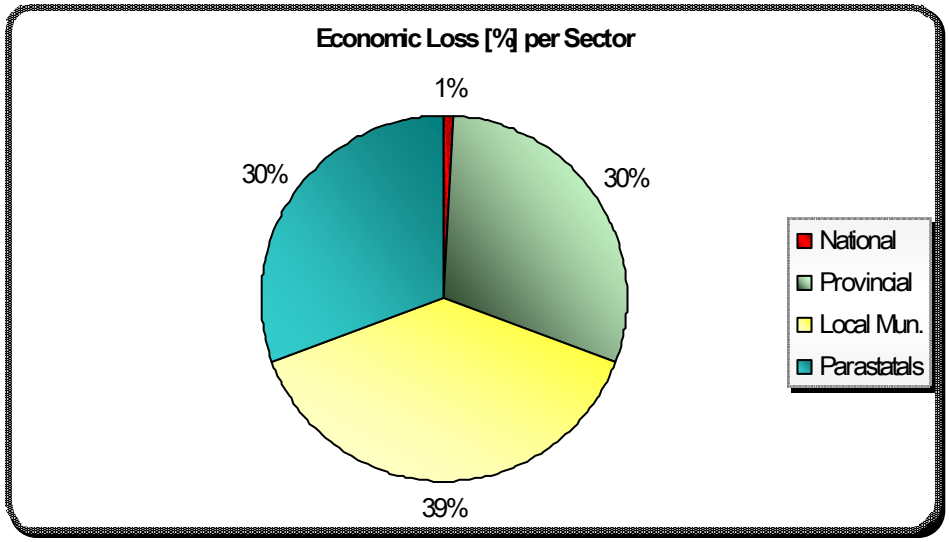


Figure 4.3.1.2: Economic Loss [in Percentage] per Sector

After reviewing all the losses incurred during the extreme weather events in June, the local municipalities in the West Coast suffered the highest cumulative loss of all the sectors, with a total of R 50 million, or 39% of the total losses. Provincial departments and parastatals incurred 30% each.

4.3.2 Direct losses sustained by National Government Departments

DWAF was the only national department that reported losses for this extreme weather event. Losses amounted to R 1 million, which is less than 1% of the total losses recorded for the June extreme weather event. The majority of these losses were attributed to damage to recording instruments at hydrological gauging stations (the location of these stations are shown in Figure 4.3.2 and Table 4.3.2).

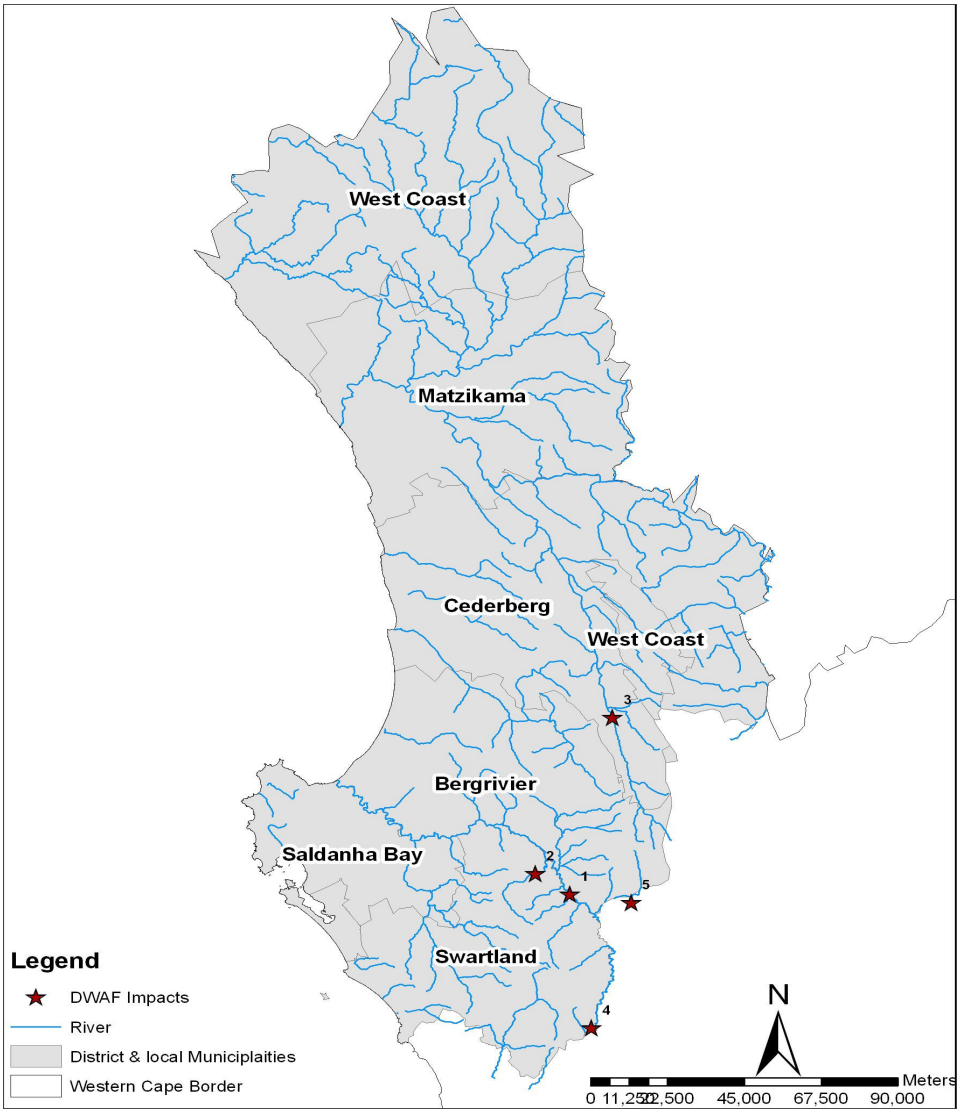


Figure 4.3.2: Location of DWAF losses

Table 4.3.2: Breakdown of DWAF losses by location

No.	River Name	Location	Impact Description	Damage Cost [ZAR]
1	Berg River	Drie Heuwels	Bridge Recording Instrument	300,000.00 100,000.00
2	Bergriver	Misverstand	EC Instruments Recording Instruments	100,000.00 150,000.00
*	Bergriver	Broodkraal	EC Instruments	50,000.00
3	Olifant River	Citrusdal	Recorder Instruments	100,000.00
4	Dorring River		Recorder Instruments	100,000.00
5	Leeu River		Silt Deposit	150,000.00
Total				1,050,000.00

* No spatial data available

4.3.3 Direct losses sustained by the Provincial Government of the Western Cape

According to impact data compiled, provincial government departments incurred an estimated R 38 million in direct losses (Table 4.3.3). Of all the departments, the provincial departments of Agriculture and Transport and Roads sustained approximately 98% of the economic losses associated with the sector, totalling R 37 million. A total of 82 impact sites were recorded.

The losses incurred by the Department of Social Development reflect the cost of the social relief (food parcels and blankets) provided to affected households.

Table 4.3.3: Economic Losses to Provincial Departments

Provincial Government Dept.	No of Records	Economic Loss [ZAR]	Economic Loss [%]
Agriculture	41	27,855,830.00	73.06%
Education	7	515,350.00	1.35%
Provincial Roads	42	9,343,565.00	24.51%
Social Development		411,000.00	1.08%
Total	90	38,125,745.00	100.00%

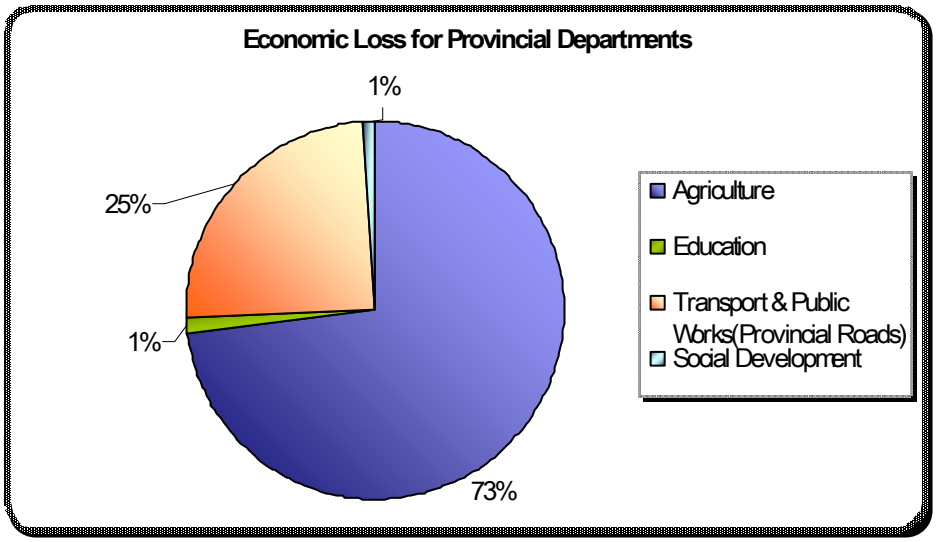


Figure 4.3.3: Economic Loss for Provincial Departments

4.3.3.1 Losses to the Department of Agriculture

The farmers in the Cederberg and Bergrivier Municipalities suffered the heaviest agriculture losses, amounting to R11 million and R 10 million respectively. Total agricultural losses for the severe weather event amounted to R28 million, as shown in Figure 4.3.3.1.1 and Table 4.3.3.1.

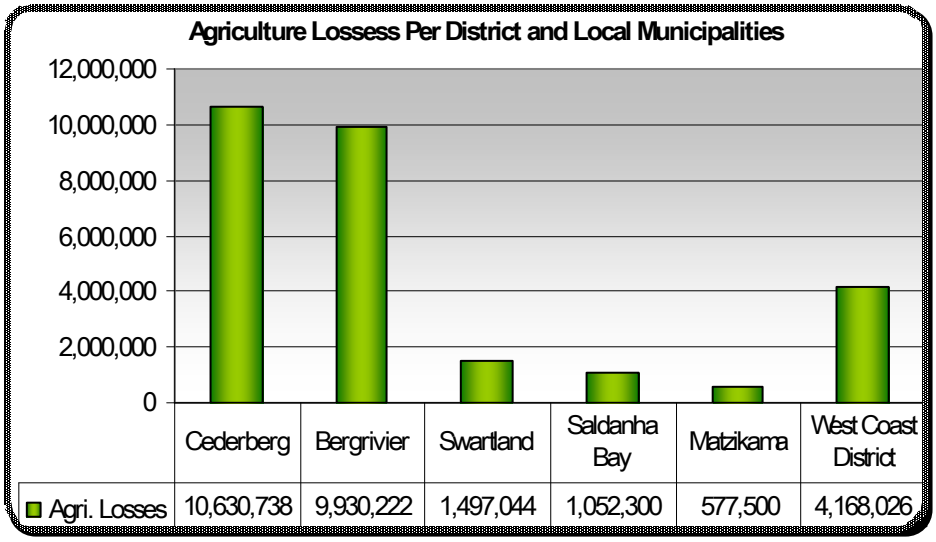


Figure 4.3.3.1.1: Agricultural losses for each municipality

Table 4.3.3.1: Agricultural losses categorised by damage type for each municipality

Loss Category	Cederberg	Bergriver	Swartland	Saldanha Bay	Matzikama	WCD
Crops loss	363,000.00	50,000.00	76,500.00	760,900.00	500,000.00	22,700.00
	60,000.00	871,432.00	50,000.00	30,400.00	0	802,718.00
	97,200.00	2,405,250.00				
	2,509,319.00	3,415,700.00				
Subtotal	3,029,519.00	6,742,382.00	126,500.00	791,300.00	500,000.00	825,418.00
Income Loss	0	6,125.00	0	0	0	79,100.00
Sub Total	0	6,125.00	0	0	0	79,100.00
Infrastructure	62,650.00	289,603.00	69,500.00	35,000.00	0	536,368.00
	425,089.00		156,950.00			51,150.00
	6,000.00		348,208.00			
Subtotal	493,739.00	289,603.00	574,658.00	35,000.00		587,518.00
Livestock	6,400.00	37,600.00	49,000.00	3,000.00		52,250.00
						234,350.00
Subtotal	6,400.00	37,600.00	49,000.00	3,000.00		286,600.00
Other Infrastructure	80,734.00	769,427.00	30,000.00	20,000.00	7,500.00	630,920.00
	470,950.00	230,000.00	131,000.00	32,000.00		16,250.00
	9,000.00	36,491.00				
	315,500.00					
	664,670.00					
Subtotal	1,540,854.00	1,035,918.00	161,000.00	52,000.00	7,500.00	647,170.00
Other Losses	69,676.00		2,536.00			103,807.00
	12,000.00					
Subtotal	81,676.00		2,536.00			103,807.00

Soil Cultivated	2,310,700.00	902,000.00	428,350.00	103,000.00	70,000.00	1,545,213.00
	1,852,850.00	60,000.00	125,000.00	30,000.00		7,200.00
	25,000.00	701,434.00				
		155,160.00				
Subtotal	4,188,550.00	1,818,594.00	553,350.00	133,000.00	70,000.00	1,552,413.00
Wind Damage	735,000.00		30,000.00	38,000.00		86,000.00
	555,000.00					
Subtotal	1,290,000.00	0.00	30,000.00	38,000.00	0.00	86,000.00
Total	10,630,738.00	9,930,222.00	1,497,044.00	1,052,300.00	577,500.00	4,168,026.00

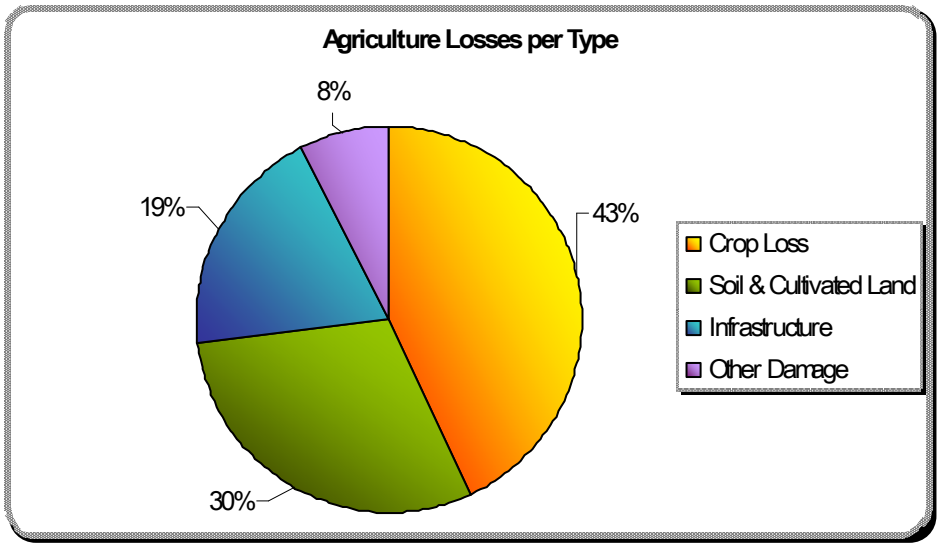


Figure 4.3.3.1.2: Agriculture losses categorised by damage type

Estimated agricultural impacts were estimated at R 28 million and constituted 23.3% of the total economic losses recorded by provincial departments. Of these, 43% were attributed to crop loss, 30% to soil losses and 19% to infrastructure; the remaining 8% can be attributed to other damage (Figure 4.3.3.1.2). Other types of damage included wind damage, livestock losses and loss of income.

4.3.3.2 The Department of Education

Most of the losses incurred by the Department of Education took the form of roof damage sustained from heavy rain and wind, underlining the need for greater attention to rain- and wind-proofing in areas repeatedly exposed to severe weather within the province. Damages amounted to R 438,350, and were spread across six schools, two in Saldanha Bay and four in Swartland local municipality (Figure 4.3.3.2 and Table 4.3.3.2). There is a equal distribution of damage for high and primary schools.

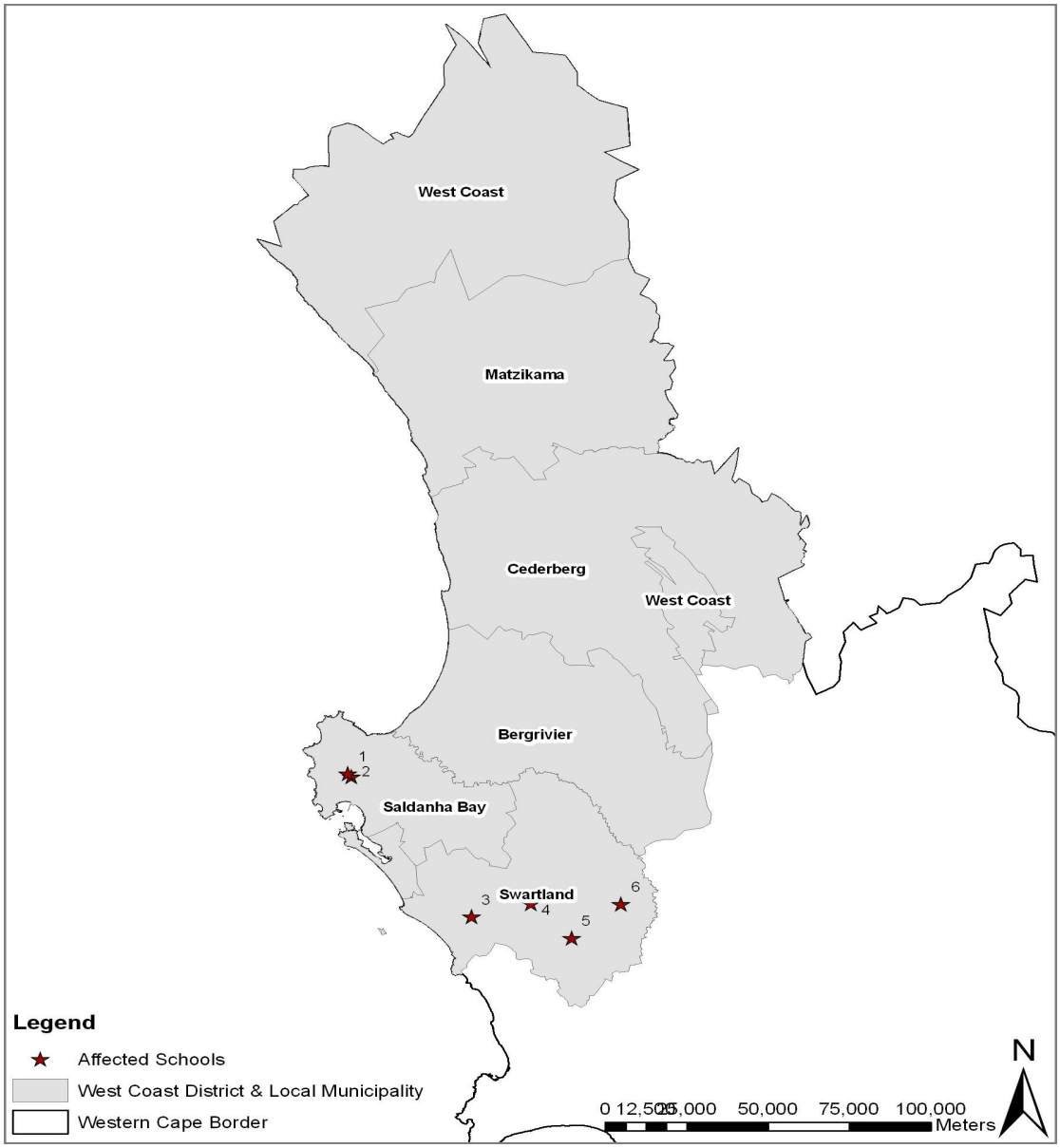


Figure 4.3.3.2: Flood damage to schools in the West Coast area

Table 4.3.3.2: Affected schools in the West Coast

No.	School Name	Type	Location	Damage	Damage Cost [ZAR]
1	Vredenburg	High	Vredenberg	Roof	55,000.00
2	Weston	High	Vredenburg	Roof and gutter	51,000.00
3	Darling	Primary	Darling	Roof	18,000.00
4	Goedehoop	Primary	Malmesbury	Roof	345,000.00
5	Wesbank No 1	High		Roof	7,000.00
6	Riebeek Wes	Primary	Riebeek West	Roof and gutter	17,350.00
Total					438,350.00

4.3.3.3 Department of Transport and Roads

Provincial roads (including major, divisional, minor and trunk roads) sustained an estimated at R 9 million in losses, 25% of all the losses recorded by provincial departments (Table 4.3.3.3.1). The provincial roads department reported damage to 41 roads, 19 divisional, 7 main and 16 trunk roads (Figure 4.3.3.3.1)

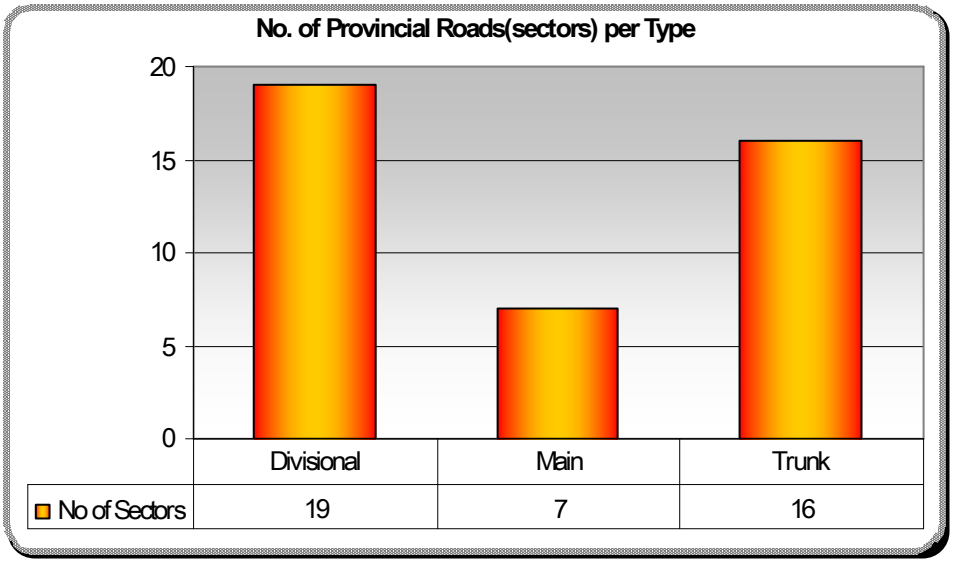


Figure 4.3.3.3.1: Provincial roads categorised by road type

Table 4.3.3.3.1: Number of roads and economic loss for divisional and main roads categorised by Municipality

Municipality	No of sectors	Economic Loss[ZAR]	Economic Loss[%]
WCD	1	63,000.00	0.8%
Cederberg	10	1,000,910.00	13.1%
Bergriver	6	1,270,700.00	16.6%
Swartland	7	2,026,505.00	26.5%
Saldanha Bay	2	3,297,205.00	43.1%
Total	26	7,658,320.00	100.0%

Saldanha Bay Municipality incurred the highest losses - R 3.2 million – but only reported damage to two roads. 10 roads were reported as damaged in Cederberg, incurring R 1 million in costs.

Data received from the provincial roads department did not specify the section of road damaged, therefore the whole road had to be recorded as damaged (Figure 4.3.3.3.2). It was impossible to spatially reference the 16 trunk roads reported and Figure 4.3.3.3.2 includes only divisional and main roads.

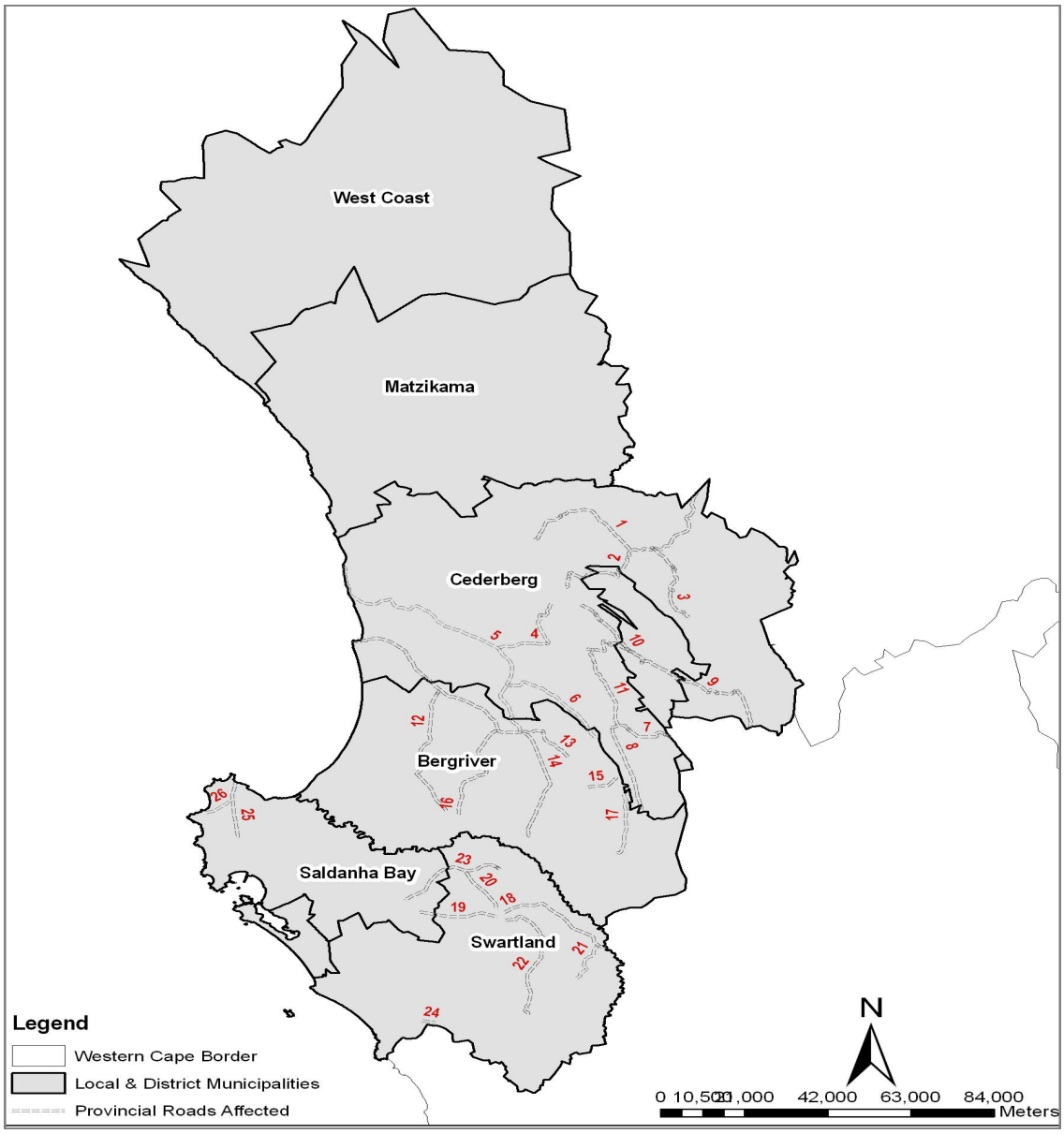


Figure 4.3.3.3.2: Main and divisional provincial roads damaged in the West Coast

Table 4.3.3.3.2: Provincial Road Sectors damaged in West Coast

No	Road No	Road Name	Road Type	Damage Cost
1	DR02196	Brakfontein	Divisional	31,160.00
2	MR00542	Clanw./Calvinia	Main	172,500.00
3	DR02262	Wuppertal	Divisional	25,600.00
4	DR02184	Witelskloof	Divisional	19,000.00
5	MR00538	Paleisheuwel	Main	13,800.00
6	DR02175	Berg-en-Dal	Divisional	75,000.00
7	MR00310	Citrusdal/Middelburg	Main	150,400.00
8	DR02215	Warmbadpad	Divisional	84,000.00
9	DR01487	Cederbergpad	Divisional	357,000.00
10	DR02182	Algeria/Ou Stasie	Divisional	63,000.00
11	MR00539	Hexrivierpad	Main	72,450.00

12	MR00534	Redelinghuys	Main	308,700.00
13	DR02173	Duikerfontein	Divisional	34,500.00
14	MR00531	Redelinghuys	Main	84,000.00
15	DR02170	Klipfontein	Divisional	103,500.00
16	DR02162	Kapteinskloof	Divisional	125,000.00
17	DR02153	Cardouwpad	Divisional	615,000.00
18	DR01161	Goudapad	Divisional	638,000.00
19	MR00231	Hamburgpad	Main	39,675.00
20	DR01171	Pampoenkraalpad	Divisional	254,250.00
21	DR01158	Riebeeck/Sandfontein	Divisional	51,750.00
22	DR01149	Moorreesburg/M.burg	Divisional	389,330.00
23	DR01173	Koperfonteinpad	Divisional	143,800.00
24	DR01147	Waterkloofpad	Divisional	509,700.00
25	DR02160	V.burg/St. Helenabaai	Divisional	295,200.00
26	DR02164	Skuitjiesklippad	Divisional	34,050.00
*	OP e	Wuppertal	Trunk	69,000.00
*	OP118	Korhaanvlei	Trunk	270,000.00
*	OP135/151	Gelukwaart	Trunk	337,500.00
*	OP149	Dasbosch	Trunk	10,000.00
*	OP20VR	Kobee	Trunk	187,500.00
*	OP3/5CL	Kleinjonenskraal	Trunk	30,000.00
*	OP354	Uitsien	Trunk	15,000.00
*	OP360,366	Arbeidsgenot	Trunk	133,000.00
*	OP371,361	Hartebeesfontein	Trunk	189,000.00
*	OP374	Groenvlei	Trunk	18,000.00
*	OP434	Middelburg	Trunk	32,000.00
*	OP445	Tafelberg	Trunk	20,700.00
*	OP5/6CL	Wuppertal	Trunk	119,000.00
*	OP87	Solatepos	Trunk	270,000.00
*	OP194	Wolfkloof/Middelpos	Trunk	2,532,500.00
*	OP91	Paternoster	Trunk	420,000.00
				9,343,565.00

* Not presented on map, no spatial data available

4.3.4 Direct losses sustained by district and local municipalities

4.3.4.1 Overall municipal losses

Data were received from the Matzikama, Cederberg, Bergriver, Saldanha Bay and Swartland manipulates. The West Coast District was repeatedly contacted but no data were received.

It was impossible to examine each individual impact for all the municipalities, as the data recorded and forwarded to UCT had already been clustered and costed by type of infrastructure. This was especially the case with the data from the Bergriver municipality.

The losses incurred in the Matzikama, Saldanha Bay and Swartland local municipal areas were considerably lower than the losses incurred in the Cederberg and Bergrivier municipalities, which incurred 82% of the total municipal losses (Figure 4.3.4.1.1 and Table 4.3.4.1.1).

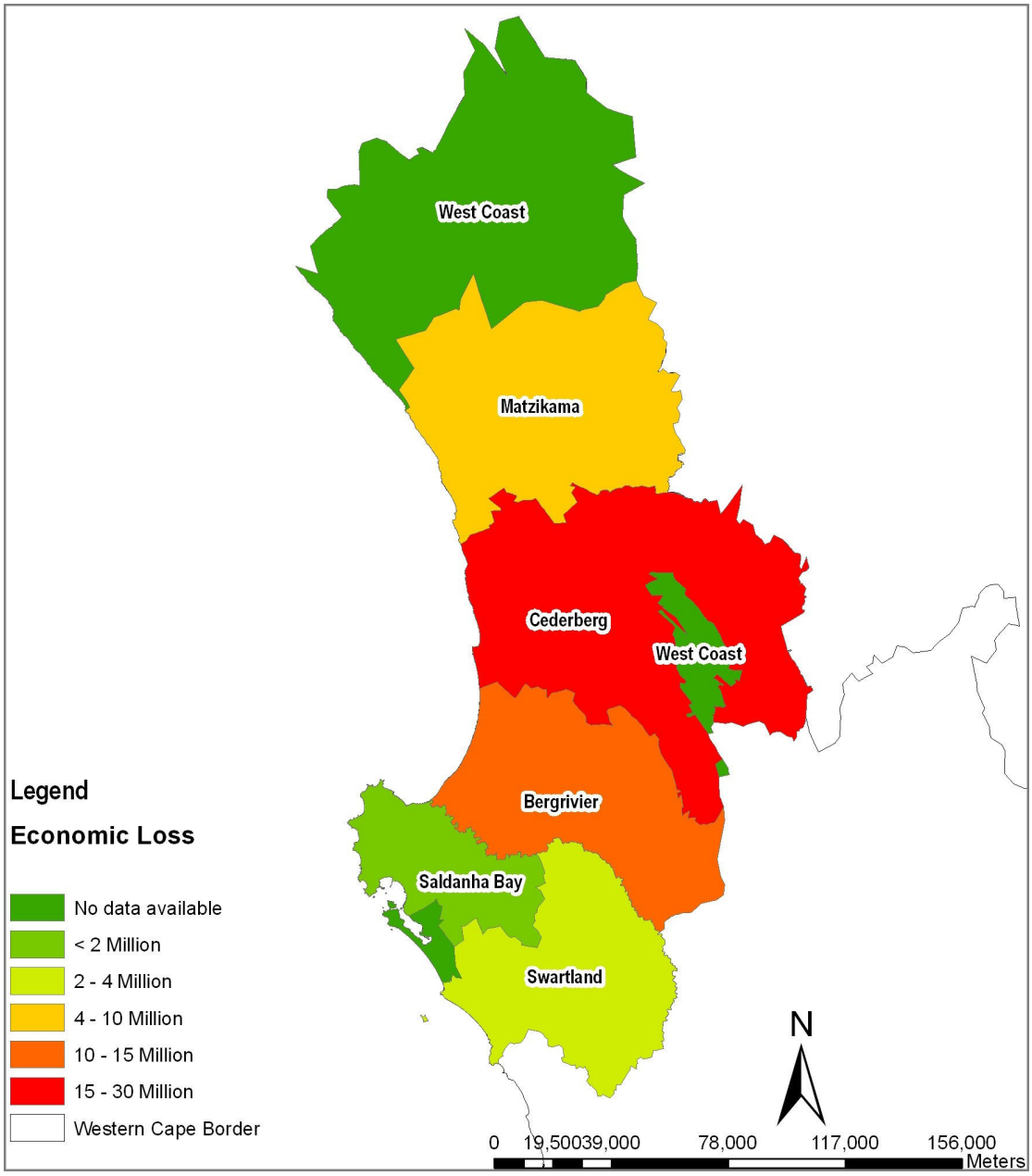


Figure 4.3.4.1.1: Overview of economic losses in local municipality

Table 4.3.4.1.1: Breakdown of economic losses in local municipalities

Local Municipalities	No of Records	Economic Loss [ZAR]	Economic Loss [%]
Matzikama	8	4,490,000.00	8.97%
Cedeberg	10	26,163,100.00	52.26%
Bergriver	42	14,748,826.00	29.46%
Saldanha Bay	14	1,460,000.00	2.92%
Swartland	20	3,202,111.62	6.40%
Total	94	50,064,037.62	100.00%

The Bergriver, Matzikama and Swartland municipalities recorded housing losses amounting to R 8 million (Figure 4.3.4.1.2 and Figure 4.3.4.1.3). In most incidents or

disasters, those living in informal settlements, farming communities and low-cost housing developments are normally more vulnerable, because of both the location of settlements and the materials used in constructing their dwellings. These groups also suffer the heaviest losses, as their dwellings and belongings are not insured, but these losses are not recorded in official estimates. Intangible losses, such as the social and psychological effects of incidents and their related health risks, are also not included in cost-estimates.

All municipalities recorded losses due to road damage. This suggests that roads in the West Coast may be passed the 'patch-up' stage and will require more extensive rehabilitation. This needs to the investigated further.

The only municipality which did not suffer any damage to their water supply system was Saldanha Bay and the only municipality which did not record any storm water system damage was Cederberg.

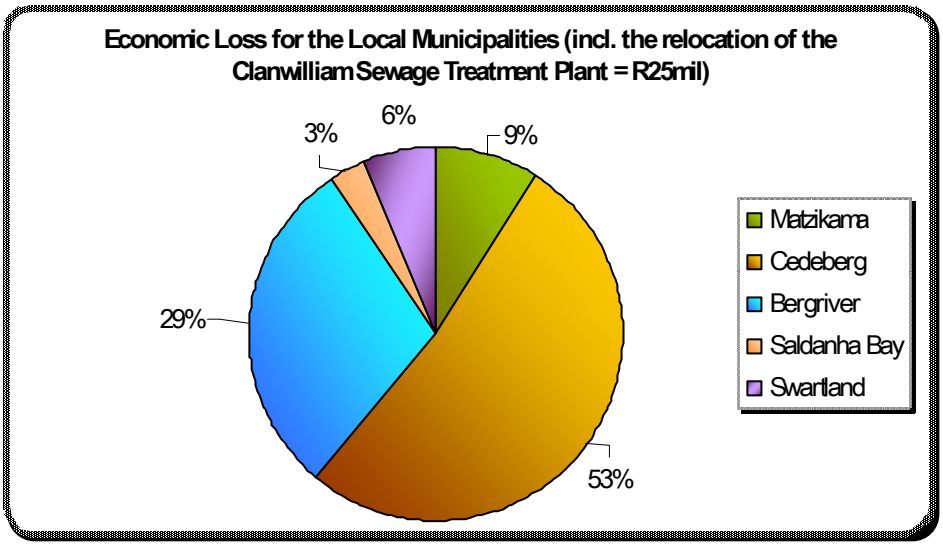


Figure 4.3.4.1.2: Economic Loss for local municipalities including the relocation cost of the Clanwilliam sewerage treatment plant

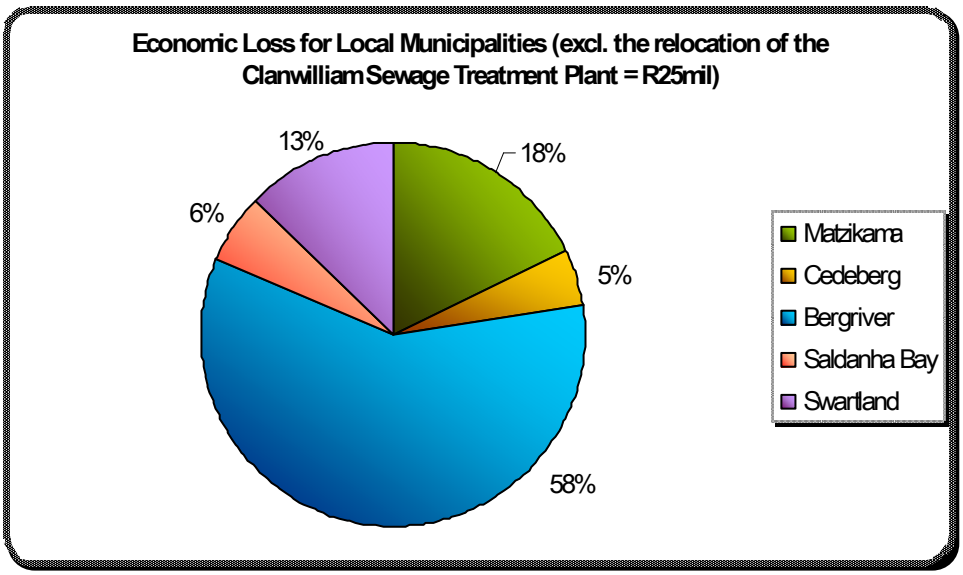


Figure 4.3.4.1.3: Economic Loss for local municipalities excluding the relocation cost of the Clanwilliam sewerage treatment plant

Bergriver municipality recorded R 5 million in agricultural losses (Table 4.3.4.1.2), but because no breakdown was submitted to UCT, it is impossible to determine whether this total is also included in the losses reported by the Department of Agriculture.

Municipal damages include damage to roads, storm water drainage systems, sewage systems, water supply infrastructure, electricity supply infrastructure, informal and formal housing, and commercial and subsistence farms. They also include damage to grave yards, sports and recreational facilities (Figure 4.3.4.1.4). The damage to roads primarily resulted from excess storm water runoff and inadequate storm water drainage. The losses shown represent severe disruptions to local economies and negative impacts on the livelihoods of affected communities.

The existing infrastructure is relatively old and was built according to the flood specifications of the time. However, the severity of the flooding increasingly experienced on the West Coast far exceeds those specifications. The logical recommendation would be refurbish this infrastructure according to more appropriate specifications, but it is expensive to lay new storm water pipes. Priority should be given to financing the maintenance and upgrading of storm water drainage in the area.

Table 4.3.4.1.2: Impacts categorised by damage type for each municipality

	Bergriver	Cederberg	Matzikama	Saldanha Bay	Swartland	Total
Roads	554,000.00	480,000.00	2,000,000.00	860,000.00	2,128,951.41	6,022,951.41
Stormwater	22,000.00	0	2,150,000.00	540,000.00	150,766.33	2,862,766.33
Sewage	41000	* 25,080,000.00	0.00	0	6,500.00	25,127,500.00
Water	255,000.00	350,000.00	300,000.00	0	60,953.76	965,953.76
Electrical	1,615,000.00	0	0	60,000.00	4,817.99	1,679,817.99
Housing	7,500,000.00	0	40,000.00	0	415,400.00	7,955,400.00
Agriculture	4,761,826.00	0	0	0	0	4,761,826.00

Other	0.00	253,100.00	0	0	434,722.13	687,822.13
Total	14,748,826.00	26,163,100.00	4,490,000.00	1,460,000.00	3,202,111.62	50,064,037.62

* Cost includes relocation of Clanwillian treatment plant

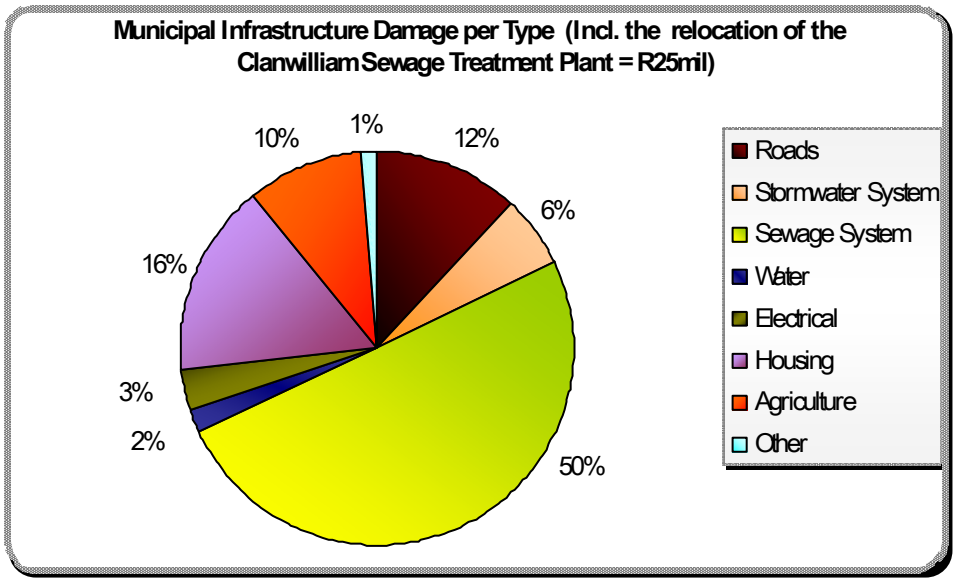


Figure 4.3.4.1.4: Impacts categorised by damage type including the relocation cost of the Clanwilliam sewage treatment plant

The relocation cost of R 25 million for the Cederberg sewage treatment plant is included in the economic loss for Cederberg Municipality. The sewage treatment plant was significantly damaged during the June floods, resulting in effluent spilling into the nearby river. This had severe negative effects on health of people in the surrounding area.

When included in the municipal cost estimates, the cost of relocating the Clanwilliam sewage treatment plant accounts for half of the municipality's total losses. However, when the relocation cost is excluded, damage to housing incurs the biggest loss, as shown in Figure 4.3.4.1.5, below.

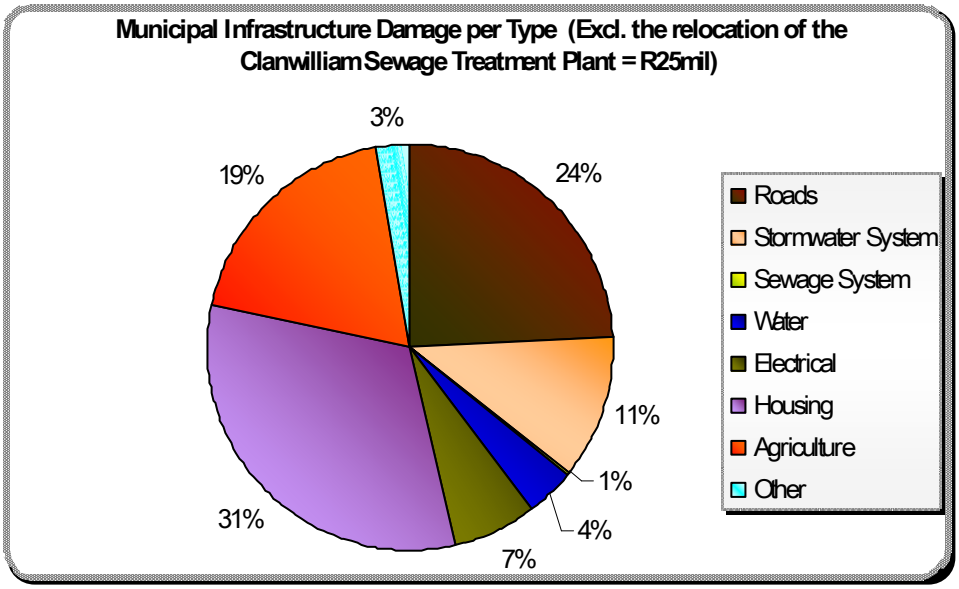


Figure 4.3.4.1.5: Impacts categorised by damage type excluding the relocation cost of the Clanwilliam sewage treatment plant

4.4 Challenges and Recommendations

4.4.1 Risk Reduction Measures for Provincial and Municipal Authorities

4.4.1.1 Agriculture

Enhanced support should be provided to farmers in areas exposed to severe storms to enable improved riverine flood-risk management, reduce 'downstream' consequences and better utilisation of heavy rain to minimise periods of rainfall scarcity.

4.4.1.2 Roads

The costly failure of provincial roads in the West Coast area suggests an urgent need to upgrade to risk-averse levels of roads critical to the region's development. Moreover, the prospect of more frequent extreme weather events in the future calls for increased budgetary allocations for repair and maintenance to minimise the risk of future failures.

4.4.1.3 Housing

Formally built homes should not be sited in flood or run-off exposed locations without robust storm-water management capacity and foundations. New developments should be constructed to meet minimum design criteria for extreme weather events, including severe storms, heavy rains and strong winds.

The structural vulnerability of low-income homes to extreme weather events represents an unaffordable pressure on already resource-constrained households. Housing developments for all economic groups – but especially for lower income categories – should actively incorporate design criteria to avert risks driven by severe weather and surface run-off.

4.4.1.4 Education

A number of school roofs were unable to withstand the heavy rains and wind. Recognising the need to ensure the safety of learners and the economic value of the teaching equipment and resources concentrated in school buildings, it is urged that the rain and wind resistance of roofs be assessed and improved.

4.4.1.5 Local and District Municipalities

Development in municipalities within the West Coast should incorporate climate and disaster risk management into urban planning and budgeting processes

The West Coast's exposure to extreme weather events calls for action to incorporate climate and disaster risk management into municipal planning processes and annual budgetary allocations. Initiatives that should be considered include:

- Incorporating technically robust disaster risk assessments into the planning phase of all major developments in weather-exposed locations, to better anticipate and mitigate the effects of weather events.

- Upgrading of critical bridge, road and storm water infrastructure to risk-averse levels.

The value of investment in municipal maintenance and repair should be further investigated and funded

Research findings form the August 2006 extreme weather event suggest an inverse relationship between per capita investment in municipal repair/maintenance and flood/run-off-related losses in heavy rainfall events. This research highlights the protective value of investing in maintenance and repair and motivates for increased municipal and provincial expenditure on infrastructural maintenance. It also calls for further cost-benefit research to determine the minimum per capita budgetary maintenance/repair allocations and/or investments needed to upgrade infrastructure to risk-averse levels.

Suburbs and settlements that required emergency assistance during the June events should be identified and mapped as 'risk-prone' for risk management planning purposes

The process of identifying suburbs and settlements that required emergency assistance is invaluable for ongoing risk identification and risk management planning, as it focuses efforts on those areas that are most at-risk and on measures that reduce the likelihood of future losses.

4.4.2 Recommendations for Streamlining Ex-Post Loss Estimation Following Future Extreme Weather Events

Loss estimation research following disaster events is a powerful research method for answering questions on 'what failed?', 'where did it fail?' and 'why did it fail?' It complements more traditional inductive risk assessment processes, by identifying the specific vulnerabilities of key services, and characterising these with respect to both their external exposure to heavy rain and run-off and their internal susceptibility.

4.4.2.1 The Timing of Ex-Post Extreme Weather Assessments

An initial assessment of affected infrastructure should be taken directly after a weather event and this should be revisited after one month

This allows the people responsible for tracking impacts to differentiate between impacts incurred during each event in a compound disaster. In cases where there is only one event, verifying the data one month later would enable the collection of information missed in the immediate aftermath of the disaster.

4.4.2.2 Improving Uniformity in Loss Estimation Procedures

Standard impact reporting procedures should be established for those municipalities and government departments that do not yet have a uniform system

This includes the standardisation of hard-copy and electronic formats, as well as the clear designation of a provincial focal point to consolidate these data (or out-sourcing arrangements for this function). Following the June 2007 events, the absence of uniform loss-reporting procedures and formats constrained the collection and consolidation of information across sectors and administrative areas, although DiMP has successfully used the same formats since 2003.

Data should never be submitted without a detailed report of each impact

As a breakdown of economic loss was not always available, this limited the level of detail achievable in the data analysis. It is also impossible to verify impacts without a detailed report of each specific loss. More detailed information should be collected in the future to support more detailed and accurate loss estimations.

All municipal and provincial losses, especially infrastructural losses, should be geo-referenced using a Global Positioning System (GPS)

The lack of geo-referenced data makes spatial identification of recurring impacts impossible. If a municipality or department does not have the capacity to geo-reference data, this should either be outsourced or 'in-house' capacity strengthened.

4.4.2.3 Focus on municipal loss reporting

When recording municipal impacts, only infrastructure for which the municipality is responsible should be recorded

A local municipality should not record and submit data for which a provincial department is responsible. Such infrastructure should be referred to the departments responsible for it, in order to avoid the duplication of data.

All municipal impacts must be recorded, even if funding is not needed.

As many municipalities only reported impacts for which they needed funding, not all affected infrastructure/services related to this event were recorded. This limits the early identification of vulnerable services and infrastructure that may come under pressure in the future. All impacts should be recorded in order to identify extreme weather "hot spots" for improved risk management.

4.4.2.4 Focus on agricultural losses

All agricultural losses should be accompanied by a Surveyor General Number (S.G. No.).

Agricultural risk management within the province is significantly limited by the absence of geo-referenced loss data. The Agricultural sector repeatedly sustains the high losses, but unlike in the case of provincial road infrastructure, where it was possible to identify repeatedly exposed infrastructure through using a Geographical Information System (GIS), it is impossible to create an agricultural loss profile for the West Coast. As recommended since 2003, this limitation could be overcome if farmers sustaining losses could record specific Surveyor General Numbers on their impact forms. The Provincial Department of Agriculture is urged to incorporate S.G. numbers on its disaster loss reporting forms.

4.4.2.5 Improving consistency and accuracy in the economic loss calculations

There should be uniformity across all municipalities and sectors for calculating and presenting damage costs. These should be accurate and not presented as estimates

There is currently no uniform approach to calculating and presenting damage costs. For example, some reports do not state whether administration costs and value added tax (VAT) has been already incorporated into totals. Uniform recording formats should be established that explicitly state how the data is recorded.

Part 5: Conclusions and Recommendations

This section summarises the main conclusions from the preceding chapters, with a specific focus on the West Coast Municipality and the local municipalities within it. It also consolidates the recommendations drawn from the field research and secondary data analysis.

5.1 Summary of main points

5.1.1 Rising disaster losses have been significantly driven by rapid urban growth and expansion

Many of the losses attributed to the extreme weather event were driven by rapid urban growth that has seriously undermined the protective capacities of the natural environment. This is measurably evidenced by the upward trend in weather and run-off-associated infrastructure losses since 2003, suggesting that the 'triple bottom-line' for sustainable regional growth and development may already be compromised.

The district's rapid urban expansion and population growth have not been matched by strategic investments in the redesign or maintenance of critical infrastructure. This is especially indicated by losses to roads and storm-water systems.

5.1.2 Disaster and climate risk management are prerequisites for sustainable integrated development in the West Coast District

Disaster and climate risk management are critical prerequisites for sustainable growth in the West Coast Municipality due to its repeated exposure to both extreme weather and endangering wild-fires. In addition, this recurring pattern illustrates how poorly managed developmental risks have been transformed and transferred onto essential services such as disaster management, emergency services and those responsible for critical provincial and municipal infrastructure.

In this context, there is a pressing need to integrate risk management considerations into the region's spatial and integrated development planning, along with the accompanying financial and human resource allocations.

5.1.3 Reducing the vulnerability of disaster-prone areas, communities and households should be prioritised

The Disaster Management Act (Act 57 of 2002) underscores the need to reduce the vulnerability of disaster-prone areas, communities and households. This would be best achieved by undertaking comprehensive community risk assessments to identify those most at risk, followed by participative community-based disaster risk management planning. In addition, such processes would also assist in identifying the individuals and groups most vulnerable to extreme weather, with a view to prioritising response activities during future events. They would also strengthen participative governance relationships between at-risk communities and local authorities.

5.1.4 Formal low-income homes are made more vulnerable to extreme weather due to a lack of 'weather-proofing' and 'run-off-proofing'

Many of the most at-risk, low-income settlements affected in the June events were situated below road level, and were exposed to endangering run-off due to limited storm water drainage capacity. In addition, poor construction standards increased exposure to heavy rain, run-off and subsidence.

The vulnerability of low-income dwellings to extreme weather events represents an unaffordable pressure on already resource-constrained households. There are currently no provisions or specifications for 'weather-proofing' or 'flood-proofing' low-income dwellings in areas exposed to heavy rain and run-off conditions. However, such measures are crucial in order to protect the assets and health of households living in high risk areas. Housing developments for all economic groups, but especially for lower income groups, should actively incorporate design criteria to avert risks driven by severe weather and surface run-off.

5.1.5 Post-disaster reconstruction provides opportunities to reduce the vulnerability of infrastructure to extreme weather events

The technical demands and administrative complexity of emergency reconstruction were apparent following the June events. Given the tight implementation time-frames imposed, it is to the credit of the technical staff concerned that repairs were completed on time.

The findings of this and previous assessments show an inverse relationship between per capita investment in municipal repair/maintenance and flood/run-off-related losses during heavy rainfall events. This highlights the protective value of investing in maintenance and repair and motivates for increased municipal and provincial expenditure in infrastructural maintenance and upgrading. It also suggests the need for further cost-benefit research to determine the minimum per capita budgetary maintenance/repair allocations and/or investments required to upgrade infrastructure to risk-averse levels.

5.1.6 Despite costly recurrent impacts it is still difficult to generate a spatial agricultural loss profile for the West Coast

The agricultural sector repeatedly sustains the highest losses associated with weather extremes, but agricultural risk management within the province is significantly limited by the absence of geo-referenced loss data. In this context, the Provincial Department of Agriculture is urged to incorporate Surveyor General numbers on its disaster loss reporting forms.

5.1.7 Post-disaster impact reporting and documentation processes require urgent streamlining

Loss estimation research following disaster events is a powerful research method for answering questions such as 'what failed?', 'where did it fail?' and 'why did it fail?' Such research complements more traditional inductive risk assessment processes by highlighting the specific susceptibility of key services and characterising these with respect to external exposure to heavy rain and run-off.

However, onerous reporting requirements have the potential to divert the energies of technical personnel from implementation to administration and reporting. This suggests the need to balance the drive for better data against the numerous

demands placed on frontline technical personnel. Reporting processes should be streamlined and harmonised in order to standardise data collection. This will allow for more comprehensive analysis that relevant to multiple activities, such as mobilising funding and post-event risk analysis.

It is important that impact assessment, recovery and reconstruction guidelines are developed consultatively and are accompanied by an orientation process for key provincial and municipal stake-holders on how they are to be applied.

5.2 Recommendations for Provincial and National Departments

Ref.	Provincial Department	Recommendation
5.2.1	Agriculture	All agricultural losses should be accompanied by SG number. The Provincial Department of Agriculture should incorporate S.G. numbers in to its disaster loss reporting forms
5.2.2	DWAF	Areas and infrastructure adjacent to and downstream from rivers where gauging stations have repeatedly failed should be identified and mapped as 'flood-risk exposed' for planning purposes
5.2.3	Education	Attention should be given to assessing and improving the rain and wind resistance of roofs in school buildings, especially primary schools
5.2.4	Housing	Formal housing should: not be sited in flood or run-off exposed locations without robust storm-water capacity and foundations low-income dwellings should be constructed to meet minimum design criteria for extreme weather events, including severe storms, heavy rains and strong winds
5.2.5	PDMC	In cooperation with the NDMC and other key role-players, the PDMC should: engage with National and Provincial Treasury to explore financial provisions for restoring critical infrastructure beyond replacement standards to risk-averse levels engage with the South African Institute of Engineers to establish a mechanism for mobilising skilled engineers after extreme-weather processes and other disasters for post-event assessment and reconstruction engage with risk-prone municipalities and relevant provincial departments about practical strategies for reducing climate risk impacts on vulnerable infrastructure establish standard impact reporting procedures for municipalities and government departments prepare simple technical, administrative and financial guidelines that streamline impact reporting formats

		and the management of emergency reconstruction. This includes ensuring that all municipal and provincial (especially infrastructural) losses are geo-referenced using a GPS ensure that a dedicated person is appointed to track the impact of extreme weather in each municipality and ensure that data are submitted with a detailed report of each impact
5.2.6	Roads	The failure of provincial roads in the West Coast should be averted through urgent investments in upgrading and risk-proofing vulnerable sections critical to the regional economy, along with upward adjustments in repair and maintenance budgets
5.2.7	Social Development	An unambiguous provincial protocol for social vulnerability assessment of at-risk households should be developed and applied after each extreme weather event

5.3 Recommendations for District and Local Municipalities

Ref.	Thematic Area	Recommendation
5.3.1	Civil and Technical Services	Municipal maintenance and repair should be prioritised and funded as front-line climate and disaster risk management services for municipalities exposed to extreme weather Reducing and managing endangering run-off should be prioritised, as should harvesting run-off to strengthen adaptive capacity during drought. This includes: protecting remaining natural flood attenuation capacity wherever possible to minimise excess run-off investing more vigorously in robust storm water, bridge and road infrastructure to avoid repeat failures investigating and/or rigorously applying municipal incentives and deterrents to reduce agricultural, commercial and residential run-off investigating and/or rigorously applying incentives and deterrents to encourage rainwater and run-off harvesting that minimise the impact of future droughts
5.3.2	Development Planning	Future urban expansion on the West Coast should actively incorporate risk reduction considerations into spatial development and integrated development planning processes Integrated climate adaptation and disaster risk research should be undertaken to determine the relationship between urban development and hydro-

		geological risks in the district, especially in areas where there is evidence of recurrent impacts. Areas and infrastructure adjacent to and downstream from rivers where gauging stations have repeatedly failed should be identified and mapped as 'flood-risk exposed' for planning purposes Risk reduction considerations should be integrated into all local planning and regulatory processes. These include: tightening land-use regulations to avoid further damage to protective environmental services incorporating risk assessment for flooding, run-off, slope failure and subsidence into all future environmental impact assessments For weather exposed infrastructure, it is recommended that the authorities: investigate existing design criteria for critical infrastructure, especially roads and storm water to determine their usefulness and susceptibility to extreme rainfall events 'rethink' investment, environmental, engineering and human resource strategies for risk-averse infrastructure develop decision-making models that evaluate the relative strengths of different proactive investment strategies for upgrading and maintaining critical road and other infrastructure to offset future losses from expected extreme weather investigate the viability of risk insurance options as potential risk transfer mechanisms to ease financial pressure on weather-exposed municipalities Integrated development planning should be used as an opportunity to reduce, not increase the exposure of poor households to endangering surface run-off, rain and subsidence damage
5.3.3	Disaster Management	With specific respect to disaster and climate risk assessment: Integrated climate adaptation and disaster risk research should be undertaken to determine the relationship between urban development and hydro-geological risks, especially in areas where there is evidence of recurrent impacts Areas and infrastructure adjacent to and downstream from rivers where gauging stations have repeatedly failed should be identified and mapped for planning

		purposes Suburbs and settlements that required emergency assistance due to the extreme weather, flooding and surface run-off should be identified and mapped as risk-prone for risk management planning. With specific respect to risk reduction planning: A Disaster Management Advisory Forum should be urgently established and identify a skilled and committed multi-stakeholder task team to identify strategies for mitigating extreme weather-associated risks Spatial loss and impact information from extreme weather events should be incorporated into integrated planning processes, to highlight at-risk sites and settlements Existing disaster management capacity should be urgently increased to manage the wide-ranging demands of post-event recovery, as well as risk reduction planning and preparedness and response Comprehensive community-based risk assessments should be conducted in at-risk communities. These should feed into participative community-based disaster risk management planning processes Creative, locally relevant, robust and sustainable risk reduction measures should be identified and communicated among residents of at-risk settlements With specific respect to preparedness and response: Contingency planning for at-risk communities and settlements should be undertaken consultatively, well in advance of a weather alert Formalised systems should be established for communicating and confirming understanding of warning information among government and non-governmental role-players Warning information, as well as response and relief updates, should be communicated in multiple, context-specific and language-appropriate formats Warnings should be communicated in appropriate formats to households and settlements known to be exposed to extreme weather, surface run-off and flood risk

		Institutional arrangements with respect to the JOCs and mini-JOCS should be formalised and agreed on by critical stake-holders well in advance of extreme weather events An effective and inclusive contingency plan should be in place for response and relief that ensures timely and equitable assistance to high-risk settlements With specific respect to post-disaster reporting: An initial assessment of affected infrastructure should be taken directly after a weather event. This should be revisited a month later Only infrastructure for which the municipality is directly responsible should be recorded. All other infrastructure should be referred to the sectors or departments responsible for the specific infrastructure All municipal impacts should be recorded, even if funding is not needed, with a view to identifying extreme weather 'hot spots' for improved risk management There should be uniformity across all municipalities and sectors for calculating and presenting damage costs. These should be accurate and not presented as estimates
5.3.4	Urban Planning	Climate and disaster risk management should be integrated into urban planning and budgeting processes. This includes: incorporating technically robust disaster risk assessments in the planning phase of all major developments in weather-exposed locations upgrading critical bridge, road and storm water infrastructure to risk-averse levels Sewage treatment plants sited near to rivers at risk of flash flooding should be identified and flood-proofed

5.4 Recommendations for South African Weather Services

Ref.	Thematic Area	Recommendation
5.4.1	Warning content	Warnings should be differentiated, stating different levels of anticipated extreme weather risk. Extreme weather warnings should, where possible, provide expected values for rainfall and wind speed. Weather warnings should include descriptions of likely localised impacts.
5.4.2	Timing of warnings	Warnings need to provide end-users with time to respond. Extreme weather warnings should be issued at least a day in advance, earlier wherever possible.
5.4.3	Dissemination	Weather warnings should be communicated directly by telephone to key provincial officials and municipal managers in the areas likely to be affected. While the SMS system is a very effective and rapid means of communication, phone calls are less easily disregarded and provide opportunity for questions of clarification

Appendix A:
Disaster Impact Form

Name of Organisation/Department:
……..

(please print)

Completed by: ……
Contact Details: ……

		C. Service Disrupted				D. to H. Nature of Impact															
		From		To		River Flooded			Rain			Run-off			Wind			Siltation			
A. Ref. No.	**B.** Name of affected Structure / Area / Service	Date	Time	Date	Time	**D1** Affected	**D2** Damaged	**D3** Destroyed	**E1** Affected	**E2** Damaged	**E3** Destroyed	**F1** Affected	**F2** Damaged	**F3** Destroyed	**G1** Affected	**G2** Damaged	**G3** Destroyed	**H1** Affected	**H2** Damaged	**H3** Destroyed	**I.** Cost

Appendix A cont…

TABLE 2: Focus on factors contributing to the risk

		C. Service Disrupted				J. to O. Factors Driving Risk																	
		From		To		Environmen-tal			Infrastructu-ral			Developmen-tal			Socio-Economic			Political Power			In-Migration		
A. Ref. No.	**B.** Name of affected Structure / Area / Service	Date	Time	Date	Time	**J1** Slope / Valley	**J2** Denuded Slope*	**J3** Debris	**K1** New/under construction	**K2** Old	**K3** Poorly maintained	**L1** Recreation-al Facilities	**L2** Schools	**L3** Hospital / Clinic / Hall	**M1** Unemploy-ment	**M2** Casual Workers	**M3** Contract Wrokers	**N1** None	**N2** Some	**N3** Strong	**O1** Low	**O2** Medium	**O3** High

Appendix B:
Guidelines for completing the Disaster Impact forms

We are hoping to spatially match the impacts of the flood event to a point on a map.

We intend to consolidate all mapped impact.

Please complete the columns the following way.

Column A

Ref no.

Write a number here – i.e. number off 1, 2, 3, 4, ... This is to assist if there are subsequent questions regarding impacts.

Column B

Name of Affected Structures / Areas / Service

Write in the name of the building, service, structure or area that was affected.

Column C

Service Disrupted

This column particularly focuses on services that were disrupted. For instance, if a road were flooded, you would write that the service was disrupted from 24/03/03 10:00 until 25/03/03 06:00.

Columns D to H focus on capturing information that relates ground impacts to particular flood/weather forces. Please tick the boxes that apply.

Columns D_1 to D_3 refer to river-flood impacts – or those impacts that were due *primarily to river flooding*.

River flood affected means structures/services/areas that were flooded.

River flood damaged means structures/services/areas that were flooded by river water and resulted in damage needing repairs.

River flood destroyed means structures/services/areas that were destroyed by river water and required reconstruction.

Columns E_1 to E_3 refer *primarily to direct rain-related impacts* – for instance leaking/damaged roofs.

Rain affected means structures/services/areas that were directly affected by rain.

Rain damaged means structures/services/areas that were damaged by direct rainfall and needed repairs.

Rain destroyed means structures/services/areas that were destroyed directly by rainfall and required reconstruction.

Columns F_1 to F_3 refer to flood impacts *primarily due to significant run-off*, run-off that exceeded existing storm water drainage capacity, or run-off down a slope.

Run-off affected means structures/services/areas that were affected by run-off.

Run-off damaged means structures/services/areas that were damaged directly by run-off, and needed repairs.

Run-off destroyed means structures/services/areas that were destroyed directly by run-off and required reconstruction.

Columns G_1 to G_3 refer *primarily to wind-related impacts* – for instance roofs blowing off.

Wind affected means structures/services/areas that were affected by wind.

Wind damaged means structures/services/areas that were damaged directly by wind, and needed repairs.

Wind destroyed means structures/services/areas that were destroyed directly by wind and required reconstruction.

Columns H_1 to H_3 refer *primarily to debris impacts* – for instance leaves, branches or rubbish being deposited on property.

Debris affected means structures/services/areas that were affected by debris.

Debris damaged means structures/services/areas that were damaged directly by debris, and needed repairs.

Debris destroyed means structures/services/areas that were destroyed directly by debris and required reconstruction.

Column I

Cost

This refers to the estimated costs for restoring a service, conducting repairs or reconstructing infrastructure.

Column J

Comments

Should you want to add any comment, please write the corresponding reference number and the comment you feel is relevant.

Appendix C:
Contributing List

No.	Name	Organisation	Contact Details	Nature of Assistance *Brief Description*
1	At Botha	Swartland Municipality	022 482-2996	Municipal impact information
2	Basil January	Saldanha Bay Municipality	022 713 5951	An account of what happened during the event.
3	Bertrand van Zyl	DWAF	082 807 3541	DWAF impacts
4	Colin Cyster	Dept. of Housing	021 483 4554	
5	Dale Morgan	Cederberg Municipality	027 482-8000	Municipal impact information
6	Dalene Vraagom	Saldanha Bay Municipality	022 713 5951	Minutes of debrief meeting
7	David Tshobotlwane	Dept. of Education	021 467 2129	School impacts
8	Elvin Pedro	Dept of Health-EMS	022 4873730	An account of what happened during the event.
9	H.G Esterhuysen	West Coast District Municipality	022 433 8500	Municipal impact information
10	Jacques Wentzel	SANRAL	082 304 6566	SANRAL impacts
11	Jan Steyn	Municipal Infrastructure Grant		Engineer contact details
12	JI Swartz	Matzikama Municipality	027 201 3436	An account of what happened during the event.
13	Lars Starke	Provincial Government of the Western Cape	(023) 312-1160	Provincial roads impact information
14	Leon Sprong	Spoornet	021 940 3004	Spoornet impacts
15	Louis Zikmann	Swartland Municipality	022 487-9400	Municipal impact information
16	Mr. Meij	Dept of Agriculture		
17	Philip Humphreys	Swartland Municipality	022 487 9400	Municipal impact information
18	Priscilla van As	Dept. of Housing	021 483 3529	An account of what happened during the event.
19	Sive Mabula	West Coast District Municipality	022 433 8400	An account of what happened during the event.
20	Tania Bergh	Swartland Municipality	022-4879400	Municipal impact information
21	Viwe Balfour	Dept. of Education	021 467 9262	School impacts