# PART 1 BACKGROUND, CONCEPTUAL FRAMEWORK AND METHODS

## 1.1 Introduction and context

The December 2004 Cut off Low triggered widespread flooding and rain damage across the Western Cape, specifically affecting the Overberg, Cape Winelands, Central Karoo and Eden District Municipalities. The extreme weather and subsequent flooding had severe direct and indirect impacts to local municipal infrastructure, the agricultural sector and vulnerable communities, such as households adjacent to riverine environments, low income housing and informal settlements.

This extreme event was however not classified a disaster as was the case with the similar event which occurred in March 2003, when a cut off low triggered widespread damage and hardship to the Western Cape. The December 2004 Cut off Low therefore provides an important case study to assess institutional mechanisms to recover, reconstruct and rehabilitate following an extreme weather event, without the classification of a disaster.

***Within Part 1:***

Section 1.1 gives a brief overview of the endangering weather system, its impacts and the general profile of the areas affected

Section 1.2 introduces the conceptual framework for the study and key terms

Section 1.3 describes the overall research approach and methods used

Section 1.4 states the ethical considerations that are reflected in the report

Section 1.5 outlines the study's limitations

Section 1.6 presents the structure of the overall report

### 1.1.1 The extreme weather event and its consequences

On the 22nd December at 14h30 the Weather Service issued a “Severe Weather Warning” after on-the-ground reports from rain affected towns in the Western Cape. By the 23 December, 188.2 mm rainfall was recorded by the official SAWS rainfall station in Robertson, 104.5mm in Swellendam, 168mm in Heidelberg, 167.2mm in Riversdale, 70.6mm in George and 218.8mm in Knysna. In Heidelberg, Robertson and Swellendam this rainfall was the highest recorded rainfall since the March 2003 cut off low, which in 2003 had been the highest recorded rainfall for one day in more than 23 years (DiMP, 2003).

The extreme weather system, extending far greater than 800 km moved eastwards over the interior until the 23 December, resulting in continued rainfall and gale-force winds over this period. This weather system triggered riverine flooding, landslides, excessive runoff on roads and steep slopes, as well as a host of other rain related impacts.

Direct economic losses exceeding R23 million were reported by local municipalities across four districts. These losses included damage to bridges, water pipes, roads, power lines, and district, municipal and provincial property. In Heidelberg the damage to the sewage works amounted to approximately R2,5 million. In Suurbraak the damage to the main drinking water pipe amounted to R2,3 million.

The Eden and Overberg municipalities sustained the highest losses, with R16,7 million and R3,03 million respectively. Commercial farmers sustained R24,5 million worth of damages, which included damage to infrastructure, loss of soil, loss of livestock and agricultural equipment such as tractors and water pumps.

Over the four districts, 10 people had to be airlifted off roofs and many towns housed people in halls overnight. In total it was reported that 3 636 houses and 40 business premises sustained rain or flood damage, due to riverine flooding, excessive runoff caused by blocked drains or steep slopes and rain related impacts. Of these 2 703 were reportedly informal or low income households.

In Heidelberg and Suurbraak several cases of water related illness such as diarrhoea were apparently reported.

### 1.1.2 The December 2004 Cut off Low and its relevance to disaster management policy

The Disaster Management Act (Act 57 of 2002) promulgated in January 2003 calls upon all organs of state, as well as the private sector and non-governmental organisations to implement measures that reduce vulnerability and risk in disaster prone areas, communities and households. The National Disaster Management Framework also specifies that all significant disaster events are recorded and assessed. The assessment of the Western Cape Flooding Event afforded an excellent opportunity to draft a case study of best practice, specifically as the event was not classified as a national `disaster'.

The research allows for the practical identification of local authority training and other capacity-building priorities that should be urgently addressed in the roll-out of the provincial disaster management framework. In addition, the timing of the research provides a platform for exploring some of the more complex aspects of recovery planning and programme implementation.

Moreover, in a context of growing climate variability, and concerns about likely increase in extreme weather events such as this, the December Cut off Low can be viewed as a case study for identifying vulnerability conditions that should be prioritised in the implementation of the Disaster Management Act.

### 1.1.3 Institutional arrangements for the research and terms of reference

The case study was financed by the Western Cape Department of Local Government and Housing under the directorate of Disaster Management and Fire Brigade Services. The research framed as a 'Disaster Debriefing' was commissioned following a request from Minister Mufamadi, National Minister of Provincial and Local Government, to document the December Cut off Low as a case of best practice, following the non classification of a national disaster.

The research terms of reference included the documentation of the disaster management recovery activities of the recent floods in the Overberg, Cape Winelands, Central Karoo and Eden District Municipalities.

Specific objectives included:

- The documentation of the institutional response, relief and recovery by relevant line departments at a municipal, district and provincial level to the flooding disaster on the 22 December 2004.

- The highlighting of cases of best practice by relevant line departments in their response, relief and recovery activities.

- Detailed recommendations for strengthening the institutional response, relief and recovery.

The Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) at the University of Cape Town was commissioned to undertake the research. The DiMP research team was co-ordinated by the DiMP Risk Research Co-ordinator, with two field researchers namely, a Masters level Disaster Risk Science (DRS) student and an Honours level DRS student from UCT. The Department of Local Government and Housing acted in a support role, by consolidating impact data and arranging a workshop with District and Municipal officials in Swellendam in May 2005.

## 1.2 Conceptual framework for this study

In the past, severe weather events such as the March 2003 cut-off low and its consequences would have been understood as a `natural disaster', or `Act of God'. However, international best practice now views disasters as interplay between natural or other threats *and* conditions of socio-economic, environmental or infrastructural vulnerability. A disaster only occurs when a *vulnerable* household, community, city, province, business, ecosystem or physical structure is subjected to a *shock or stress* which it *cannot withstand* or from which it *cannot recover without external assistance.*

Normally, a `hazard' is viewed as an external phenomenon *with potential to cause harm*, while vulnerability refers to the *internal characteristics* of the household, community or area that increase the likelihood of loss. In this context, it is no longer appropriate to state that a storm `caused' the flooding, but rather to state that the storm `triggered' the resultant flooding.

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 external assistance.

With respect to the December Cut off Low 2004, the *hazard* is understood as the weather system, characterised by heavy rains over a specific area, for a reasonably short period of time.

With respect to this research report, vulnerability is viewed as those characteristics likely to increase the probability of loss with respect to riverine systems, rural livelihoods, physical infrastructure and critical services, as well as human well-being and health status.

The research presented below seeks to identify those risk conditions that increased the likelihood of loss, as well as the household/community responses and institutional mechanisms that reduced the severity of the impacts associated with the weather event.

## 1.3 Assessment Methods

The multi-disciplinary nature of this study demanded the identification of a skilled team with capacity to work across disciplines. The research team comprised a disaster risk specialist, and two students with backgrounds in extreme weather events, hydrology and community level risk assessment.

The research required a suite of both quantitative and qualitative methods, which included the following:

- **Streamlining, verification and analysis of economic loss data and Municipal reports**
- **Collection, streamlining and analysis of municipal reports**

- **Collection and analysis of meteorological data from the South African Weather Service**

- **Collection and analysis of hydrological data from the Department of Water Affairs and Forestry**

- **Workshop with district and municipal level officials from the Overberg, Cape Winelands, Central Karoo and Eden District Municipalities.**

- **Interviews with key municipal and district level departments, community leaders and councillors**

- **Interviews with local residents in Suurbraak and Droëheuwel**

- **Workshops and focused interviews with farmers and conservation officials on the Duiwenhoks River**

- **Workshop with community representatives in Suurbraak**

- **Workshop with affected households in Suurbraak**

- **Observations of the reconstruction to damaged infrastructure**

### 1.3.1 Streamlining, verification and analysis of economic loss data and Municipal reports.

All Provincial, District and Municipal reports, minutes and correspondence pertaining to the December 2004 Cut off Low were received from the Directorate Disaster Management and Fire Brigade Services. The information contained therein was then compiled into a spreadsheet format.

### 1.3.2 Collection, streamlining and analysis of municipal reports

The Municipal reports regarding the cut off low were collated into a single spreadsheet. This was then divided up according to district and municipality. These area specific spreadsheets were printed out and verified with the various sources at the Disaster Debriefing meeting in Swellendam, May 2005.

### 1.3.3 Collection and analysis of meteorological data from the South African Weather Service

Daily rainfall data for the periods 21st to the 23rd December 2004 and 10th to the 12th April 2005, for all stations in the Western Cape was requested from the South African Weather Service. Additionally, where available, the co-ordinates of the stations were requested. This data was then formulated into a single table and station data was chosen for use on the basis that it was complete over the period, had co-ordinates and was within the area affected by the cut off low.

A table of this relevant and complete rainfall data for the two periods was sent to Wesley Roberts who formulated it into GIS maps showing the daily rainfall interpolated over the study area. Rainfall data for the March 2003 cut off low was obtained from the Consolidated Report as well as from the South African Weather Service. The three periods, March 2003; December 2004 and April 2005, were used as a means of rainfall comparison, though the focus of investigation was on the period from the 21st to the 23rd December 2005. To understand the relevance of the amount of rainfall which fell during this period, average rainfall data for certain stations was requested from the South African Weather Service and compared to the amount of rainfall that was recorded at those stations from the 21st to the 23rd December.

### 1.3.4 Collection and analysis of hydrological data from the Department of Water Affairs and Forestry

Information regarding the areas affected was given to DWAF, who then established what rivers they had data on in the areas concerned. Data on these rivers was then supplied in the form of river height and flow rate data. This data was plotted on two separate graphs and presented to the participants at the Disaster Debriefing meeting held in Swellendam in May 2005.

### 1.3.5 District level workshop in Swellendam

**Fig 1:** Disaster debriefing workshop held in Swellendam in May 2005, with national, provincial, district and municipal level participants.

On the 4th May 2005 a workshop was convened in Swellendam with national, provincial, district and municipal level departments. The aim of the workshop was for each district to present an overview of emergency response and identify key lessons learnt in terms of the co-ordination of the emergency. Each district was further required to outline the key success or limitations of the recovery, reconstruction and rehabilitation post the December 2004 Cut off Low. In addition representatives from DWAF and SAWS presented an overview of the meteorology and hydrology of the December 2004 Cut off Low. In a plenary session, recommendations were discussed.

### 1.3.6 Interviews with key municipal and district departments, community leaders and councillors

Interviews were conducted with key municipal and district departments, community leaders and councillors. This included disaster managers in Robertson, community leaders and councillors in Droëheuwel, disaster managers from Swellendam, community leaders in Suurbraak, representatives from the Langeberg Municipality and a sister at the Heidelberg clinic.

### 1.3.7 Interviews with local residents in Suurbraak and Droëheuwel

In Droëheuwel (Robertson) and Suurbraak interviews were conducted with flood affected residents. Community leaders and municipal officials assisted in the identification of flood affected households.

**Fig 2:** Interview with local residents in Suurbraak

### 1.3.8 Workshops and focused interviews with farmers on the Duiwenhoks River

On the 6th May a workshop was run in Heidelberg with flood affected farmers, who are farming alongside the Duiwenhoks River. The aim of the workshop was to illicit information from the farmers regarding the impacts of the flood on farming. The challenges of rehabilitating the catchment following the December 2004 Cut off Low was also discussed in detail. The workshop was attended by over twenty farmers, a representative from the Eden District AgriSA, the DWAF representative responsible for the Duiwenhoks River Water Forum, the Cape Nature Conservation Officer for the area and a representative from the Duiwenhoks Conservancy.

### 1.3.9 Workshop with community representatives in Suurbraak

On the 5th May a workshop was run in Suurbraak with community leaders, residents, local business associations and youth workers to assess the impact of the cut off low on local residents and businesses. Particular attention was given to the impacts of the destruction of the drinking water pipe when the Buffeljags River flooded. The consequences of the temporary measures taken to provide safe drinking water to the Suurbraak community were explored. The workshop was highly participatory and used a range of methods, such as community mapping, chronologies and transect walks.

**Fig 3:** Workshop held in Suurbraak in May 2005 with community leaders, residents, local business associations and youth workers.

### 1.3.10 Workshop with affected households in Suurbraak

On the 5th May a workshop was run in Suurbraak with local residents who had been affected by the severe weather event. The forty men and women were divided into two groups, each facilitated by a DiMP researcher. The aim of the workshop was to understand the direct and indirect impacts of the Cut off Low on Suurbraak households. As the majority of community members were not directly affected by the flood event, the focus of these discussions was primarily on the impacts of the broken water pipe. There were however two households who live alongside the river that were evacuated during the flooding of the Buffelsjags River. A representative of the Swellendam Municipality arranged the workshop.

**Fig 4:** Community level workshop held in Suurbraak in May 2005 to gather information regarding the impacts of the cut off low on residents.

### 1.3.11 Observations of the reconstruction to damaged infrastructure in Heidelberg

On the 6th May a meeting was held with the Langeberg Municipality Water and Sanitation Manager at the Heidelberg sewage works. The damage was surveyed and the repair works examined. A drive was then taken around Heidelberg with the Municipal representative in order to examine the extent of the damage and repairs.

**Fig 5:** The flood line inside a house on the banks of the Duiwenhoks River, Heidelberg, May 2005.

## 1.4 Ethical Considerations

In order to ensure confidentiality of 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 official designation or as a representative of specific organizations.

A further ethical consideration was that one member of the research team had been visiting family who live alongside the Duiwenhoks River in Vermaaklikheid during the time of the event. There is therefore the need to declare the notion of positionality and reflexivity due to vested interest in the geographical area. Transparency in this regard has been practiced throughout the duration of this research.

## 1.5 Limitations of Research

Limited time and resources was a major limitation to the research in that it was not possible to conduct in-depth interviews with all those involved. A further implication was that only three affected areas, namely Robertson, Suurbraak and Heidelberg could be researched in-depth.

Another chief constraint to the implementation of the research was the consistently uneven management of incident recording/ tracking documentation, along with processes for recording impacts/loss. In the absence of clear and streamlined recording systems - specifically in respect to tracking losses, members of the research team spent considerable time consolidating the loss information. In some instances there was a concern of duplication of loss information which the team tried to validate. This may have resulted in unintended misrepresentation of information collected.

## 1.6 Structure of this Report

This report is structured in the following way:

**Part I** introduces the *background, conceptual framework and methods* used in this research.

**Part II** provides an overview of the *`biophysical' aspects of the disaster event*, specifically the meteorology, weather forecasts and early warning, flood hydrology and environmental conditions that contributed to its severity. This section also includes a comparison between the December 2004 Cut off Low and the March 2003 Cut off Low.

**Part III** addresses the *institutional arrangements* around the emergency response to the disaster incident

**Part IV** presents an overview of total losses to the four districts in terms of damages to critical infrastructure. An overview of agricultural losses is also presented. This section also critically explores the recovery, reconstruction and rehabilitation of municipal infrastructure and the agricultural sector through two cases, namely the reconstruction of the Heidelberg sewage works and the rehabilitation of the agricultural sector along the Duiwenhoks River.

Here the concept of recovery needs to be differentiated from that of coping. Recovery is to return to a state of well being and general security similar to that which existed before the shock or stress was experienced. Coping on the other hand involves short-term responses to manage the immediate event. Such responses may heighten individuals and communities level of vulnerability and hence livelihood insecurity.

**Part V** presents an overview of the key lessons learnt and some critical recommendations for future action.

Boxes of information provide examples from the field that highlight certain concepts which have been discussed in the report.

# PART II THE DECEMBER 2004 CUT OFF LOW: EXTREME WEATHER AND RAIN TRIGGERED HAZARDS

## 2.1 Introduction

The scale, distribution and severity of the disaster losses were in part shaped by the powerful character of the weather system, which triggered not only heavy rain, but riverine flooding and excessive runoff.

***Within Part 2:***

Section 2.2 outlines the South African Weather Service forecast and early warning for the December 2004 cut off low, with an overview of the steps taken in the dissemination of the early warning.
Section 2.3 presents a meteorological overview of the December 2004 Cut off Low
Section 2.4 describes the rain triggered hazards, such as riverine flooding, runoff and drainage.

## 2.2 Forecasting Extreme Weather

### 2.2.1 The South African Weather Service Early Warning

Only on the 22$^{nd}$ December at 14h30 did the Weather Service issue a Severe Weather Warning which stated that "heavy falls of rain are expected over the South Western Cape Interior, Overberg, South Coast, Little Karoo as well as the Central and Southern Karoo regions" (SAWS, 22/12/2005). By the time the warning had been issued the cut off low had already produced heavy rains, which had been recorded in Robertson, Swellendam and Heidelberg.

**Box 1: Definitions of a cut-off low:**

"A closed low in the upper air supported by a low-pressure system on the surface" (SAWS report).

"A cold upper-level low that has become displaced out of the basic westerly flow of the jet stream. It usually lies to the south of the jet … creating a slow-moving area of unstable weather" (http://www.krdotv.com/WeatherDef.asp).

In simpler terms, circulation which becomes detached from the predominant flow/system, often resulting in heavy rainfall, gale-force winds and other severe weather.

### 2.2.2 Forecasting the spatial extent and severity of a cut off low accurately

The exact characteristics of a particular cut off low are extremely difficult to predict. Even though it is generally a simple matter to see the formation of a cut off low, it is challenging to predict what the consequences of a particular system will be and where these consequences will be felt. Not all cut off lows produce high rainfall and thus not all justify warning the disaster management community. Firstly it is difficult to decide which are going to be the systems that will produce the high rainfall and thus be a concern and secondly it is exceptionally challenging to predict the track of a cut off low, i.e. in which direction the system will travel. The basic cause of these difficulties lies in the fact that the cut off lows which have the potential to affect South Africa, form over the sea where the SAWS is reliant on sparse data from selected island weather stations, ocean weather buoys and satellite images.

The SAWS has made a request for real time, on the ground information from people experiencing the weather system. For example if someone to the west is experiencing heavy rainfall and alerts the SAWS to this fact, if the system is moving towards the east then the SAWS can alert those to the east that they will almost certainly experience heavy rainfall within a time. According to the SAWS this type of feedback can dramatically improve the weather warnings they will be able to disseminate. It is important to note that SAWS is the only official source of weather related information, and while local weather specialists may express opinions, disaster managers must ensure that they react to all SAWS warnings or advisories.

### 2.2.3 Dissemination of the Weather Early Warning

The South African Weather Service (SAWS) is responsible for the production and dissemination of severe weather warnings. Forecasters determine the probability of the onset of the severe weather system and attempt to determine what impacts this will have in terms of rainfall, winds, ocean swells and other outcomes. These warnings are disseminated by both the Pretoria Head Office and the local Weather Office (in this case-study, the Cape Town Weather Office). Typically a severe weather warning is preceded by a `weather advisory' which is disseminated via the local media, SABC TV and three of Cape Town's leading newspapers. However, in this case the first warning to be disseminated was the severe weather warning which went out on the 22$^{nd}$ December at 14h30.

The severe weather warning issued on 22$^{nd}$ was disseminated along with normal weather forecasts through all media types (print, radio, and TV). According to the SAWS it would also have been carried on Telephonic Weather Information Services for the relevant areas.

Cape Town Weather Office disseminates warnings via SMS to Provincial disaster managers as well as disaster managers in areas expected to be affected. A few other organisations such as the National Department of Agriculture, Cape Nature Conservation, and NSRI also receive the warnings.

Disaster Managers receiving the SMS warnings are expected to relay the warning message downward to role players in their specific areas on a need to know basis. At a municipal level however several officials reported never receiving either the weather advisory or the severe weather warning. The SAWS explained that this may in part be due to the initial `list of individuals to contact' being incomplete.

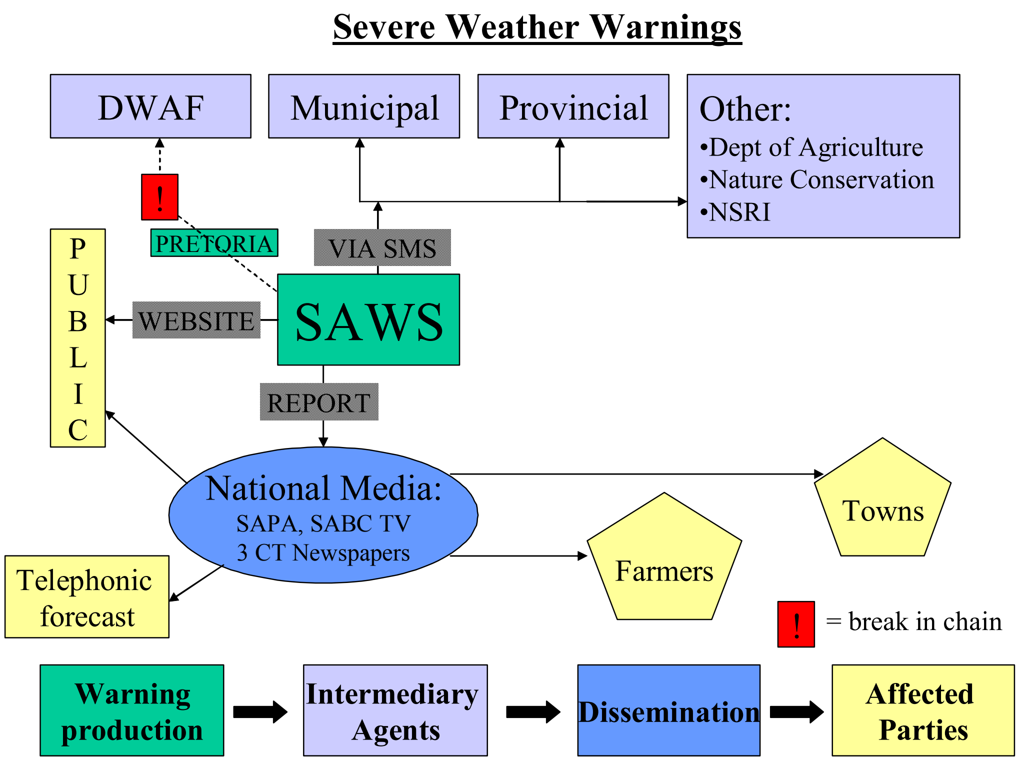



**Fig 6:** Schematic chart summarising the operations of weather warning production and dissemination

## 2.3 December 2004 Cut off Low: A Meteorological overview

On the 21st December 2004 a cut off low formed over the south west coast of South Africa. Cut off lows cause a low level jet, strong wind, which in this case, as well as that of the March 2003 Cut Off Low, came inland after passing over a relatively warm sea. While passing over the warmer sea the air picks up significant amounts of moisture. The jet then reaches the coast and mountains and is forced to rise. The moisture laden air cools as it rises and no longer being able to hold that amount of moisture, produces rain. The Cut Off Low itself has a pool of cool air associated with it which is a large area of instability and in itself has the potential to cause rainfall. In the case of the March 2003 cut off low as well as that of December 2004, the rainfall caused by these processes was substantial.

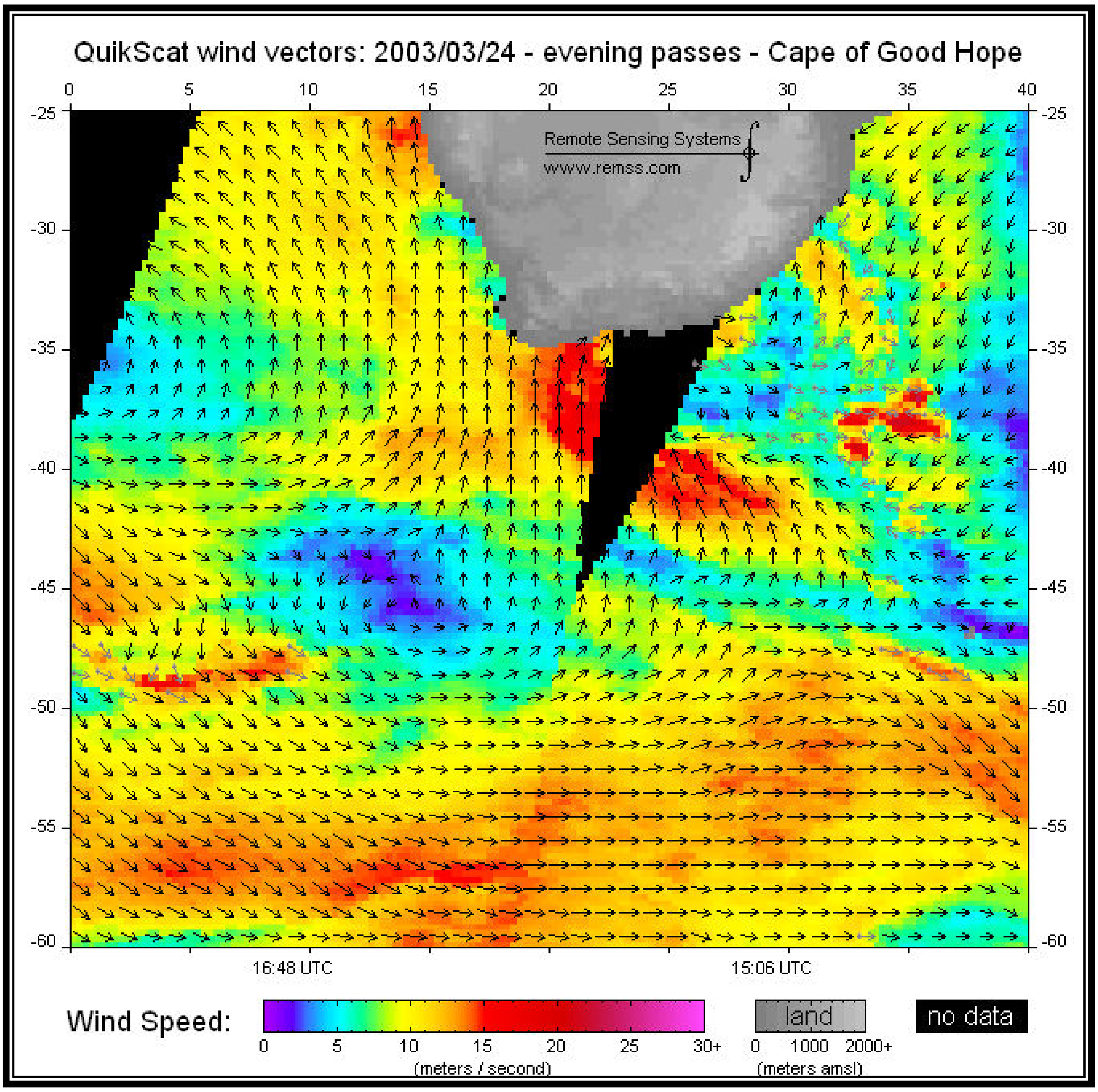



**Fig 7:** Quickscat wind vector image of South Africa during its evening pass of 24th March 2003

From the two Quickscat images portrayed above and below, it can be seen that the speed of the jet was considerably higher for the March 2003 event as apposed to that of the December 2004 event. Never the less, both events produced significant amounts of rainfall.

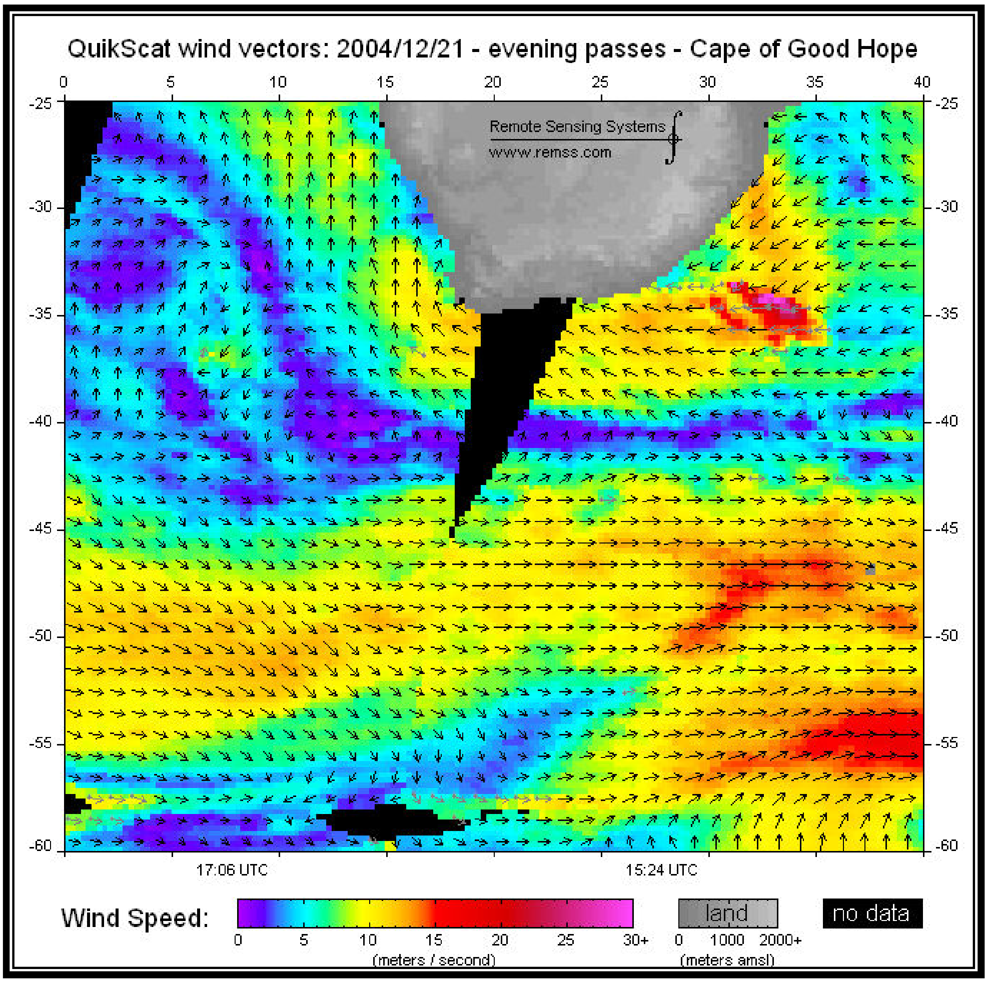
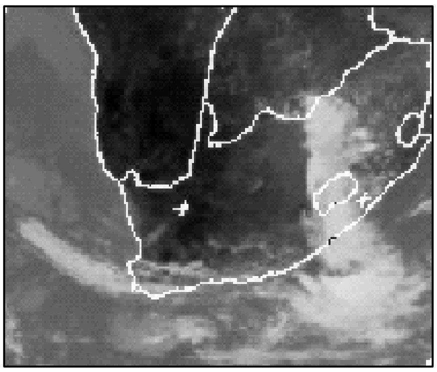



**Fig 8:.** Quickscat wind vector image of South Africa during its evening pass of 22nd December 2004

Satellite Infra Red images indicate temperature, white being the coldest and black the warmest. The white on the adjacent image therefore shows clouds which are high and



cold and have a high potential for rain. On the day represented here, Heidelberg and George received their highest rainfall for this event, 118.5mm and 99.8mm respectively. The clouds in the satellite image for the 21st December are most likely very large cumulonimbus cells which developed in the warm moist and unstable circulation from the north, ahead of the Cut-off Low. There was no recorded rainfall in Robertson and Swellendam for this day while stations in Riversdale recorded 21.4mm, George 99.8mm and Knysna 15mm.

**Fig 9:** EUMETSAT Infra Red Satellite Image of South Africa 9a.m. on the 21st December 2004

This Infra Red satellite image for the 22nd December 2004 shows the clouds formed by the now fully developed cut off low. Rainfall was highest on this day for the areas under study with the exceptions of Heidelberg and George where highest rainfall was experienced over the first day of this event (21st Dec). Recorded rainfall at Robertson was 185mm, Swellendam 97.5mm, Heidelberg 46.5mm, Riversdale 126.6mm, George 57.6mm and Knysna 199.2mm. The cloud cover visible in this image reveals the extent of the area affected by this event.

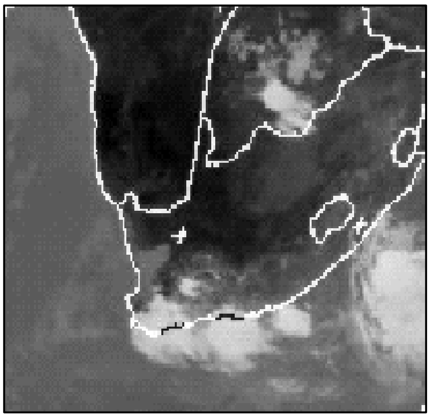


**Fig 10:** EUMETSAT Infra Red Satellite Image of South Africa 9am on the 22nd December 2004

By the 23rd December 2004 the cut off low had begun to dissipate. This is seen clearly in the EUMETSAT Infra Red image for this day through the visible breakdown in structure of the cloud formation. The rainfall over the study area for this day corresponds with the dissipation of the cut off low as stations at Robertson recorded 3.2mm rainfall, Swellendam 0mm, Heidelberg 3mm, Riversdale 19.2mm George 8mm and Knysna 4.6mm, considerably less than the previous two days.

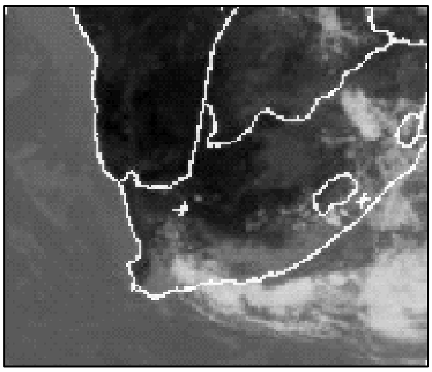


**Fig 11:** EUMETSAT Infra Red Satellite Image of South Africa 9am on the 23rd December 2004

The significance of the high rainfall experienced over this period is made clear when the amount of rainfall over this three day period is compared to average rainfall for

December in these locations, as is done in Table 1, as well as with previous daily December rainfall since 1993, as in the graphs in Appendix 1.

Over the three day period in December 2004 Robertson experienced 6.59 times more rainfall than it experiences on average over the entire month of December. Over the rest of the study area Swellendam experienced 1.67, Heidelberg 6.96, Riversdale 3.76, George 2.48 and Knysna 4.09 times more rainfall than they normally do over the entire month of December. All the rainfall figures for the December 2004 event, March 2003 event and the April 2005 event as well as the totals, averages and other information are included in Table 1. Looking at the three day rainfall event of December 2004 on a daily scale and comparing it to December daily rainfall since 1993 reveals just how anomalous this event was. This data is displayed in graph form in Appendix 2. The only municipality which has experienced higher rainfall than during the December 2004 event over a single day in December since 1993 is Swellendam where 109.7mm of rainfall was recorded on the 23rd December 1994. Again with the exception of Swellendam, no other municipality has experienced even close to the amount of rainfall in one day to that which fell on the 21st and 22nd December 2004.

**Table 1:** Rainfall Data for the December 2004 Cut Off Low event

| | **Robertson** | **Swellendam** | **Heidelberg** | **Riversdale** | **George** | **Knysna** |
|---|---|---|---|---|---|---|
| 2004.12.21 | 0 | 0 | 118.5 | 21.4 | 99.8 | 15 |
| 2004.12.22 | 185 | 97.5 | 46.5 | 126.6 | 57.6 | 199.2 |
| 2004.12.23 | 3.2 | 0 | 3 | 19.2 | 8 | 4.6 |
| **Total** | **188.2** | **97.5** | **168** | **167.2** | **165.4** | **218.8** |

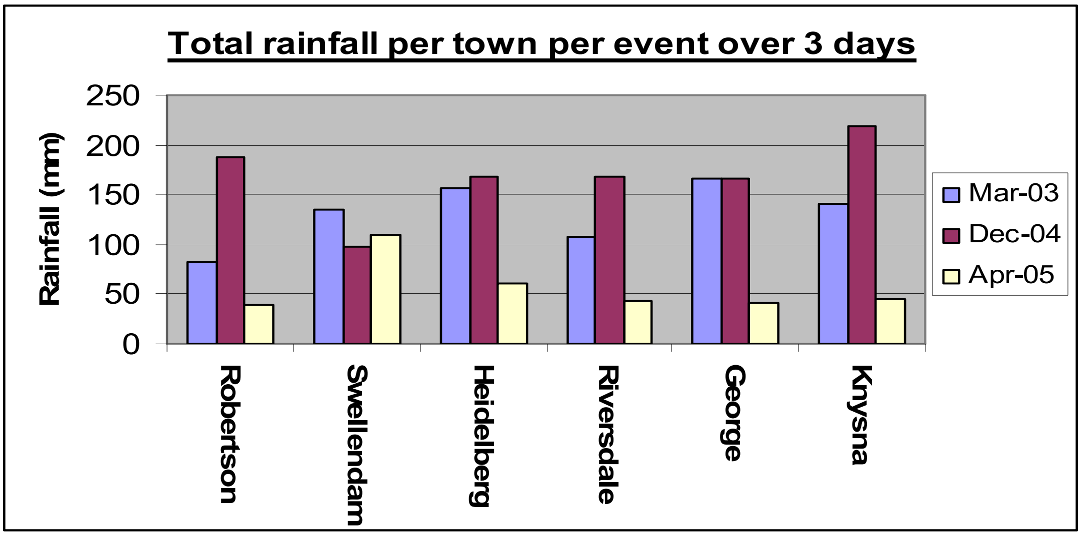



**Fig 12:** Graph comparing rainfall data from the March 2003, December 2004 and April 2005 events

The meteorological study of this event reveals that this was indeed a far reaching, anomalous event with extreme rainfall as a consequence in the form of an excessive amount to be experienced for the month of December let alone to occur over the space of a day.

## 2.4 Rain triggered hazards: Riverine flooding, run off and drainage

### 2.4.1 Introduction

In a heavy rain event such as the one experienced on the 22nd December 2004, the hazard is not the flooding, but rather the excessive rain which triggers flooding and other related damages. When in excess of 200 mm of rain falls over a few hours, as was the case in this event, flash flooding essentially occurs with devastating results. Although flash floods are usually associated with the arid and semi arid parts of South Africa, for example the Karoo, events such as the March 2003 and December 2004 floods were of relative short duration with a peak discharge as much as ten times the normal rate (refer to figures 13 &14). This heavy runoff is exacerbated by factors such as bad farming practices, removal of vegetation in the catchments and alongside rivers and badly planned settlements. Built environments suffer the most damage due to reduced soil infiltration, increased runoff, blocked drains and rain damage to sometimes inadequately built houses.

### 2.4.2 Riverine flooding

In the December 2004 rain event, most of the rivers in the southern Cape area came down in flood, causing damage to property and infrastructure estimated to millions of rands. Riverine flooding is significant in the southern Cape as there are many small to medium sized rivers which have quite large catchment basins on the steep southern slopes of the Cape Fold Belt. These rivers typically flow rapidly down the often quite rocky slopes to the coastal plain below, where they slow down and broaden and wind their way to the nearby ocean. In the event of exceptionally heavy rainfall as experienced on the 22nd December 2004, the steep terrain in the catchment, coupled with the relatively thin soils, result in high runoff, short delay flash floods. These highly destructive floods gouge out river banks, destroy infrastructure in their paths, rip up large tress, inundate flood plains and carry an enormous amount of sediment and debris down river.

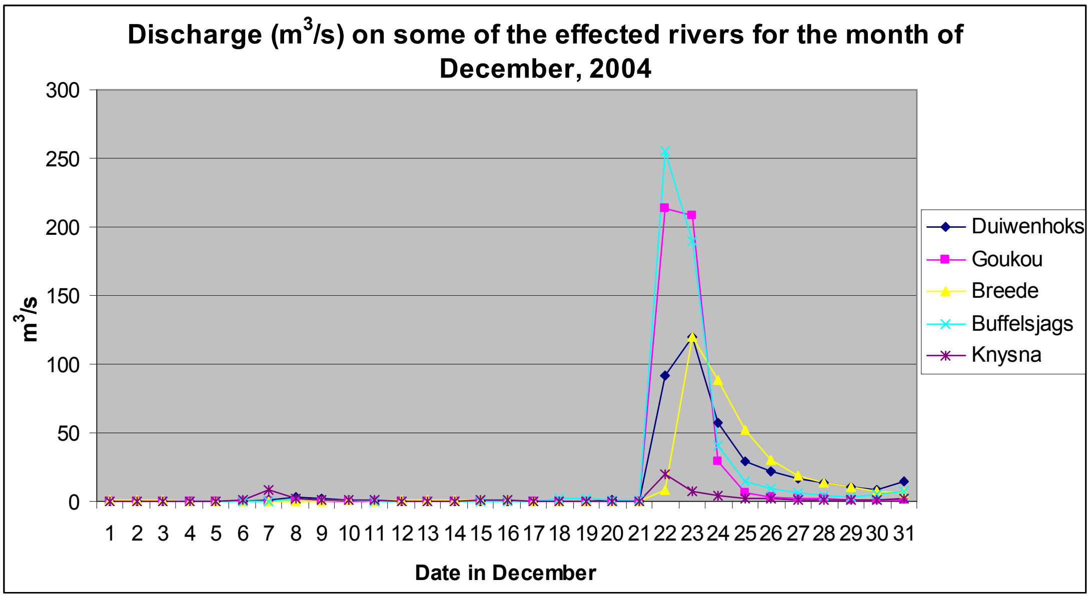



**Fig 13:** Discharge for the month of December on some of the rivers in the affected area. Note how rapidly they rise to over 10 times the normal discharge in just 24

hours, and then return to almost pre-flood levels in just a few days. (Data source: DWAF)

This situation is further exacerbated by anthropogenic factors such as bad farming practices and the built environment. In both Suurbraak and Heidelberg, it was pointed out that during the past few years DWAF's Working for Water programme has been clearing alongside the Buffelsjags and the Duiwenhoks rivers respectively. This entails extensive clearing of alien vegetation both in the catchments and alongside the rivers on flood plains etc. Two problems arose from this with regard to the flooding. The first one being that the removed vegetation is left just above the one in fifty year flood line. As the flooding which occurred in December 2004 was above the one in hundred year flood line the removed vegetation provided additional debris that could dam up at a narrow point or blockage in the river, such as a bridge or a low water drift, exacerbating damage levels. The second impact of significance in a flood situation is the actual removal of these often very dense single species growths of alien vegetation, leaving the soil bare and therefore exposed to extensive erosion for some time post clearing, until the indigenous vegetation has had time to re-establish itself. Both of the above mentioned factors contribute significantly to flood related damages, particularly of significance to farms and built up areas.

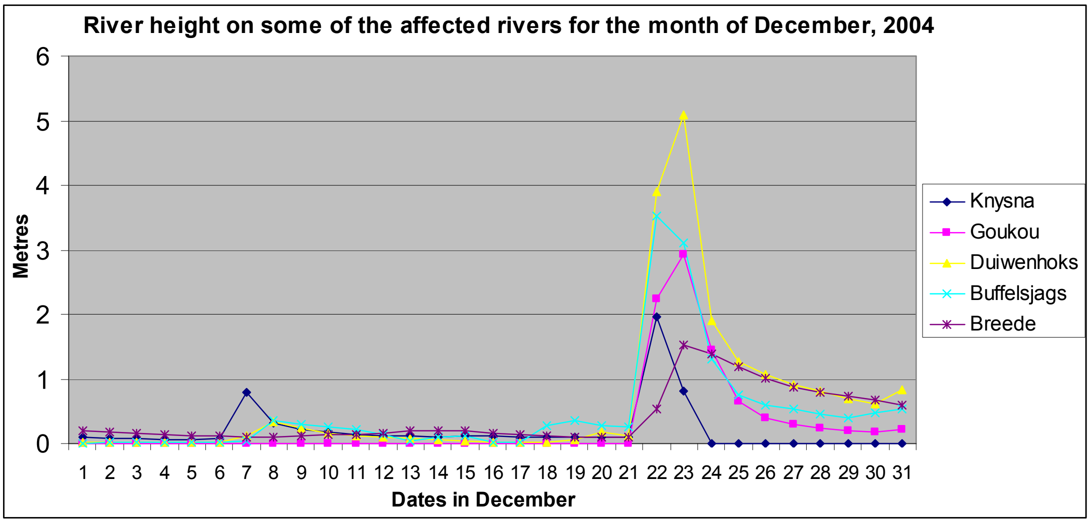



**Fig 14:** River height in metres of the same rivers as shown in figure 13. Note the relatively small rise in river height on some of the rivers around the 6-8 December. This is the rise in river level to be expected from a more usual rain event for this period

of the year. In some cases, like on the Duiwenhoks River, the river height is measured at almost ten times its normal height for the month of December. This is a very significant height difference. (Data source: DWAF)

In addition to the clearing of alien vegetation, natural flood 'buffer zones' such as wetlands and flood plains, are often subjected to inappropriate land use, thus significantly reducing their effectiveness in flood attenuation. In undisturbed riverine systems, these 'buffer zones' have the capacity to take up a lot of flood water, thus reducing the volume of water, and therefore reduces the capacity of the flooding river to inflict damage. With the loss of these 'buffer zones as well as the river being further channelled or restricted in places, for example due to canalisation through towns, the destructive potential of the river in flood is amplified. Under 'normal' rain conditions measures such as canalisation serve to contain the river and thus protect the built environment from flood damage, however in an extreme rain event such as the one experienced, these canalised rivers speed up with the increased water load and rapidly turn into raging torrents, due to the lack of the natural, sediment and vegetation covered bed which would act to slow the flow down.

The estuaries of many of these rivers are popular holiday destinations, characterised by holiday houses typically built right on the river frontage, making them extremely susceptible to flood damage. Similarly, many towns are situated alongside rivers for the essential water supply they provide. The valleys and the fertile flood plains are equally attractive to farmers as they provide irrigation and good soil. The very nature therefore of the land use adjacent to these rivers places people, property and infrastructure at risk. Given this context, it is of major importance that flood attenuation and risk reduction measures should be identified and encouraged.

**Box 2: Case study: Heidelberg**

The town of Heidelberg was particularly badly affected in this regard, as 'The Canal', a stream which is canalised through the extent of the town, flooded extensively and as a result, ripped up concrete pathways and damaged bridges and roads (See fig 16). The canalised river flows into the Duiwenhoks River, which was itself flooding extensively (see fig 17), just on the outskirts of the town. In this case, the meeting of these two raging torrents created a backwash back into the town, magnifying the damage sustained, with the result that approximately fifty percent of the houses and numerous businesses in the town flooded, bridges and roads washed away, as well as the total flooding of the sewage works. The following pages contain some dramatic photographs taken both during the flood period as well as after.

**Fig 15:** The Heidelberg Municipal chalets flooded by the Duiwenhoks River, 22 December 2004.

**Fig 16:** Photograph taken on the 22nd December 2004 of a bridge in Heidelberg spanning the flooding canal

**Fig 17:** The same bridge as in Fig 16 above, photographed on the 28th December 2004.

**Fig 18:** Heidelberg on the 22nd December 2004


**Fig 19:** The interior of one of the Municipal chalets on the banks of the Duiwenhoks River. Photograph taken on the 23rd December 2004.

### 2.4.3 Runoff, drainage and storm water

The extensive damages spoken of in this report are not caused by riverine flooding alone, but other major contributing factors such as inadequate or blocked storm water systems and excessive runoff caused by inappropriate land use. The built environment, due to its very nature, exacerbates runoff by reducing the infiltration potential over large areas. The water therefore remains on the surface for longer and is channelled down roads, paths and pavements, speeding up as it flows down these smooth surfaces thus increasing its destructive force. It is therefore imperative that storm water drains be both adequate and well maintained at all times in order to be able to cope with situations of this magnitude. Municipalities typically clear storm water drains at the onset of the rainy season, but in this case, due to the event being out of season, many towns were not fully prepared in this regard.

**Box 3: Case Study: Suurbraak**

`Most of the original dwellings in Suurbraak are situated close to the river. Many new dwellings have however been built in recent years on the hillside above the town as part of a government-subsidised low income housing project. These are laid out in rows perpendicular to the gradient of the hill, separated by dust roads. Lining these roads are small open drains as shown in the photograph below. As is clear from the photograph, these open drains are hardly adequate to deal with normal levels of rain, let alone extreme rainfall. In effect what happens during heavy rainfall is that the drains overflow, flowing over the roads and into the houses, thus creating damp houses at best and flooding houses at worst. This is exacerbated by litter and other blockages in these drains as well as houses that are unplastered and therefore more susceptible to damp.

**Fig 20:** Shallow, debris filled stormwater drain in Suurbraak.

Certain farming practices, such as crop monoculture, excessive tilling and hillside crop farming without contours can also lead to reduced soil infiltration capacity and environmental degradation. These should be addressed at catchment management level.

# PART III EMERGENCY RESPONSE AND INSTITUTIONAL ARRANGEMENTS

## 3.1 Introduction

By 09h00 on the 22nd December emergency situations were being reported across the four districts. Reports included damage to critical infrastructure, households at risk to being flooded by rising floodwaters, roads being impassable and so on. The rapid onset and intensity of the rainfall required a rapid emergency response. By 11h00 the first JOC was formed and by the end of the day all four districts had JOC's up and running. Breede River Winelands Municipality was the only local municipality to set up a JOC and this, as is elaborated on later in the report, is seen as a case of best practice. Most of the district level JOC's encountered many difficulties in co-ordinating and managing the emergency response due to challenges posed by the spatial extent of the affected areas as well as accessibility and communication problems.

***Within Part 3:***

Section 3.2 presents the challenges in the co-ordination of the identification of affected areas

Section 3.3 describes the role of local institutions in the emergency response and relief to affected households.

Section 3.4 explains the co-ordination of the emergency response with reference to the Disaster Management Act

## 3.2 Identification of affected areas, communities and households

### 3.2.1 Introduction

The identification of affected areas, communities and households is imperative in defining the emergency response by disaster management and relevant line departments. Local municipalities across the four districts rely on a number of strategies to identify affected areas, communities and households. It is important to note however that many of these strategies are employed randomly in response to either phone calls from the public, local councillors or community leaders. In cases where areas, communities or households affected have been identified by officials, it is largely due to previous knowledge of areas at risk. This knowledge may have been informed by a risk assessment, but was mostly through past working experience in the affected areas. Across the four districts only the Breede River Winelands Municipality used a rigorous method to assess affected communities and households.

### 3.2.2 Municipal and district strategies to identify affected areas, communities and households

These include:

- Local residents contacting the municipality directly
- Local municipal officials alerting disaster management of areas that were affected
- Local councillors and community leaders informing the local municipality of affected low income housing areas and informal settlements

- **Local residents contact the municipality directly**

Residents may contact the local municipality directly to report impacts, such as the case of Swellendam where local residents contacted the SAPS. In Robertson one official received over 300 phone calls from the public after his cell number was made public. In the same town there were four people in a designated office collecting reports from local residents but this was discontinued when it was realised that the reports did not correlate.

- **Local municipal officials alert disaster management of areas that have been affected**

Local municipal officials, such as the traffic department or South African Police may alert disaster management to areas that have been affected. In the case of Droëheuwel in Roberston an engineer that had previously worked in that area was aware that the area could potentially be affected by flooding. Despite the fact that he was on leave, he informed the local disaster manager based in Ashton who immediately alerted other municipal staff. Unfortunately, by the time they arrived at the settlement, the Droë River had already flooded the low water bridges leading into Droëheuwel, effectively cutting off the community.

In the case where a Joint Operations Centre (JOC) is established, municipal line departments may report impacts, such as flooded roads, broken bridges or broken water pipes directly to the centre. However, during the December 2004 cut off low only one municipal level JOC was established from the outset of the event. In cases where the JOC was absent, the line departments respond independently, sometimes without notifying Disaster Management.

- **Local councillors and community leaders may inform the local municipality of affected low income housing areas and informal settlements**

Due to a lack of formal town governance structures within informal settlements, damages are often reported directly to the various councillors and community leaders and via these representatives to the relevant town authorities. This is also often the case in low income housing settlements.

**Box 4: Case Study: Breede River Winelands Municipality**

The local councillors and community leaders contacted government ministers directly and reported that over 900 households were affected. Subsequently, these ministers contacted the municipality to query the adequacy of the emergency response and relief which the municipality was providing in the face of such a large scale calamity. The municipality was not able to give exact figures of the households affected, and therefore, assisted by Provincial Department of Social Services and Poverty Alleviation in Worcester, conducted a rapid formal investigation using a door to door questionnaire. Ten people were sent out on the 23rd December to conduct the assessment of the various areas surrounding Robertson and MacGregor in order to gauge the impact of the rain event at a household level as well as to quantify the number of households affected and ascertain how many of these were in need of assistance. This survey then informed the relief process as well as served to feed information about the scale of the event to the government ministers concerned and other interested parties outside the area. On the completion of the assessment it was reported that only 200 households had been seriously affected, which contrasted significantly with the 900 households originally reported by the local councillors and community leaders. In the meantime, many people had gathered at the municipal offices claiming extensive damages and demanding monetary payouts for relief as was the case in the March 2003 floods. The results of the survey could then also inform this process, and the people that were in need of relief could be helped.

It is important to note that one explanation provided by the municipality for the large discrepancy in the total number of households affected was that in 2003, affected households had been provided with financial relief following a similar extreme rain event. It was suggested by the municipality that these communities were concerned that should the event be classified as a disaster and they had not reported losses they would lose out on the financial remuneration. This particular case study highlights the importance of rapid local level post disaster assessments following an extreme event. Across the four districts which reported flood and rain damages, the Breede River Winelands Municipality was the only municipality to have initiated such a rigorous household level assessment to identify affected households.

**Fig 21:** Residents of Droëheuwel assessing the damage post the dramatic flooding of the Droë River.

Conflicting accounts of an event further complicate the assessment process. The research team came across some discrepancies in reported accounts of the December 2004 event. An example of such conflicting reports was encountered on meeting with residents and the local councillor of the affected area Droëheuwel. The residents reported that the flood came through their settlement as a wall of water or a large wave. They believe that this anomalous flow was due to the failing of a municipal dam upstream. This was denied by the municipality. On inspection it was noted that extensive repairs had been made to the road opposite the dam such as would have been necessary had a large amount of water passed through a relatively small area, for instance an eroded spill-way. The research team however, lacked the expertise to verify or disprove the theory that the wall of water was indeed caused by a failed dam.
It was conveyed that after the flood a person from DWAF had been there to assess the dam wall. This has not been verified.


**Fig 22:** The municipal dam wall on the Droë River alleged to have burst.

### 3.2.3 The limitations of the identification process

The lack of a uniform approach in the identification of affected areas, communities and households may result in many being overlooked. Consequentially they would not be provided with the necessary emergency assistance or relief. For this reason it must be realised that there are severe limitations to using recorded statistics of households that were reported to be affected as an indicator of the event's severity or spatial extent. A complete 'on the ground' survey of the four districts would be required in order to ascertain the level of inaccuracy of the data. Unfortunately, due to time constraints it was not possible for this to be done in a project such as this.

## 3.3 Emergency assistance and relief to affected households

### 3.3.1 Introduction

The rapid speed of onset and the intensity of the rainfall due to the December cut off low, triggered flash flooding and excessive runoff requiring a rapid emergency response. Across the four districts at least ten people had to be airlifted to safety from their rooftops. In both Robertson and Heidelberg, holiday makers staying at municipal holiday resorts next to rivers were evacuated by the local municipality and temporarily housed at local halls. There were cases, however, where the river rose so quickly that people evacuated without waiting for assistance from Disaster Management. This was the case in Droëheuwel, Robertson.

Across the four districts, over 3 600 houses and 40 business premises sustained rain and flood damage. Of these 2 703 were informal and low income households most of which were rain affected, sustaining damages such as damp walls and leaking roofs, or were flooded due to blocked storm water drains. Of the low income housing settlements, Droëheuwel was the only settlement that was directly affected by riverine flooding. In Heidelberg approximately 50% of the formal residential houses as well as a significant number of businesses were flooded. Of the four districts, the Eden and Cape Winelands Districts sustained the highest damages.

### 3.3.2 Evacuation of at risk households

In Suurbraak three households on the northern bank of the Buffelsjags River had to be airlifted to safety as the area had effectively become an island. Six people had to be airlifted from rooftops of houses on the banks of the Duiwenhoks River in Heidelberg. In both Robertson and Heidelberg holiday makers staying at the respective municipal holiday resorts were evacuated when the rivers running next to them burst their banks. They were then temporarily housed at local halls.

**Fig 23:** The Duiwenhoks River flooding the chalets in the Heidelberg Municipal Holiday Resort on the 22$^{nd}$ December 2004.

There were cases where rivers rose so quickly that people evacuated without the assistance of disaster management or any other emergency services. As mentioned above, this was the case in Robertson where the Droë River flooded the low income settlement of Droëheuwel so rapidly that some residents only just managed to get to higher ground in time, saving themselves but little else. Many belongings, food and

Christmas presents were swept away; furniture and household appliances were damaged and in some cases the actual houses sustained structural damage. A similar rapid onset situation occurred in Suurbraak. A farm worker and his wife living just outside of the village of Suurbraak related the story of how they evacuated just in time before the Buffelsjags River washed away their house.

The wife explained how, as her husband was leaving for work, she told him that if the river rose too high he should stay the night on the farm rather than return home. After her husband had left the wife walked to a neighbour's house, when she turned back, she describes, her house was gone. Fortunately their children were staying with relatives at the time and as such were out of harms way. Due to the speed of the destruction of their house though, nothing could be saved and two days before Christmas the family lost all their belongings. The farm manager, having his hands full with other flood related issues on the farm, was not available to offer any assistance to the family and neither was the farm owner who lived in Cape Town. This family was therefore destitute over the Christmas period, relying on the charity of relatives to survive. It was only about two weeks later the farm worker learned that he could go to the municipal offices and apply for flood relief, etc, which he promptly did.

In some cases people were left isolated i.e. farmers in the Heidelberg area. One dairy farmer living in the upper catchment reported that he crossed a low-water bridge in his tractor to fetch a relative coming to visit for the Christmas period, only to find out on his return journey shortly thereafter that the bridge had been washed away. They were therefore forced to stay on the neighbouring farm for over twelve hours before they were able to negotiate the river back to his farm. The farmer describes this as a traumatic event as his wife and children were cut off on the farm for those twelve hours. In addition to this the milking machines failed and his wife could not fix them. This meant that his cows could not be milked which had the potential to give them mastitis. The following day the farmer was able to fetch an electrician from town and cross onto his farm to repair the machines. Due to the destruction of the low-water bridge however, the Parmalat tanker could not come and fetch the milk resulting in the loss of ten days milk anyway and thus negatively affecting his livelihood.

Livelihoods were also negatively affected through people's health being impacted due to them being stuck in the wet. The women of Suurbraak present at the workshop on the 4th May 2005 described how the rain came through their unplastered walls and the overflow from the stormwater drains flowed in under their doors. They remained with their children inside the flooding houses as they explained it was raining outside and they had no where else to go. In Heidelberg, a local nurse explained that following shortly after the flood, residents downstream from the sewage works were reporting cases of diarrhoea to the local clinic where they were provided with re-hydrate. Unfortunately, the research was not able to validate the extent of these cases.

Exacerbating the numbers of people needing to be evacuated was the timing of this event which took place three days before Christmas. During this peak summer holiday period most resorts and holiday accommodation adjacent to rivers across the four districts would have been in use, therefore placing many more people at risk than at other less busy times of the year. It is not certain how effective evacuation strategies were for accommodation along these rivers as this information, unless heavy losses or deaths occur, is generally not reported. No deaths due to this particular flooding event have been reported.

### 3.3.3 Relief to flood and rain affected households

The Breede River Winelands Municipality in Robertson provided flood affected people with blankets and food as well as food parcels and a hall to sleep in. They also arranged for the Department of Home Affairs to come to Robertson in order to facilitate the re-issuing of documents that had been lost in the flood. The George Municipality issued fifty starter kits to owners of damaged informal houses, as well as providing food parcels and blankets where necessary. Mossel Bay gave 150 blankets to affected communities, as well as helping children at a church camp by putting up dry tents and providing dry blankets. The towns of Heidelberg and Knysna also provided emergency relief to households whose houses were flood damaged.

In general, reporting of the relief provided is scant and in most cases not specific or quantified. By contrast the reporting of damage and repair work to infrastructure is far more thorough and exact. This indicates a lack of significance placed on social impacts. The case of Heidelberg clearly illustrates this. Heidelberg was extremely hard hit by the floods, and yet there is little mention in the reports of how this affected the people of Heidelberg, or of the relief provided to them.

**Box 5: Case study: Suurbraak**

In the town of Suurbraak, due to the destruction of their main water supply pipe, relief was provided initially in the form of trucked in water. This water was believed by the community leaders to be unfit for human consumption. The local residents who participated in the workshop on the 4th of May however, disagreed. They believed that the trucked in water was of a sufficient health standard. Water could not be trucked in for the entire period until the pipe was fixed so after consultation with the residents of Suurbraak on its location, a temporary pump and pipe was placed in the Buffelsjags River. Residents believed that this river water was polluted due to dead animals which had been washed downstream during the flood. In response, the local municipality set up a task team, with local residents from Suurbraak to investigate the reports of dead animals. Further tests were also conducted by the municipality to assure the community that this 'brak' tasting water was in fact safe for human consumption.

The original water pipe across the river was built in 1998 but had to be replaced after the March 2003 rainfall event. At time of writing the report the pipe was being reconstructed. Learning from the past, it has been decided that to reduce the risk of the pipe breaking in the future a slightly larger investment will be made and it will be placed beneath the river bed.

### 3.3.4 Rain affected households were not provided with emergency assistance or relief

In a rain triggered emergency situation, such as the flooding that occurred on the 22nd and 23rd of December 2004, priority as far as relief is concerned is generally given to flood affected households over those affected by rain. This is becoming increasing problematic, as many low income houses are not completely rain proofed by the time they are handed over to the owners. The situation encountered in Suurbraak, where many low income houses have been built, highlights this problem.

In the disaster debriefing workshop held with residents in Suurbraak, the men informed the research team that many of them had opted to do the actual building of the houses themselves, even though few of them had any expertise in this area. This had two benefits; one to reduce the overall cost of the housing project to themselves as future homeowners, as well as providing employment for the duration of the building period. This was described in retrospect as a short term gain with a long term loss, as the houses were not properly built. It was explained that the materials used were often substandard and poor workmanship often resulted in the houses leaking and or being damp. This is further exacerbated by the fact that the level of completion of most of these low income dwellings at hand over is often not final, i.e. usually not plastered etc. It is usually understood that this will be completed by the owner at a later date.

In Suurbraak, some of the homeowners used the money they got from the March 2003 flood payouts to retrofit their houses and thus reduce their risk to flooding and rain damage. However, not all homeowners did this, particularly not those who rent out their houses. The homeowners therefore effectively gained the same amount of rent without reducing the risk of their tenants to flooding and rain through investing in the structural improvement of the dwelling. In some instances households may be damp for as long as six weeks after a heavy rain event, thus causing secondary impacts such as health related impacts.

**Fig 24:** This picture of the low income settlement in Suurbraak shows the shallow open storm water drainage system. As well as being of an inadequate size to deal with the amount of rain typically experienced in this area, as is illustrated, these drains become blocked by litter and other debris,. This area is situated on a slope, so when the drains overflow, the water runs across the road and into the houses.

## 3.4 Co-ordination of the Emergency Response

At the time of this event, the implementation of the Disaster Management Act was still underway. It is therefore vital to look critically at the coordination of the emergency response as this is a key area of the new Act.

The Disaster Management Act 57 of 2002 S 54(1)(*b*), states that the district municipality, in consultation with the relevant local municipality, is responsible for the co-ordination and management of local disasters that occur in its area. The Act does however go on to say that a district municipality can cede primary responsibility for the co-ordination and management of a disaster to the local municipality subject to both party's agreement. With the rollout of this relatively new legislation, most districts had a designated disaster manager in place by the time the December 2004 cut off low event occurred. These were not extremely effective in co-ordinating and managing the initial emergency response due to many factors, primarily those regarding the spatial extent of the areas concerned as well as the means of communication relied upon.

In effect the reality on the ground rapidly became one in which roads and bridges were flooded and often impassable or even completely washed away, phone lines and cell phones did not work, electricity lines were damaged, water supply was interrupted and people were in many instances effectively cut off from outside help. This made the co-ordination from district level, as well as in some extreme cases from local municipal level, quite impractical. There was only one Joint Operations Centre (JOC) set up at municipal level, namely by the Breede River Winelands Municipality, and this is viewed as an example of best practice as far as the co-ordination of the emergency response is concerned.

In most other cases local municipalities dealt with the emergency according to their respective line functions, each doing the best they could under the circumstances. Leadership or co-ordination in this situation is dictated by the nature of the emergency, for example fire services would co-ordinate the response to a fire.

A further complication arose according to the actual classification of a disaster, in that it is an emergency which is beyond the capacity of the municipality trying to deal with it. When this happens, the onus is on the local municipality to call for help from the district disaster management, or if on a district level, for the district disaster manager to call for help from provincial disaster management etc. It is through the reporting that an event is beyond the management and capability scope of the area it is affecting, that an event is classified as a disaster. It was mentioned by district level disaster managers at the workshop held in Swellendam in May 2005, that one of the major problems experienced in this event was that local municipalities did not call for help from district disaster management. As a result, each line function individually did what they could but there was no overarching co-ordination of the initial response to the emergency. Members of the SAPS who participated in the workshop in Swellendam in May 2005 expressed their concern that municipal disaster managers where going out during an emergency to physically help. This meant that they were not in an office somewhere where they would be able to effectively co-ordinate the response and be accessible to the reporting of the line functions.

Adding to this issue was that the district level JOCs were mostly instituted post the actual emergency, i.e. late on the 22nd December or on the 23rd December, thereby effectively functioning primarily in a post-disaster role, co-ordinating and managing the relief and emergency reconstruction.

Given the spatial extent of the districts, and the nature of the extreme event documented in this report, it seems the more practical option would be to co-ordinate and manage such disasters as locally as possible. In this case this only happened in one municipality.

# PART IV COUNTING THE COSTS OF RECOVERY, RECONSTRUCTION AND REHABILITATION POST THE DECEMBER 2004 CUT OFF LOW

## 4.1 Introduction

Direct economic losses exceeding R23 million were reported by local and district municipalities across the four districts. The estimated cost of damages to the commercial farming sector amounted to over R 24 million. Compounding this loss was the fact that many of the municipalities had just spent similar amounts on repair, recovery and rehabilitation due to the similar in scale 2003 event. This 'double whammy' effect occurring in less than one year, has made recovery a major challenge to many of the municipalities involved. Furthermore, as the event was not classified a disaster due to the fact that Disaster Management legislation is currently in a process of transition, with the 'roll out' of the Disaster Management Act, 2002 and the National Disaster Management Framework. The result is that a 'legislative vacuum' has developed, which has meant that neither a National Fund nor Provincial Contingency Funds were available to finance post disaster recovery, rehabilitation and reconstruction. The implications were that a disaster could not be 'classified' and therefore Municipalities, Districts and Province had to fund repairs themselves or through the Municipal Infrastructural Grants (MIG).

***Within Part 4:***

Section 4.2 examines the direct economic losses to district and local municipalities across the four districts. A case study from Heidelberg explores the challenges and successes in the reconstruction of the Heidelberg sewage works.

Section 4.3 presents the economic losses to the commercial agricultural sector. A case study from Heidelberg region explores the challenges in the rehabilitation of agricultural land (and nature conservation areas).

## 4.2 Direct Economic Losses

### 4.2.1 District and Municipal level economic losses

The direct economic losses amounting to R 23 million as reported above, excludes private sector, agriculture, provincial and national costs. These are costs borne by the local and district level municipalities. They include damage to critical infrastructure such as roads, sewage works, bridges, storm water drains, water pipes etc.

| **District** | **Estimated cost of damage** |
|---|---|
| Eden District | R 16 753 115 |
| Overberg District | R 3 030 000 |
| Cape Winelands District | R 1 200 000 |
| Central Karoo District | R 30 000 |
| **TOTAL** | **R 23 000 000** |

**Table 2** Economic losses per district

Table 2 above highlights the relatively large economic losses sustained by the Eden district in comparison to the other districts. This is partly due to the level of damage sustained by the district as a whole. For example, the repair and reconstruction of the sewage works in Heidelberg alone was estimated at R 2.5 million. In addition to this, the estimated cost of damages to roads and stormwater in Heidelberg came to R 2.3 million, and in Knysna a further R 2 million. The repair costs in Riversdale were estimated to be R 1.7 million and in George to be R 320 000.

The Overberg district sustained the second highest costs per district, with damages such as the washing away of the freshwater pipeline to Suurbraak being a major contributor, costing an estimated R 2.3 million.

The estimated cost of repairs to provincial roads across the four districts amounted to over R 9.4 million.

**Fig 25**: Damaged road near Heidelberg, Eden District.

### 4.2.2 The challenges and successes in the reconstruction of state infrastructure: a case study on the Heidelberg sewage works

Although Heidelberg sustained damage in the floods of March 2003 and April 2005, it was particularly hard hit by the floods that occurred in December 2004. This flood has been referred to by local farmers, residents and municipal workers alike as the worst in living memory. The level of damage sustained in Heidelberg itself is partly due to the physical situation of the town. It lies adjacent to the larger Duiwenhoks River, with a tributary, the Doorn River, canalized through the middle of the town. The confluence of these two rivers is on the outskirts of Heidelberg. In the December 2004 flood event, the tiny stream that represents the Doorn River became a raging torrent, burst its banks and flooded adjacent properties, ripping up cement walkways and tearing out chunks of road. The Duiwenhoks River also burst its banks, and together these two rivers inundated a large part of the town, causing extensive damage to both property and infrastructure. The most significant damage was due to the complete inundation of the sewage works which resulted in raw sewage being discharged into the Duiwenhoks River for days on end. Although the flood of March 2003 was of a slightly smaller magnitude, it also resulted in complete flooding of the sewage works. On neither occasion was much effort made to inform those downstream, with a letter being placed in the local newspaper as the only form of notification.

This repeated flooding of the sewage works and subsequent effluent pollution of the Duiwenhoks River lends itself to further examination. Pivotal to the vulnerability of this infrastructure is its placement on the 1:50 year flood plain. In addition to this, it is situated on the opposite bank of the river to the town, which means that all the sewage has to be transported over the river via a pipeline. This pipeline is the first vulnerable point in the sewerage infrastructure to be damaged in a flood situation. Due to the nature of the placement of the sewage works, and the lack of a high water bridge to access the plant, repair workers have to wait for the water to subside before any repair work can be started. This magnifies the pollution impact on a temporal scale as it translates into days on end of raw sewage flowing down the river. Once repair workers could access the works, two unlined dams were dug on the opposite river bank to the flooded sewage works to act as temporary sewage dams until such time as the proper sewerage works were repaired. This raw sewage is discharged directly into the Duiwenhoks River via an open channel cut across the flood plain. There is no fencing around these dams or the channel. This poses both a health as well as a safety risk as there is a low income and informal settlement overlooking this flood plain and the children from this settlement play on this plain right next to the dams and channel. When the site was visited in June 2005, the sewerage works were nearing completion, but the dams were still unfenced and in use (See fig 26 below.)

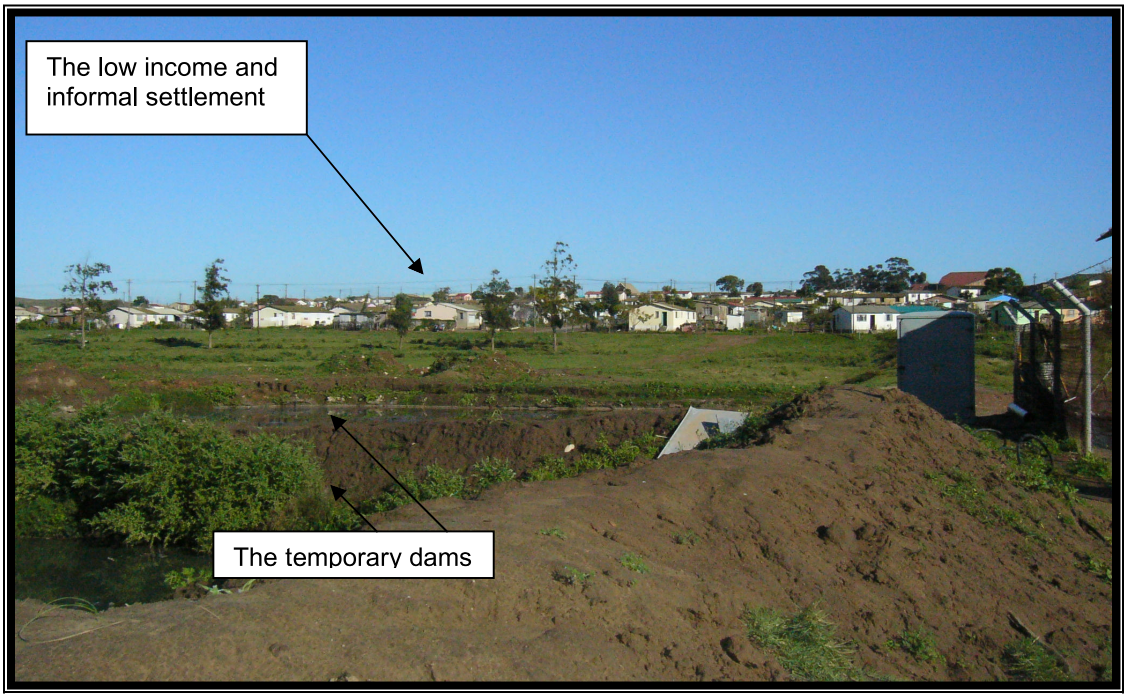



**Fig 26:** The temporary sewage dams. Photo taken in June 2005.

A quotation was received for both repair work to the sewage works in situ and for relocating of the sewage works to a more appropriate site higher up and on the town side of the river. Due to a lack of funds, it was decided to repair the sewage works in situ and not move it. Both the flood of March 2003 and December 2004 were not classified a disaster in this area (Eden District), with the result that no money was allocated from National Government for post-flood repairs etcetera, this meant that the Municipalities, Districts and Province have had to fund repairs themselves and through the Municipal Infrastructural Grant (MIG).

At present the repairs to the sewage works are still underway, while the sewage in the temporary dams is being treated with chlorine and pumped into the Duiwenhoks River further downstream. The current location of the sewage works presents a high risk to those living downstream and to the ecology of the river itself. This situation is highly problematic, posing health risks to those downstream and negative impacts on the ecology of the river itself. This is not sustainable, particularly if these flood events are to become a more common feature of this region due to possible climate change in the form and increase in the frequency and severity of the cut-off low systems responsible for floods of this nature.

**Fig 27:** The reconstruction of the Heidelberg sewerage works, June 2005. The concrete pillars across the river are to carry the sewage pipeline from the Heidelberg side of the Duiwenhoks River to the opposite bank where the sewerage works are situated.

## 4.3 Agricultural Losses

### 4.3.1 Commercial Agricultural losses

Commercial farmers across the four districts sustained an estimated **R 24.5 million** worth of damages. This included large areas of orchards and plantations being flooded, loss of and damage to equipment, damage to dairies and equipment resulting in cows not being milked, farm roads and low water drifts washing away as well as damage to farm workers dwellings. Farmers were alerted via radio that the Department of Agriculture would be meeting with farmers so that they could formally report their damages.

### 4.3.2 The challenges in the rehabilitation of agricultural land (and nature conservation areas): a case study of the Heidelberg region

During the week following the December 2004 flooding event a meeting was called for the farmers in the Heidelberg area. At this meeting it was explained that the event had not been classified as a disaster event and as such the farmers would not be receiving any compensation.

There was a workshop held in Heidelberg on the 5th May 2005, for farmers in the Heidelberg region who had been affected by the December 2004 flood event. At this workshop the farmers described that, among other things, they had sustained damage to their private electricity lines, bridges, farm workers' housing, pumps, soil and land in general. Farmers upstream described how they had lost a substantial amount of their fertile topsoil and farmers downstream complained that this, now sandy soil, had been deposited on their fields, covering their crops and causing them to rot. In some areas between 500mm and 600mm of sand covered the lands costing farmers over R70 000 to clear. Mudslides occurred in the areas surrounding the river resulting in massive sediment dumping into the river. The increased sediment load added to the deposition in the riverbed and on the neighbouring farmlands.

It was not only sediment that the farmers reported seeing being taken by the flooding river. They claim that a substantial amount of debris from the March 2003 flooding event had not been cleared and as such was swept downstream during the December 2004 flood adding to the destruction of infrastructure such as bridges. The destructive nature of the flood was also attributed to the speed of the water. This, the farmers believe, was increased by the clearing of vegetation upstream and they suggest that the methods used by 'Working For Water' be re-evaluated. They propose that the alien vegetation is cleared at a slower rate allowing for the natural vegetation to regrow thus not leaving vast tracts of bare land.

The farmers realised that along with undesirable vegetation removal schemes, bad farming practises could have exacerbated the damage caused by the flooding river. They explained how after the March 2003 flood, compensation was given to farmers for the removal of sand and the replacement of soil. They claim that the majority of the land for which the compensation was received, was below a reasonable farming flood line and as such should not have been farmed in the first place. By giving compensation the government is promoting bad farming practises often no only to the detriment of those farmers involved but to those downstream as well.

With all this in mind a representative from Nature Conservation described how there is a mountain area near Riversdale that has not been tampered with by people. There is no alien vegetation in the area, none of the land is farmed and no vegetation removal has taken place. This area however, still experienced large amounts of environmental degradation as a result of the December 2004 extreme event. The overland flow was so powerful that growing vegetation was ripped up and washed away and the kloof in the area substantially increased in size. It is understood among the farmers that this was an extreme event most likely in the range of one in one hundred years and they believe that little could have been done to lessen the damage which occurred as a result of this severe event.

In addition to their direct losses through damages, the farmers expressed a growing concern for the changed morphology of the river. Knowing the nature of ones surrounding environment is imperative to being able to farm successfully. Many farmers state that they no longer ‘know’ the river. Where there was once vegetation there is now gravel. The excessive deposition which took place in the riverbed has resulted in there being large islands or humps in sections of the river, splitting the flow in two. The riverbed has also become generally shallower raising the concern that it would now not take much rainfall for the river to flood its banks.

Upstream the river is locally known as the Klip River. Until the December 2004 flooding event the farmers in the area did not understand the name as the river had a sandy bed. The riverbed is now made up of stones. This indicates that the river once before had a stone bed and that it is most likely a natural cycle of the river system for it to change from stone gradually to sand and then rapidly back to stone. This is substantiated by the memory of a farmer’s mother who recalls that about seventy years ago the river changed over night from a sand river to a ‘klip’ one. Although the farmers acknowledge that the changes in the riverbed are natural, many of them have tried to manipulate the flow back to how they understand it. These attempts proved to be a waste of resources as the heavy rains in April 2005 destroyed most of them.

Not only does the changing riverbed complicate farming but the shape of the catchment results in there being little or no warning time before flooding occurs. Farmers upstream phone the police in the town of Heidelberg if they think that flooding is going to occur. They also try and warn their neighbours downstream. This they find problematic as, if the warning proves to be a false alarm people are angry with them but if flooding occurs and they haven't tried to warn anyone, people get upset. It is felt that a formal monitoring system of the river is needed. The monitoring need only take place after a weather warning has been issued.

Overall it is widely believed between the Department of Agriculture and the Department of Water Affairs and Forestry as well as the farmers that general management of the river system would benefit all. To maximise the benefits of a management system it would need to be in place not only in time for an extreme event but should also help facilitate the rehabilitation of the river system after an event such as that of December 2004 and before the next one.

### 4.4 Economic Losses covered by Private Insurance

***still awaiting economic loss information from the private insurance sector***

# PART V CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Introduction

This report aimed at capturing and recording characteristic of the December 2004 Cut off low which triggered widespread flooding and rain damage across the Western Cape, specifically affecting the Overberg, Cape Winelands, Central Karoo and Eden District Municipalities. This chapter provides conclusions and recommendations that will improve capabilities to minimize the likelihood of future disaster losses to extreme weather events.

## 5.2 Conclusions and recommendations

The following key conclusions were drawn from the Disaster Debriefing of the December 2004 Cut off Low

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| Conclusion I | The December 2004 Cut Off Low was an extreme weather event |
| Conclusion II | The Early Warning was disseminated only after initial reports of heavy rain were received by SAWS |
| Conclusion III | Flooding was exacerbated by the lack of Integrated Catchment Management |
| Conclusion IV | Most towns do not have storm water drainage with the capacity to withstand events of such an extreme nature |
| Conclusion V | Local level JOCs were more effective in coordinating a rapid emergency response |
| Conclusion VI | Lack of formal identification mechanisms to identify affected areas, communities and households of high risk areas in need of emergency assistance and relief |
| Conclusion VII | Uneven reporting of social impacts across the four districts |

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| Conclusion VIII | Post disaster assessment should be integrated into risk assessments |
| Conclusion IX | Disaster management legislation is in transition and therefore the non classification of a disaster |

## Conclusion I The December 2004 Cut Off Low was an extreme weather event

On the 21st of December 2004 a Cut off Low passed over the Western Cape, South Africa. Over the following three days this Cut off Low produced extreme amounts of rainfall over the four districts of Cape Winelands, Central Karoo, Eden and Overberg. A significant number of municipalities experienced up to six times their average December monthly rainfall over this three day period. For the municipalities affected, in terms of rainfall the December Cut off Low event was more severe than both the March 2003 and April 2005 events. With regard to extreme weather events it is important to consider the affects of climate change. The IPCC third assessment report, 2001[1], states that with the likely future climate change, it is expected that there will be changes in the frequency and intensity of extreme weather and climate events. It is commonly accepted that one of the affects that the change in climate will have on the Western Cape is that there will be an increase in the number of extreme weather events, such as Cut off Lows, affecting the area.

**Recommendations**

- **Due to the changing climate certain hydrological and meteorological data needs to be updated.**
  - In many areas it is probable that the river floodlines will be changing and that those on record are no longer accurate.
  - The onset of seasonal rainfall has already been observed to be changing. This has implications for tasks such as clearing the storm water drains before the onset of the rainfall season.

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[1] http://www.grida.no/climate/ipcc_tar/wg1/050.htm
IPCC Third Assessment Report, Climate Change 2001: Working Group 1: The Scientific Basis

- **When planning development it is no longer prudent to simply consider past climate data. For development to be sustainable for a significant length of time, the future climate in the area needs to be speculated.**

## Conclusion II  The Early Warning was disseminated only after initial reports of heavy rain were received by SAWS

The first Weather Early Warning of this extreme weather event was disseminated by the South African Weather Service at 14h30 on the 22nd December 2005. By this stage many municipalities had already experienced their heaviest rainfall for this event. Due to their irregular nature, the characteristics of a Cut off Low are generally very difficult to predict. The first Weather Warning was issued in response to on the ground feedback which SAWS had received and not due to a model prediction. It is important to note that the South African Weather Service issues warnings about the weather and not about the affects the weather will have at ground level.

**Recommendations**

- SAWS has requested that there be continuous report back to them from the ground as to how a weather system is progressing. Given this information SAWS will be able to considerably improve their warnings and will be able to provide finer detail to what is to be expected where and when.
- Farmers with weather monitoring stations should be encouraged to feedback weather data to SAWS. This may need to include an audit of weather monitoring stations across the Western Cape not owned by SAWS.

## Conclusion III  Flooding was exacerbated by the lack of Integrated Catchment Management

Although it may be divided into sections by man made boundaries, a river system works as a whole and events in the upper regions will be felt by those below. One of the findings of this study was that the lack of coordination in the management of river systems before the flooding event, exacerbated the affects of the heavy rainfall, increasing the damage sustained by flooding and, in some cases, even intensifying the flooding itself. A question raised by this event was, who is responsible for the overall management of a river. It is understood that the Department of Water Affairs and

Forestry is responsible for the water within the river but the practices affecting the risks posed by the river system, extend far beyond its banks. River and riverside management cannot be divided between different groups such as the Department of Water Affairs and Forestry, the Department of Agriculture and the Municipality.

**Recommendations**

- The National Water Act (Act 36 of 1998) calls for the development of Catchment Management Agencies (CMAs). These agencies should comprise of those interested and affected by the catchment as well as departments such as DWAF and the Department of Agriculture and relevant municipal officials. Part of the designated responsibilities of the CMAs is the management of water use and development in the catchment. Where CMAs have been developed it would be logical for them to include in their responsibilities that of riverine risk reduction. In light of this Disaster Management would be recommended as an active member of the Catchment Management Agency Committee.

## Conclusion IV Most towns do not have storm water drainage with the capacity to withstand events of such an extreme nature

The extensive damages spoken of in this report are not caused by riverine flooding alone, but other major contributing factors such as inadequate or blocked storm water systems and excessive runoff caused by inappropriate land use. The built environment, due to its very nature, exacerbates runoff by reducing the infiltration potential over large areas. The water therefore remains on the surface for longer and is channelled down roads, paths and pavements, speeding up as it flows down these smooth surfaces thus increasing its destructive force.

**Recommendations**

- Storm water must be well maintained at all times in order to be able to cope with situations of this magnitude. Municipalities typically clear storm water drains at the onset of the rainy season, but in this case, due to the event being out of season, many towns were not fully prepared in this regard.

## Conclusion V Local level JOCs were more effective in coordinating a rapid emergency response

Due to many factors, it was not practical to coordinate the emergency response from district level. These include factors such as the rapid onset and intensity of events of this nature, lack of communication due to phone lines being down, roads and bridges being washed away, towns being large distances apart, lack of robust high resolution risk assessments to inform local response, etcetera. Over the four districts, one local level JOC was established at the outset of the emergency. This has been highlighted as a case of best practice as it was very effective in co-ordinating and managing the emergency response. In the absence of local level JOC's, line functions respond individually, often with little or no central coordination or management. Disaster management at district level are often not alerted to the scale of the disaster as the various line functionaries go into emergency response mode and act individually often according to past experience.

### Recommendations

- Local level disaster management structures be put in place in order to facilitate central co-ordination and management of emergency situations at local level in the event of district level co-ordination not being possible.
- Training be given at all levels in order to familiarise municipal staff with the requirements of the new Disaster Management Act.
- Risk assessments be conducted at local level in order to inform effective emergency response. It is imperative that post disaster risk assessments feed into these, as lessons learnt provide empirical evidence of where high risk situation occur.

## Conclusion VI Lack of formal identification mechanisms to identify affected areas, communities and households of high risk areas in <u>need</u> of emergency assistance and relief

The identification of affected areas, communities and households is imperative in defining the emergency response by disaster management and relevant line departments. Local municipalities across the four districts rely on a number of informal strategies to identify affected areas, communities and households. It is important to note however that many of these strategies are employed randomly in response to either phone calls from the public, local councillors or community leaders. In cases where areas, communities or households affected have been identified by officials, it is largely due to previous knowledge of areas at risk. This knowledge may have been informed by a risk assessment, but was mostly through past working experience in the affected areas. Across the four districts only the Breede River Winelands municipality used a rigorous method to assess affected communities and households.

**Recommendations**

- **Improve the effectiveness of emergency responses with:**
  - Identification of all communities/households affected by the hazard's impact through a comprehensive assessment – especially those that are most vulnerable.
  - Provision of timely and appropriate emergency assistance (i.e. confirmation of availability of possible evacuation facilities, transport arrangements, blankets, mattresses and relief food, community security services, and provision of black plastic bags for securing belongings).

- **Strengthen and standardise methods for identifying and assessing affected communities/ households by:**
  - Conducting on-site assessments for all vulnerable communities/households affected by the weather event and its consequences.
  - Focusing on the impacts to livelihoods and not solely on impacts to infrastructure, to provide a more sensitive indicator of need.
  - Developing standard procedures and guidelines for determining affected households and communities, to be implemented by both local authorities as well as humanitarian assistance organisations.
  - Designating one position responsible at municipal and provincial levels for consolidating information on the extent of disaster impacts on households and individuals.

- Establishing a multidisciplinary provincial monitoring mechanism to verify communities/households identified as 'disaster affected', as well as those who may have been overlooked. This oversight function applies to the determination of emergency relief as well as access to Social Relief.

## Conclusion VII Uneven reporting of social impacts across the four districts

The level of reporting across the four districts varied extensively. This made it difficult to ascertain the extent of the disaster, the relief provided and the estimated costs. The reporting generally had a strong focus on infrastructural impacts, which are far easier to quantify and report on than social impacts. Social impacts were generally under reported, with the exception of one case where robust post disaster assessments were done at local level, followed by comprehensive reporting of the results. Low income and informal settlements suffered more from rain damage than flood damage, which is not reported much as it is not seen as high risk. This lack of standardised reporting means that these reports cannot be used as an indicator of the severity of the event in any particular area.

**Recommendations**

It is recommended that templates be developed and used at all municipal levels to capture the impacts, relief and costs. Training should be provided with the roll out of these.

## Conclusion VIII Post disaster assessment should be integrated into risk assessments

Post disaster assessment provide an excellent opportunity to identify at risk areas, communities and households. A post disaster assessment uses a deductive approach, by recording and assessing areas, communities and households affected and impacted. A risk assessment on the other hand uses an inductive approach, by 'modelling' areas at risk.

**Recommendations**

- **Post disaster assessment findings should be integrated into risk assessments as the post disaster assessment provides 'actual' data on areas at risk as opposed to 'hypothesized' potential areas at risk.**
- **The findings from this Disaster Debriefing should be integrated into the Provincial Risk and Vulnerability Assessment (RAVA) to inform accurate decision making around disaster risk management and development planning.**

## Conclusion IX Disaster management legislation is in transition and therefore the non classification of a disaster

Disaster Management legislation is currently in a process of transition, with the 'roll out' of the Disaster Management Act, 2002 and the National Disaster Management Framework. The result is that a 'legislative vacuum' has developed, which has meant that neither a National Fund nor Provincial Contingency Funds were available to finance post disaster recovery, rehabilitation and reconstruction. The implications were that a disaster could not be 'classified' and therefore Municipalities, Districts and Province had to fund repairs themselves or through the Municipal Infrastructural Grants (MIG).

**Recommendations**

- **Post disaster funding criteria should be established to ensure that the reconstruction and rehabilitation of critical infrastructure is informed by disaster risk assessments**. The reconstruction and rehabilitation process will therefore need to indicate that risk reduction measures have been accounted for in order for funding to be provided. These criteria should be applied to both National and Provincial post disaster funding, as well as MIG funding.