EDEN & CENTRAL KAROO DROUGHT DISASTER 2009 -2011

"THE SCRAMBLE FOR WATER"

REPORT

July, 2012

Disaster Mitigation for Sustainable Livelihoods Programme

Stellenbosch University

Funded by:

STELLENBOSCH UNIVERSITY

REFERENCE NUMBER:	LG 10/2011/2012
REPORT NAME:	Eden and Central Karoo Drought Disaster 2009 -2011: "The Scramble For Water"
AUTHOR(S):	Holloway, A., Fortune, G., Zweig, P., Barrett, L., Benjamin, A., Chasi, V. and de Waal, J.
REPORT STATUS:	Final
DATE:	20 September 2012

Submitted on behalf of the Disaster Mitigation for Sustainable Livelihoods Programme by:

Ailsa Holloway
Director

PROVINCIAL DISASTER MANAGEMENT CENTRE

The authorised representatives of the Western Cape Provincial Disaster Management Centre, listed below, hereby acknowledge this independent drought disaster assessment report for the Eden and Central Karoo district municipalities.

Hildegarde Fast
Head of Department: Western Cape Local Government

Colin Deiner
Chief Director: Disaster Management & Fire Brigade Services

Jacqui Pandaram
Director: Disaster Operations

EXECUTIVE SUMMARY

1. Study overview

This study, commissioned by the Provincial Disaster Management Centre (PDMC) of the Western Cape, seeks to provide a comprehensive review and analysis of the Western Cape drought disaster that affected the Eden and Central Karoo Districts between 2009 and 2011.

Specifically, the research team was required to:

- conduct a comprehensive post-event study and analysis of the January 2009-January 2011 Western Cape drought
- produce a comprehensive written report reporting the findings of the study, including examination of technical and engineering interventions that alleviated its severity
- identify further research gaps and opportunities for studies on droughts, floods and water security, that could be incorporated into a 5-year strategic drought management plan.

This research was directed and guided by the PDMC's Directorate: Disaster Operations, through the leadership of the Deputy Director, Recovery. As with previous successful post-event studies, the research team worked closely with the PDMC to formulate a Project Steering Committee and to finalise the research methodology. During the course of the project, SU/DiMP met regularly with the Project Steering Committee to ensure satisfactory progress monitoring and to timeously address implementation concerns.

2. Methods Used

Although the study terms of reference specifically refer to a two-year drought (from January 2009-January 2011), the research team was required to extend the time-frame back to 2007. This was due to evidence gathered from meteorological data and field research which indicated that proximal drought-risk factors could be traced as early as November 2007.

The spatial and temporal scales of the drought, along with its diverse rural and urban impacts, necessitated a complex research methodology. The research team acknowledged the importance of an approach that was sufficiently robust to accommodate both quantitative measures of rainfall deficit at district and municipal scale as well as 'knock-on' social consequences over time. Therefore the resulting methodology incorporated a wide range of data sources, as well as qualitative and quantitative research methods.

The research process involved complex data-handling owing to the disparate datasets provided by six municipalities and two provincial departments. To address the need for in-depth local analysis, the research team applied a 'sentinel site' methodology for three localities. Specifically, the towns of George, Beaufort West and Uniondale were identified as sentinel sites for differing drought exposures and impacts. Respectively located in the southern, northern and eastern areas identified as drought-affected, each represented a different livelihood zone and drought risk profile. A more detailed examination of rainfall, water consumption and risk management measures was undertaken for each site.

An extensive process was undertaken to collect, compile and integrate the indirect and direct impacts that were identified as drought-associated. This was undertaken through in-person and telephonic interviews, as well as through the detailed review of drought reports provided by government and nongovernmental informants. Although the research team compiled numerous anecdotal reports of hardship and loss consolidated information on livestock losses or diminished crop yields was, regrettably, difficult to source.

All farms that were allocated agricultural relief were geo-referenced to municipal scale to show the spatial distribution of assistance for agriculture between 2009 and 2011.

Primary data were collected through semi-structured interviews, and focus group discussions in the affected areas. Altogether, this involved more than 80 interviews and discussions in the field followed by telephone calls to a diverse range of stakeholders. In this way, causal chains of impact became evident, providing deeper insights and clearly illustrating the interconnectedness of impacts and the knock-on consequences of the water crisis over time and space. This was illustrated by the livelihood impacts sustained by seasonal farm workers who, due to reduced labour needs in drought-affected orchards, moved to towns, seeking casual work and food relief (refer Glossary and Section 6.7).

3. Study Conclusions

3.1 A period of extreme dryness, with sustained low rainfall for +/- two years

The period 2008-2011 was reflected in exacting meteorological, hydrological and agricultural drought conditions across the Eden and Central Karoo District Municipalities. These were evidenced by measurable reductions in rainfall, stream flow, groundwater levels and vegetation cover. These reductions were also not limited to a single annual cycle, and spanned at least two to three years. Unfortunately, the drought coincided with the global economic recession, whose impacts were most intense in 2008 and 2009, and which constrained the range of options available to manage the drought and its consequences.

Despite the duress sustained in the course of 2009-2011, the research team identified remarkable accomplishments achieved in the course of the drought response operation. However, the drought also revealed numerous deficiencies in water resource management, highlighting gaps to be addressed.

3.2 An impressive response by stakeholders - despite late detection of declining water availability

The 2009-2011 drought emergency generated a huge, complex operation by civil society, national, provincial and local governments that spanned two district municipalities and that secured R 572m for wide-ranging relief activities. It was also supported by five separate local disaster declarations.

The effectiveness of the response to the drought was enabled through the establishment of two multi-stakeholder mechanisms as well as the availability of experienced disaster management expertise at district and provincial centres. Similarly, the involvement of competent personnel in technical departments at provincial and municipal levels was essential, along with access to updated monthly climate, agricultural and water risk management information for timely decision-making. The development and application of a water crisis risk rating mechanism in 2009 was central to the effectiveness of the drought emergency response over time and across multiple municipalities.

The Provincial Department of Agriculture supported drought-stressed farmers, in cooperation with Agri-SA, and secured R 76.9m for relief. Unfortunately, due to the late finalization of DAFF's Framework for Drought Aid on 23 December 2010, the first phase of fodder relief did not commence until February 2011.

At the time this drought study was concluding (May 2012), R 26.9m had been expended, primarily for fodder relief, although not all recipients approved for relief assistance had redeemed their allocated vouchers.

3.3 A costly response, exceeding R 500 million

The 2009-2011 operation resulted in R 572.04m being allocated for drought response. Of this, R 495.0m (86.5%) was directed to improving urban water supply infrastructure, while R 76.9m (13.44%) was allocated for agricultural relief. Altogether, the National Treasury provided R 287.2m, or 58.0% of all funding for municipal water supply infrastructure. This was complemented by municipal co-funding, estimated cumulatively to be R 89.3m (18% of total costs). PetroSA's contribution added a further R 92.5m (18.7% of total expenditure), specifically for Mossel Bay. Smaller amounts from the Regional Bulk Infrastructure and Municipal Infrastructure Grants totalled R 24.2m, while the Eden District Municipality contributed R 1.8 m, primarily for awareness raising.

Although Mossel Bay received the largest National Treasury allocation for all municipalities (R 108.5m), Hessequa farmers were allocated the highest amount of agricultural assistance (R 14.3m).

While the allocation of substantial funding (R 495.0m) to expand urban water infrastructure addressed urgent water supply imperatives, this contrasted sharply with the very modest financial support released for agricultural risk management (R 76.9m). In Box 1 below, an experienced water engineer questions the disparity in the funding allocation, and contrasts the availability of skilled expertise available for agricultural risk management, with that in well-resourced municipalities.

Disparity in Capital Funding

"The drought converted to official disaster status, resulted in substantial capital being released for capital works for municipalities. This was essentially a capital contribution to the Industrial Water and Domestic Water use sectors. Contrary to this, no capital investment was released for agricultural use, e.g. for the construction of infrastructure to aid and augment the assured yield of irrigation water for, say, storage of water from periods of abundance in dams.

Disparity in resources

The drought disaster situation also highlighted the lack of resources in the agricultural sector and the abundance of resources on the other hand located in municipalities. The seven municipalities involved were all supported by a dedicated salaried team of technical people able to understand and work with the intricacies of financing, and could also depend on professional financial support within the municipalities. This was not the situation with agriculture, where under-staffed, under-resourced efforts tried to source desperately needed funds. The result was a disparity in investment in capital projects for Domestic/Industrial Water Use compared to the Agricultural Water Use. The limited funding of operational required fodder will not alleviate future drought imposed hardships – this contrary to the urban sector which can now rest assured that sufficient sustainable sources have been developed.

Disparity in Benefits attained

The drought disaster resulted in capital works being done in haste and under pressure to relieve especially water shortages in towns. This resulted in a number of projects which, in retrospect, could have been more beneficial if more thinking time was allowed. A typical example is the clearing of invasive alien vegetation in the Karatara area where a smaller investment would have resulted in sustainable jobs, immediate guaranteed water supply and environmental benefits compared to a substantial investment in a desalination plant with limited water, capital being exported and severe maintenance cost".

Source: Gorra Water and WCDoA

Box 1: Balancing municipal and agricultural allocation of resources for drought response – an experienced engineer's perspective

3.4 Active engagement by municipalities, the Department of Water Affairs and Department of Agriculture were central to effective response

3.4.1 The crucial role of engaged municipalities

Focused municipal response to the drought emergency resulted in numerous achievements. Impressive reductions in municipal water demand in particular were achieved between April 2008 and October 2010, with daily water consumption reportedly declining by a staggering 41% for Bitou, George, Mossel Bay, Knysna, Oudtshoorn and Hessequa Municipalities over this period. Such reductions were achieved through a focused suite of interventions, including increased tariffs, water restrictions, repairs to leaking infrastructure and intensive public awareness campaigns.

In addition, energetic efforts by district and municipal engineers ensured a remarkably rapid temporary expansion of local water supplies. These were measurably reflected by the expansion of groundwater supplies, as well as the establishment of reclamation, waste-water treatment and desalination plants, supplemented by increased river abstraction (in George, specifically).

It was, however, the extraordinary achievements in water conservation demand management that 'saved the day', (guided by a monthly urban water supply monitoring and monthly risk rating report). This was because the majority of additional water supply projects did not come on-line until late 2010-2011, after the drought had broken.

3.4.2 Essential engagement by the Department of Water Affairs

The Department of Water Affairs (DWA) played a crucial role in co-facilitating and coordinating emergency meetings, liaising with Provincial and National Treasury, as well as the Development Bank of Southern Africa (DBSA). It was also instrumental in facilitating the disaster declarations and for providing 'hands-on' support to municipalities and other governmental departments. DWA's involvement in the operation ensured that regular status updates were provided to the MEC for Local Government, as well as the Premier and Provincial Cabinet.

The DWA also took the lead in the process of increasing abstraction from groundwater resources. This support from the Groundwater Section of DWA was wide-ranging, and included technical guidance, engagement in multi-stakeholder processes, and facilitation of legal/administrative/regulatory processes.

3.4.3 The protective role of agricultural relief

2,434 farms were approved for fodder relief by the Provincial Department of Agriculture, located primarily in the Eden District, with more than 900 farms in Hessequa alone, allocated fodder relief vouchers. Unexpectedly, in the first phase of the agricultural relief programme, fodder relief vouchers were not redeemed for 409 farms, notably in Kannaland, Oudtshoorn and the Eden DMA. Furthermore, 40% of these were small-scale livestock farmers with undiversified livelihoods, many of whom were located in areas with limited access to water and unable to cross-fund their proportion of the fodder allocation from other income sources or cash reserves.

3.5 Drought severity amplified by risk drivers

Consistent with prevailing studies on drought and water scarcity elsewhere in the world, the severity of the 2009-2011 Eden and Central Karoo drought was amplified by interacting risk drivers that had progressively escalated the risk of a wide-spread water shortage. These included greatly increased water consumption prior to the onset of meteorological drought conditions, both in agriculture and in rapidly growing coastal towns. Prior to the drought emergency, such conditions had been accompanied neither by rigorous water demand management, nor systematic investment in water infrastructure and (in some municipalities) the requisite technical capacity required to manage water supplies sustainably. Water resource development had not kept pace with rising demand. These risks were further exacerbated by a lack of systematic drought risk management planning – especially where this applies to urban settings. Specifically, there was no uniform definition of 'drought', nor were there accompanying indicators that would have allowed for early signal detection and possible early action. Prior to the drought emergency, no indicator-linked contingency plans existed that would have enabled an earlier, 'less resource-intense' response.

Climate variability and changing weather conditions were also widely noted as a key risk drivers by those interviewed. Farmers and others stressed the difficulties in managing the impacts of the 'see-saw' weather and variable rainfall patterns, with the impacts experienced during severe storms in the region exacerbating the effects of exposure to later periods of reduced rainfall. For instance, farm dams destroyed by earlier floods remained unrepaired and could not provide the necessary buffer to help tide farmers through the later drought.

3.6 Wide-ranging impacts reported, but poor documentation and records

Although field research and findings from extensive interviews and document review indicated a broad suite of drought impacts, it was seldom possible to attribute reported agricultural losses exclusively to drought conditions. This was due to the convergence of the drought's timing with the global economic recession, the associated local economic downturn and other environmental factors.

All livestock farmers interviewed noted the destructive influences of pest animals and livestock diseases. Specifically, they underlined that jackals and lynx posed more significant and consistent causes of small livestock loss than drought. Farmers also stressed the seriousness of livestock diseases such as Rift Valley Fever, which they noted after the heavy rains following a drought. It was beyond the study's scope to investigate the relationship between drought and pest animals, although jackal-associated livestock losses were also reported in the severe 1930s droughts (Vogel; pers comm.).

The lack of documentation on stocking levels during the course of the drought made it impossible to differentiate the severity of livestock losses by location, type of farming, exposure to reduced ground and surface water supplies, or relative coverage through fodder relief. Similarly, although the research team pursued multiple avenues to establish the scale of the social impacts, none of the various relief NGOs and organisations interviewed was able to corroborate its observations with quantitative data.

There was evidence of enormous initiative taken by diverse stake-holder groups to minimise the drought's effects. These ranged from individual farmers exploring groundwater sources and small businesses installing on-site water storage tanks to the reprioritisation of budget lines by proactive municipalities. Access to capital to finance drought-minimising interventions constituted a crucial enabler, with evidence of many private enterprises self-funding strategies to reduce losses (often at great personal cost, and, in the case of bore-hole drilling, with no guarantees of successful return on investment).

Poor, rural households whose livelihoods depended (directly or indirectly) on agriculture came under particular pressure. There were clear instances (e.g. in Haarlem) where socioeconomic vulnerability was compounded by insufficient access to water (for irrigation and livestock) and was amplified by poor access to fodder and livestock inoculation. Similarly, farm worker livelihoods became increasingly precarious due, first, to a contraction in agricultural labour requirements and, second, by lack of access to formal social protection and social relief.

4 Summing-up of key gaps identified

4.1 Operational gaps related to Provincial and District Disaster Management Centres

- Limited discernment of **drought onset and impending water scarcity** (across multiple stake-holder groups), along with definitional difficulties with accurate 'disaster classification and declaration'. Specifically, there was no **uniform definition of 'drought'**.

- **Limited application of the Standardised Precipitation Index (SPI) values to specific municipal jurisdictions** that may have delayed/excluded assistance for areas that were meteorologically drought-affected – for instance localities in 'transitional zones'/grey areas (i.e. Swellendam, Overberg District Municipality) that shared borders with drought-declared municipalities.

- Lack of functioning **meteorological drought 'warning system'** in which SAWS advised the NDMC / PDMC / DDMCs of advancing/accumulating rainfall deficits (i.e. quarterly SPI maps overlaid with municipal boundaries), combined with forecast conditions and interpretations by experienced personnel.

- Lack of **water risk rating/monitoring system** and inclusion of these assessments in quarterly reports to PDMC/DDMCs that would have identified escalating water supply risks before these reached critical levels.

- **No contingency plans existed for managing advancing urban water shortages** in areas exposed to erratic rainfall (although George, Bitou and Mossel Bay have now generated drought management strategies after their 2009-2011 experience).

- Lack of **monthly/quarterly PDMC drought progress monitoring templates** that would have enabled wide-area monitoring over time – nor **project monitoring/summative reporting** processes for reconciling funds secured from National Treasury against actual deliverables (despite excellent meeting reports and administrative reports on activating funding).

- Serious shortcomings in the water sector that exacerbated the drought's effects, including: ageing municipal water distribution infrastructure, unaccounted-for water losses, and limited water management capability.

4.2 Sector-specific difficulties in agriculture and social development

4.2.1 Agriculture

The Western Cape Province's complex agricultural risk profile (i.e. annual back-to-back weather disasters, veterinary diseases and wild-fires) calls for urgent expansion of the Provincial Department of Agriculture's risk management capacity. Since 2003, agriculture has sustained the highest losses in every major weather-related disaster within the Province. This has generated heavy technical and support requirements for the Provincial Department, whose staffing has not kept pace with rising demand.

4.2.2 Social Development

Inadequate mechanisms for assessing social relief needs, especially of farm workers, resulted in unexpectedly low numbers of households receiving assistance for only three months. However, field research indicated clear evidence of considerable hardship in this instance that far exceeded the scale of social relief provided. This was in part due to deficits in agricultural support for commercial farmers and small-scale farmers, which were amplified by the economic downturn. The scale of contraction in agriculture and its knock-on consequences to farm labour between the first quarters of 2010 and 2011 were measurably reflected in the loss of 51,000 agricultural jobs (Statistics SA, 2011).

Although it is not possible to attribute agricultural job losses specifically to drought or conditions of economic duress or other factors, it is noteworthy that the Western Cape's agricultural labour force shrank by 29.7%, from 172,000 to 121,000 jobs between January-March 2010 and January-March 2011 (Statistics SA, 2011).

4.3 Recommendations

4.3.1 Recommendations applicable to the Provincial Disaster Management Centre

- In consultation with relevant stake-holders, **develop uniform drought definitions** linked to:
  - unambiguous meteorological drought monitoring indicators (including SPI values)
  - quarterly water supply risk monitoring indicators
  - municipal drought and/or escalating water scarcity contingency plans.
- **Incorporate spatially-represented meteorological drought indicators** in identifying drought-affected municipalities to avoid excluding towns that may be affected but fall outside the disaster-declared areas (this especially applies to small towns in transboundary drought 'transition zones' that may not have the resources to respond).
- Strengthen **drought early warning and response capabilities** by:
  - consulting with the Department of Agriculture and Agri-SA on improving the effectiveness and accessibility of timely meteorological drought warning information for farmers
  - consulting both the DWA and Eden District Municipality to restore the urban water supply risk-rating and monitoring system that was crucial to the management of the drought emergency, but has since been discontinued
  - requesting the National Disaster Management Centre consult the South African Weather Service to:
    - regularise the quarterly dissemination of **national SPI maps** (3-month, 6-month, 12-month and 24-month) overlaid with municipal boundaries
    - locate SAWS rainfall stations strategically for adequate rainfall monitoring (e.g. the Beaufort West Municipality has installed its own rainfall station near the Gamka Dam as there is no SAWS gauge within this crucial catchment).
- **Support efforts by DWA to strengthen urban water security by:**
  - encouraging municipalities to invest in reducing unaccounted-for water losses and bringing into operation water conservation and demand management practices

- ensuring that all municipal water supply schemes have functioning reservoir operating rules in place, as well as flow gauging and other resource monitoring installations

- ensuring that municipal disaster risk assessments incorporate considerations of urban water scarcity/shortage and drought, given patterns in population growth and provision of free basic water services

- encouraging municipalities to implement strong water conservation and demand management programmes, in instances where is little scope to increase supply.

- **Develop uniform drought monitoring templates for monitoring relief activities,** including monthly/quarterly PDMC *progress* monitoring templates that enable wide-area monitoring over time and *summative* reporting processes for reconciling funds secured from National Treasury against actual programme outputs or payouts.

- **Support efforts by the Department of Local Government to locate skilled engineering** personnel within high-risk municipalities (not only for infrastructure development, but also to ensure robust on-going management of water resources).

4.3.2 Recommendations for the Provincial Department of Agriculture

- **Urge review of current agricultural relief assessment** processes to establish methods that:

  - are more effective in identifying and supporting farms that repeatedly sustain weather and other shocks (and that cannot recover)

  - incorporate economic risk factors that influence farm resilience and recovery under conditions of drought duress.

- **Improve the effectiveness of the current agricultural relief scheme, specifically:**

  - investigate the reasons for farmers *not taking up* their fodder relief allocations compared to those who redeemed their fodder vouchers

  - during drought episodes, compile livestock counts/registers at municipality/district municipality scale at least annually but preferably at six-monthly intervals in high-risk areas to track changes in asset profiles

  - investigate alternative drought relief strategies that include increased water allocations and/or livestock vaccination campaigns for small-scale farmers (combined with planned and managed de-stocking early into the drought – before the animals have lost too much condition), due to the increased likelihood of animal diseases during drought episodes

  - investigate the viability of 'fodder banks' to take advantage of abundant rainfall periods to store animal feed to minimise livestock risks during dry spells

  - in cooperation with DWA and the WRC, **undertake research to determine reasons for failure of farm dams** under conditions of intense rainfall.

- Mobilise **Department of Labour training schemes for farm worker support** under conditions of drought duress, rather than support from Social Development's Relief of Distress scheme, due to the latter's narrow eligibility criteria.

- **Urge review of technical support requirements for agricultural risk management within the Provincial Department of Agriculture.**

This refers to the need for urgent expansion of current agricultural risk management technical capacity due to the disaster-related demands in the province and associated agricultural losses.

TABLE OF CONTENTS

List of Tables and Figures

Tables

Figures

Boxes

ABBREVIATION AND ACRONYMS

ADMP	Agricultural Drought Management Plan
ARC	Agriculture Research Council
Av.	Average
B&B	Bed and Breakfast
CBD	Central Business District
CKDM	Central Karoo District Municipality
CoCT	City of Cape Town
CoGTA	Department of Cooperative Government and Traditional Affairs
COL	Cut-off low
CSIR	The Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DDMC	District Disaster Management Centre
DEADP	Department of Environmental Affairs and Development Planning
DiMP	Disaster Mitigation for Sustainable Livelihoods Programme
DM	District Municipality
DMA	District Management Area
DRS Mphil	Master of Philosophy in Disaster Risk Science
DoA	Department of Agriculture
DoLG	Department of Local Government (Provincial Government Western Cape)
DSD	Department of Social Development (Provincial Government Western Cape)
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
EDM	Eden District Municipality
EDMC	Eden Disaster Management Centre
FAO	Food and Agriculture Organization of the United Nations
FIFA	Fédération Internationale de Football Association
FSC	Full Storage Capacity
GAR	Global Assessment Report
GDP	Gross Domestic Product
GRD	Garden Route Dam
HFY	Historic Firm Yield
H'holds	Households
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resource Management
KKRWSS	Klein Karoo Rural Water Supply System
LSU	Large Stock Unit
MBM	Mossel Bay Municipality
MEC	Member of the Executive Council
MIG	Municipal Infrastructure Grant
ND	Undated
NAC	National Agrometeorological Committee
NDA	National Department of Agriculture
NDMC	National Disaster Management Centre
NDMF	National Disaster Management Framework
NDVI	Normalized Difference Vegetation Index
NGO	Nongovernmental organisation

NT	National Treasury
OSD	Occupation Specific Dispensation
PASG	Percentage of Average Seasonal Greenness
PCF	Premier's Coordinating Forum
PDMC	Provincial Disaster Management Centre (Provincial Government Western Cape:
PetroSA	The Petroleum Oil and Gas Corporation of South Africa (SOC) Limited
P.N.	Provincial Notice
PT	Provincial Treasury
RADAR	Risk and Development Annual Review
RBIG	Regional bulk infrastructure Grant
RDP	Reconstruction and Development Programme
RHP	River Health Programme
RSA	Republic of South Africa
RO	Reverse Osmosis
ROD	Record of Decision
SAFCEI	The Southern African Faith Communities' Environment Institute
SAIA	South African Insurance Association
SALGA	South African Local Government Association
SANDF	South African National Defence Force
SASSA	South African Social Security Agency
SAWS	South African Weather Services
SEDA	Small Enterprise Development Agency
SPI	Standardised Precipitation Index
SSU	Small Stock Unit
SU	Stellenbosch University
OSD	Occupation Specific Dispensation
UNDP	United Nations Development Programme
UNIEP	Uniondale Integrated Empowerment Project
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
USA	United States of America
WCDoA	Western Cape Department of Agriculture
WwTW	Wastewater Treatment Works
WfW	Working for Water
WMA	Water Management Area
WMO	World Meteorological Organisation

Units

kL	Kilolitre
L	Litre
m	Million
mm	Millimetre
mm^3	Cubic millimetre
ML	Megalitres
MT	Metric ton
yrs	Years
ZAR/R	South African Rand

GLOSSARY

Causal chain	"A causal chain is a series of statements that link the causes of a problem with its effects". *Source: Belausteguigoitia, 2004*	
Climate variability	"Refers to variations in the mean state and other statistics of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic forcing (external variability)". *Source: IPCC, 2012: 559*	
Climate extreme (extreme weather or climate event)	"The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of a range of observed values of the variable." *Source: IPCC, 2012: 557*	
Cut-off low	A cut-off low is a mid-latitude cyclone that becomes 'cut-off', or severed, from the main planetary circulation, and spins off independently. Because it is no longer attached to the westerly pressure wave to the south, it loses all momentum and can just sit for days, or move very slowly before dissipating. Cut-off lows are associated with very strong atmospheric instability and powerful convection. This also brings a range of severe weather, including torrential rainfall, snow in mountainous areas and violent winds. Cut-off lows are one of the main drivers of damaging floods in South Africa, and can also trigger thunderstorms. *Source: DiMP, 2010: 18*	
Disaster Risk	"The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery". *Source: IPCC, 2012: 558*	
Disaster Risk Management	"Processes for designing, implementing and evaluating strategies, policies and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life and sustainable development". *Source: IPCC, 2012: 558:*	
Drought	Agricultural	The lack of availability of soil water to support crop and forage growth due to the departure of normal precipitation over some specified period of time. *Source: UNISDR, 2011:57 and UNISDR, 2009a:8*
	Hydrological	Deficiencies in surface and subsurface water supplies relative to average conditions at various points in time through the seasons. *Source: UNISDR, 2011:57 and UNISDR, 2009a:8*
	Meteorological	A precipitation deficiency over a pre-determined period of time. The thresholds chosen, such as 50 percent of normal precipitation over a six-month time period, will vary by location according to user needs or applications.

<table>
<tr><td></td><td></td><td>Source: UNISDR, 2011:57 and UNISDR, 2009a:8

Meteorological drought can be defined on the basis of the degree of dryness in comparison to ‘normal’ or average amounts of rainfall for a particular area or place and the duration of the dry period.
The common practice to date has been to use the percentage of normal rainfall as an indicator of drought. Less than 75% of normal rainfall is regarded as a severe meteorological drought but a shortfall of 80% of normal will cause crop and water shortages which will ultimately affect social and economic factors. Normal rainfall for a particular place is calculated over a 30-year period using rainfall figures for at least 30 years.
Source: SAWS, 2003a</td></tr>
<tr><td>El Niño-Southern Oscillation (ENSO) phenomenon</td><td colspan="2">A complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregularly occurring episodes of changed ocean and weather patterns in many parts of the world, often with significant impacts over many months, such as altered marine habitats, rainfall changes, floods, droughts, and changes in storm patterns.
Source: UNISDR, 2009a:13</td></tr>
<tr><td>Gross Domestic Product (GDP)</td><td colspan="2">Is the total market value of all final goods and services produced in a country for a given period.
Source: RHP, 2006:46</td></tr>
<tr><td>Hazard</td><td colspan="2">A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.
Source: UNISDR, 2009b:17</td></tr>
<tr><td>Load shedding (for power systems)

Water demand ‘load shedding’</td><td colspan="2">The primary function of power systems is to supply electricity to their customers. However, when the system itself is in an emergency state, it may shed partial loads to ensure the power supply to important loads, as the last resort to maintain system integrity.
Source: Xu and Girgis, 2001: 788-793

In the drought study, respondents in Beaufort West frequently referred to water ‘load shedding’. This occurred when water supplies to residential areas in the town were systematically cut for 36-48 hour periods on a rotational basis to preserve water supplies to the central business district, hospitals and industries.</td></tr>
<tr><td>Mitigation</td><td colspan="2">The lessening or limitation of the adverse impacts of hazards and related disasters.
Source: UNISDR, 2009b:19</td></tr>
</table>

Normalized Difference Vegetation Index (NDVI)	Remote sensing images of the earth's surface are used to measure and map the density of green vegetation, in order to identify where plants are thriving and where they are under stress (e.g. due to lack of water). By carefully measuring the wavelengths and intensity of visible and near-infrared light reflected by the land surface back up into space scientists use an algorithm called a "Vegetation Index" to quantify the concentrations of green leaf vegetation around the globe. Combining the daily Vegetation Indices into 8-, 16-, or 30-day composites, scientists create detailed maps of the Earth's green vegetation density. The NDVI is one such ratio that is calculated using the following formula: $NDVI = \frac{NIR-VIS}{NIR+VIS}$ where VIS is the spectral reflectance for visible (red) wavelengths and NIR is the spectral reflectance for near-infrared wavelengths. *Source: Weier and Herring, undated*
Percentage of Average Seasonal Greenness (PASG)	This is a measure of the accumulated seasonal greenness (NDVI ratio) up to a point, relative to the long-term, historical average of greenness for the same season. A PASG of 100% would suggest that vegetation conditions are normal relative to the long-term average. *Source: National Drought Mitigation Center, 2012*
Post disaster/ Ex post / Post-event studies	Research on realised risk or disaster events (such as floods). Such studies are useful for identifying areas, production activities and services that resist or fail in response to a severe shock. *Source: DiMP, 2010:99*
Recharge	The process where water is added to an aquifer or groundwater, for example, from rainfall. *Source: RHP, 2006:46*
Recovery	The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. *Source: UNISDR, 2009b:35*
Risk accumulation	The incremental (and largely undetected) accumulation of hazardous (i.e. declining rainfall) risk factors, combined with exacerbating vulnerability conditions.
Risk escalation	Refers to the acceleration of risk factors to the point that they are detected and causally linked to an adverse consequence (i.e. acute water shortage). In the case of the Southern Cape drought, this phase was also characterised by the establishment of initial coordination mechanisms and structures – recognizing the urgency for response.
Risk de-escalation	Refers to continued reduction in adverse impacts, plus reversal of hazard conditions (i.e. restoration of rainfall), and down-scaling of emergency response. This phase was indicated operationally by dismantling of emergency structures and mechanisms and the restoration of water to storage systems and normalization of flows within the abstraction systems.
Risk intensification	Refers to the occurrence of recognizable first-, second- and third-order impacts and multiplier effects that indicate cross-linkages between socio-economic and environmental conditions (e.g. rapidly declining dam levels, reduced household and livestock access to water,

	compromised vegetation cover, farm job losses). In the Southern Cape drought, this phase was associated with concerted and focused emergency measures by multiple organizations and individuals to contain further progression of water shortages and associated impacts.
Risk stabilisation	Refers to deceleration of the occurrence of the most wide-reaching adverse impacts, mainly through a combination of focused emergency measures (that either increased water supply and/or reduced demand). While exposure to the (drought) hazard may not have decreased, the consequences of exposure maybe minimised by focused interventions.
Standardised Precipitation Index (SPI)	This index is based on the probability of rainfall for any time scale and can assist in assessing the severity of drought. The SPI can be calculated at various time scales which reflect the impact of the drought on the availability of water resources. The SPI calculation is based on the distribution of rainfall over long time periods (preferably more than 50 years). The long-term rainfall record is fit to a probability distribution, which is then normalised so that the mean (average) SPI for any place and time period is zero. SPI values* above zero indicate wetter periods and values less than 0 indicate drier periods. *The SPI values adopted in this report and at the South African Weather Service (SAWS) are the same as those developed by McKee, Doesken and Kleist in 1993 (for more information on SPI values, refer to: **http://old.weathersa.co.za**) *Source: SAWS, 2003b*
Transboundary events	Severe (weather) events that affect more than one district municipality or administrative jurisdiction. *Source: DiMP, 2010:79*
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. For positive factors, which increase the ability of people to cope with hazards, see definition of capacity. *Source: UNISDR, 2009b:30*
Water Scarcity	The point in space, or the moment in time, at which the aggregated impact of all users impinges on the supply or quality of water, under the prevailing institutional arrangements, to the extent that the total demand by all sectors, including the environment, cannot be fully satisfied. *Comments:* Water use has been growing at more than twice the rate of the population increase during the last century, while the fresh-water resources availability remained unchanged. Therefore, the water problem is perceived mostly as a physical "shortage" (scarce in supply). *Source: FAO, 2006*

ACKNOWLEDGEMENTS

This 'ex-post' drought report has required the assistance of many people across the Western Cape. Their involvement and input in the process is greatly appreciated by all members of the study team. We would, however, like to particularly acknowledge the people and organisations mentioned below for their support in this research.

We are thankful for the time and energy given by those farmers willing to participate in interviews and telephonic clarification. For this support we would like to thank Ben Burger, Danie Conradie, Jan Crafford, Andre De Wit, Frans Esterhuyse, Dave Hodgson, Jannie Le Roux, Gustav Lind, Pietie Lund, John Moodie, Wilhelm Nel, Bob Reynecke, Thuys Swart, Jan Van Der Wywe and Nelius Van Greunen.

The findings of this report have been greatly strengthened due to the input and assistance of many government officials across the region. The generous provision of information and collected data is deeply appreciated. In this regard, we are grateful to Jaffie Booysen, Michelle Buys, Ingrid Cronje, Charl Du Plessis, Kobus Du Toit, Sue Du Toit, Deon Haasbroek, Kenneth Kirsten, Patrick Laws, Nico Liebenberg, Piet Lodder, Heinrich Mettler, Florina Mouton, Rodney Nay, Gerhard Otto, John Roberts, Andre Roux, Hein Rust, Louw Smit, Rob Smith, Callie van Den Heever, Gerhard Van Zyl, Carlie Venter, Karel Venter, Pierre Venter, Fathima Watney, Hettie Weyman, Pietie Williams, Christopher Wright and Wendy Young.

Similarly we would like to thank the specialist information and services given by Antoinette, Steven Anthony, Attie Arnoldie, Richard Batson, John Christie, Terry Cockroft, Angela Conway, Laurie Conway, Mareyna De Vries, Ernie Fourie, Renaldo Groenewald, Paul Hoffman, Esmarie Joubert, Johan Kotze, Andries Kruger, Jaco Pienaar, Hennie Smit, Andries Stander, Wiehan Steyn, Koos van Zyl and Ruan Veldman.

We would also like to acknowledge the input of the Amaliensteyn residents, Barrydale residents (business and farming representatives), Haarlem small farmers and Mossel Bay Technical Services Division as well as the organisations that participated at the multiple stakeholder focus groups in Knysna and thank them for the valuable insights provided.

Particular thanks are expressed to colleagues who gave of their time to provide constructive and critical comment on the draft in order that this report could be finalized, and who supported the implementation of the research. We would like to acknowledge Harold Basson, Arthur Chapman, Retief Kleynhans, Lindsay Mooiman, Simpiwe Maschicila, Andre Roux, Mike Smart, Callie Van den Heever, Kosie van Zyl and Coleen Vogel who generously gave of their time to provide constructive and critical comments on the draft report. Similarly, the research team is grateful for the support of the Provincial Disaster Management Centre, particularly Marlene Barnes, Richard Haridien, Jacqui Pandaram and Ronelle Pieters, as well as former PDMC staff member Elmien Steyn.

Last, the development of this report would not have been possible without the financial support of the Western Cape Department of Local Government and Housing, through its Provincial Disaster Management Centre, the United States Agency for International Development and the Water Research Commission.

CONTRIBUTORS TO THE REPORT

The recommended citation for this report is:

Holloway, A., Fortune, G., Zweig, P., Barrett, L., Benjamin, A., Chasi, V. and de Waal, J. (2012) Eden and Central Karoo Drought Disaster 2009 - 2011; "The Scramble for Water." For the Provincial Disaster Management Centre, Western Cape by the Disaster Mitigation for Sustainable Livelihoods Programme, Department of Geography and Environmental Studies, Stellenbosch University. Pp 158.

Disaster Mitigation for Sustainable Livelihoods Programme, SUN

Vimbai Chasi (Disaster Risk Researcher)

Jan de Waal (Disaster Risk Researcher)

Gillian Fortune (Knowledge Manager)

Ailsa Holloway (Director)

Patricia Zweig (Risk Reduction Co-ordinator)

Specialist support

Laura Barrett (Independent Consultant)

Ameen Benjamin (SAFCEI, formerly Cape Peninsula University of Technology)

Arthur Chapman (OneWorld Sustainable Investments)

South African Weather Service (SAWS)

Graphics

Anne Westoby

Beaufort West maps

Takunda Mambo (Independent Consultant)

PART I: BACKGROUND, CONCEPTUAL FRAMEWORK AND METHODOLOGY

1.1 Introduction and Context

From 2009-2011, municipalities located in the Eden and Central Karoo Districts of the Western Cape Province of South Africa experienced moderate, severe and extreme meteorological drought. This resulted in almost immediate effects for livestock farmers due to compromised grazing conditions. In addition, diminished rainfall resulted in numerous lagged, 'knock-on' consequences to ground and surface water resources that translated into critically low urban water supplies in the Southern Cape municipalities and Beaufort West. These 'hydrological drought' conditions generated additional effects and necessitated significant emergency responses over the two-year period.

However, low rainfalls were also recorded for the City of Cape Town (CoCT), as well as parts of the Overberg and the Cape Winelands District Municipalities, although these areas were not eligible for drought assistance. Similarly, and beyond the administrative boundaries set for this study, significant meteorological and hydrological drought conditions were reported over the same time-scale in the Eastern Cape Province.

The reduced rainfall from 2008 to 2010 exposed more than 500,000 people in Western Cape municipalities to meteorological drought conditions. However, this exposure did not translate into uniform impacts, with municipalities located within the coastal areas of Eden District reporting the most significant effects, along with Beaufort West residents within the Central Karoo District.

Government assistance and provision of relief were facilitated by three local disaster declarations. On 20 and 27 November 2009, drought disasters were respectively declared for George, Mossel Bay and Knysna (Provincial Gazette, 2009a; Provincial Gazette, 2009b and Provincial Gazette, 2009c). Six months later, on 28 May 2010, a local disaster was declared in the Central Karoo (Provincial Gazette, 2010a). This was followed on 11 June 2010 by the declaration of a local disaster that now included all municipalities within the Eden District Municipality (Provincial Gazette, 2010b). The declarations, which were primarily intended to address increasing water stress within urban areas, also facilitated access to agricultural relief for farmers in both the Eden and Central Karoo District Municipalities.

Altogether, **R 572,035,501** was allocated to alleviate the drought's effects. These included R 364,1m from National Treasury, R 92.5m in commitments by PetroSA, R 89.29m in contributions by the affected municipalities, and R 1.8m from the Eden District Municipality. Additional support valued at R 9.21m and R 15.0m was respectively provided through Municipal Infrastructure Grant and Regional Bulk Infrastructure Grant mechanisms. The Western Cape Department of Social Development also released R 135,000 for assistance to distressed farm workers.

Although there was no official declaration marking the end of the emergency, the heavy rainfall that accompanied an intense cut-off low system in June 2011 is widely viewed as confirming the drought's endpoint in the Eden District. Within the Central Karoo, June 2011 also marked the point at which the Gamka Dam began to refill.

As ex-post documentation of a declared disaster is an explicit requirement of South Africa's National Disaster Management Framework (RSA, 2005), this report, commissioned by the Western Cape Provincial Disaster Management Centre (PDMC), ensures compliance with national policy. Specifically, this report consolidates the findings of ex-post research on the 2009-2011 drought, building on DiMP's past studies of severe weather occurrences within the Western Cape. These studies have provided important insights on the factors that increase or minimise the adverse impacts associated with severe storms and cut-off low weather systems (DiMP, 2010). They have also indicated that the character of discrete 'disaster events' is shaped by risk conditions that long precede a severe storm warning, including the adverse consequences of previous disasters and emergencies. This experience prompted the research team to explore connections between previous disaster occurrences and the 2009-2011 drought.

This chapter provides an overview of the drought emergency and introduces the report.

Specifically:

Section 1.1 introduces the temporal and spatial extent of the meteorological drought, its consequences, and specifies areas officially declared local disasters.
Section 1.2 introduces the conceptual framework for the study and key concepts.
Section 1.3 clarifies the temporal scope of the research.
Section 1.4 describes the overall research approach and methods used.
Section 1.5 states ethical considerations that are reflected in the report.
Section 1.6 outlines the study's limitations.
Section 1.7 presents the overall structure of the report.

1.1.1 The 2008–2010 drought: rainfall and dam levels

During 2008 and 2009, the eastern and southern coastal areas of the Western Cape Province experienced reduced rainfall. This is illustrated in Figures 1.1 to 1.3, which respectively represent the progression of annual Standardised Precipitation Index (SPI) values for 2008, 2009 and 2010. These indicate moderately dry weather conditions to the east of the province in 2008, followed by moderate to extreme dryness in the coastal municipalities during 2009. In 2010, moderate to extreme dryness was experienced by the south-western municipalities, including those located in the Overberg District Municipality.[1]

Figure 1.1: SPI values January-December 2008, Western Cape (Data courtesy of SAWS)

[1] The Standardised Precipitation Index is able to identify and classify wet cycles as well as dry periods. However, due to this study's focus on drought, SPI values for wet periods were not determined or mapped. In the following maps, these values are represented with blue shading as 'wet cover'.

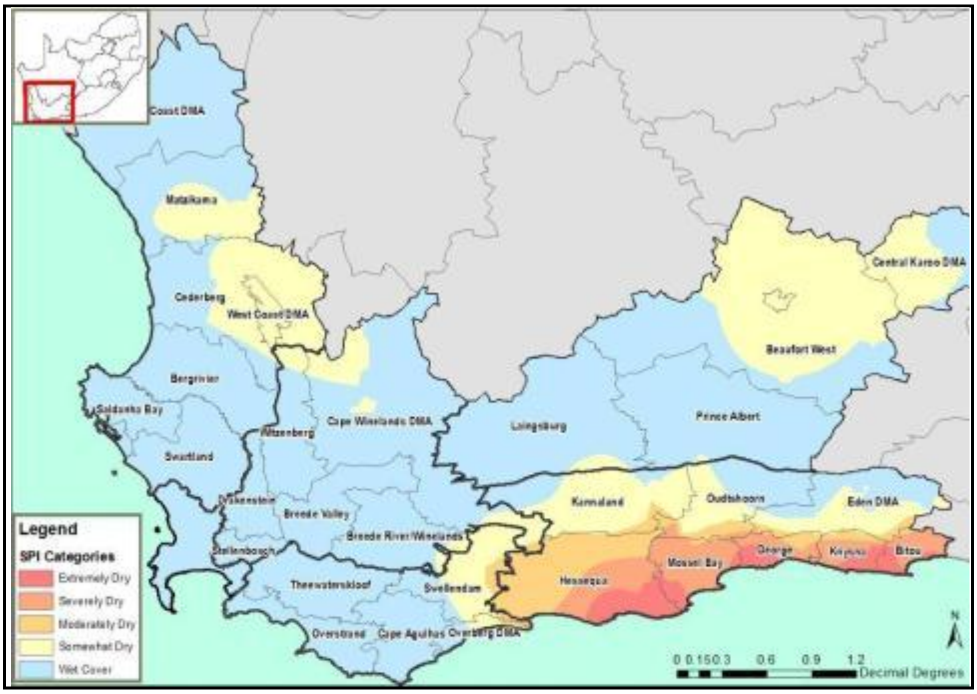


Figure 1.2: SPI values January-December 2009, Western Cape (Data courtesy of SAWS)

Figure 1.3: SPI January-December 2010, Western Cape (Data courtesy of SAWS)

Although rainfall conditions reportedly normalised in the later months of 2010, the lagged, 'knock-on' consequences for diminished ground and surface water persisted well into 2011. For instance, the Gamka Dam in Beaufort West only began to refill in June 2011.

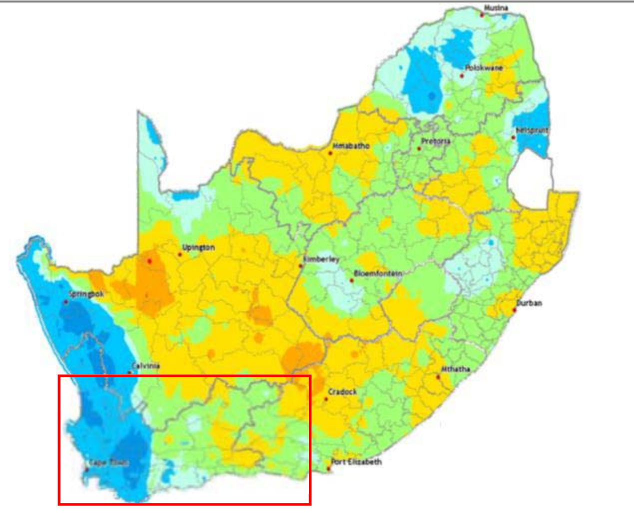


Figure 1.4: Total rainfall (% of long-term mean): 1 July-31 December 2008, RSA (ARC, 2009:9)

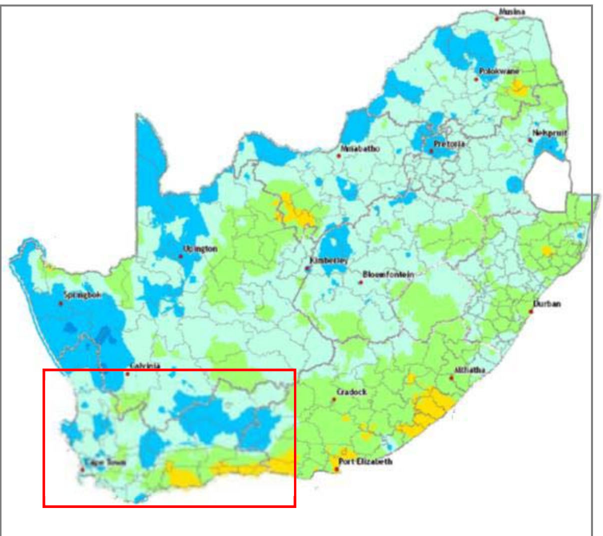


Figure 1.5: Total rainfall (% of long-term mean): 1 January-31 December 2009, RSA (ARC, 2010:11)

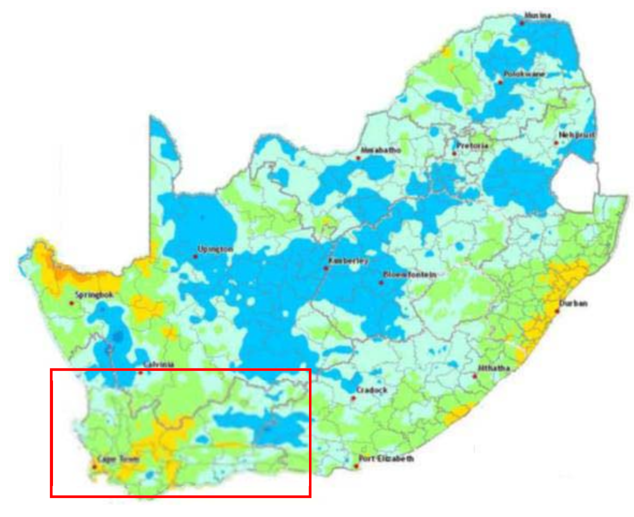
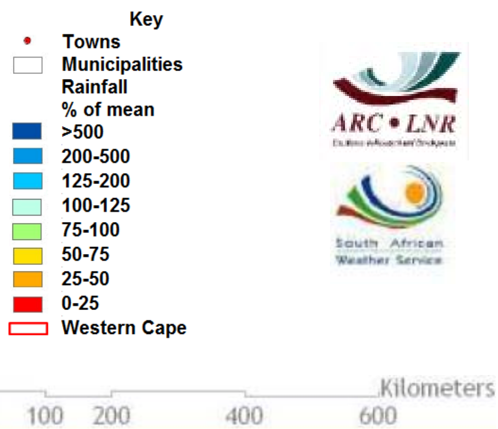


Figure 1.6: Total rainfall (% of long-term mean): 1 January-31 December 2010, RSA (ARC, 2011:1)



Key, scale bar & copyright holders for Figure 1.4-1.6

Between 2009 and 2011, lower than normal rainfall was partly responsible for falling reservoir levels across the Central Karoo and Eden District Municipalities. Figures 1.7 to 1.9 illustrate these reductions in available water storage for the same period respectively for the Garden Route (George), Gamka (Beaufort West) and Haarlem (Uniondale, in the former Eden District Management Area (DMA)) Dams. These show markedly diminished water levels in reservoirs which necessitated the introduction of vigorous water demand management strategies. Significantly, the Gamka Dam north of Beaufort West was completely empty by September 2010. This resulted in water 'load shedding' (refer to Glossary) and additional emergency measures – including bottled water distribution.

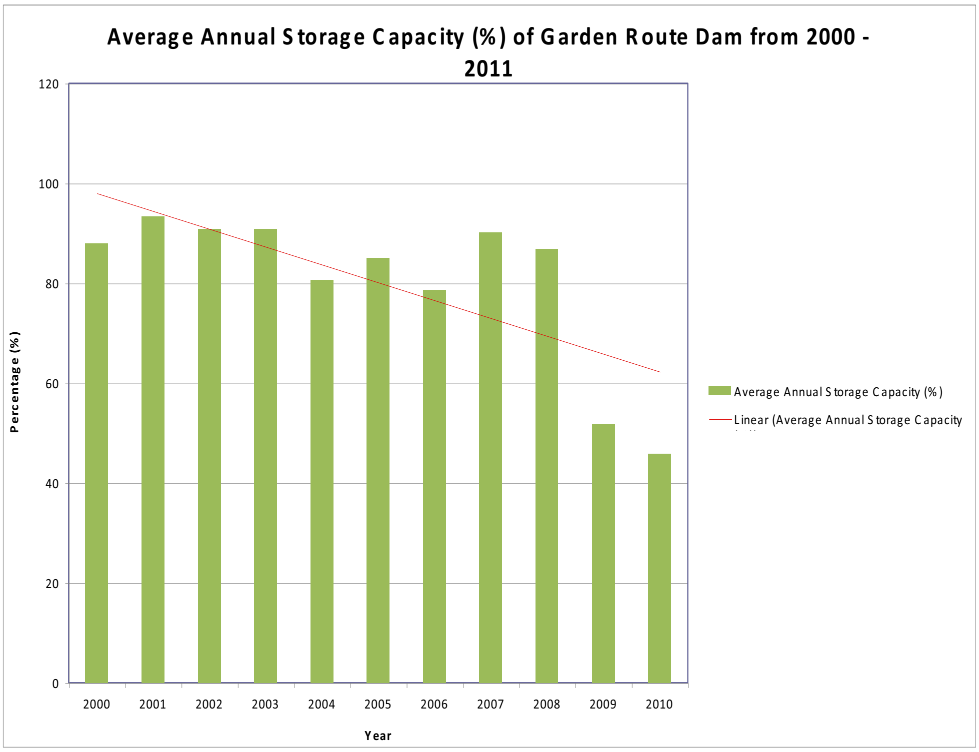


Figure 1.7: Water Availability (% Full Storage Capacity: FSC) 2000-2010: Garden Route Dam (GRD), George (Barrett, 2012)

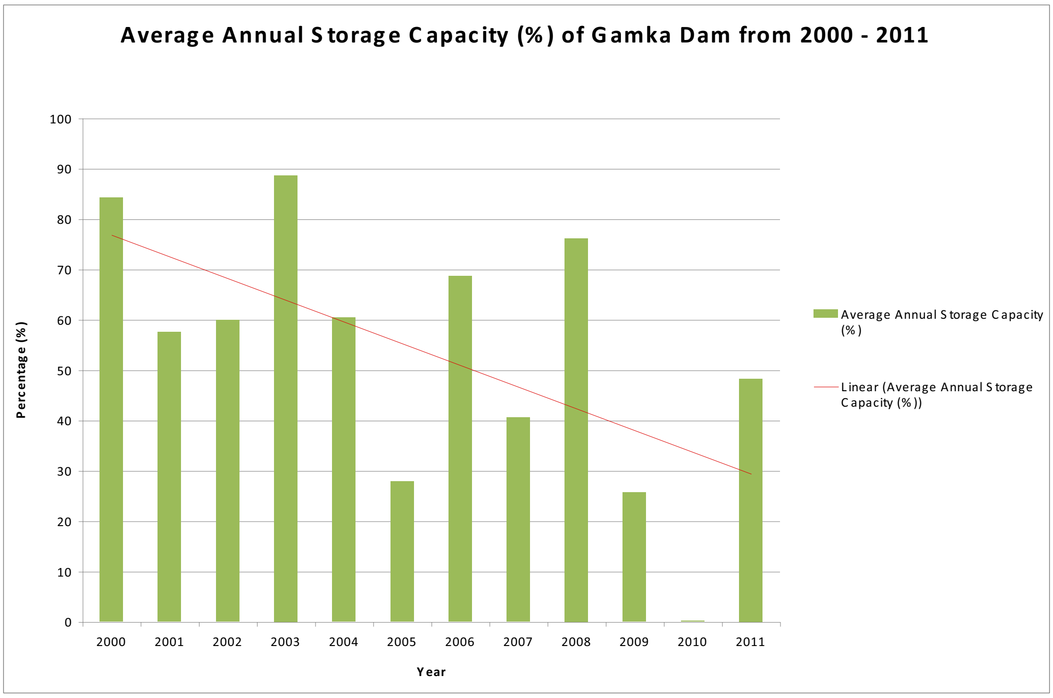


Figure 1.8: Water Availability (% FSC) 2000-2010: Gamka Dam, Beaufort West (Barrett, 2012)

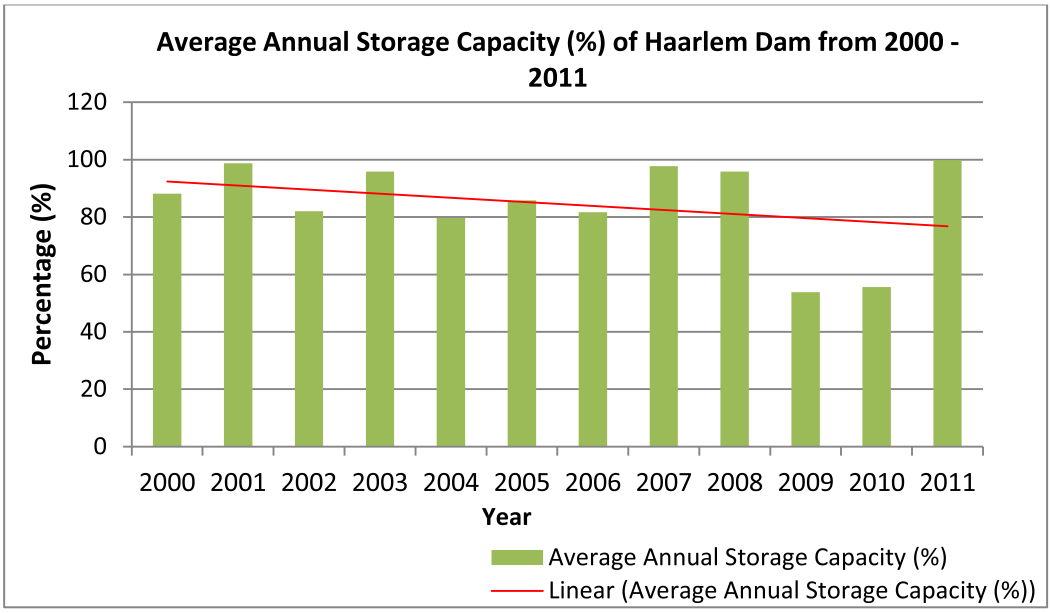


Figure 1.9: Water Availability (% FSC) 2000-2010: Haarlem, Uniondale (Barrett, 2012)

1.1.2 Profile of drought-affected area – alignment with the Gouritz Water Management Area (WMA)

The areas reporting both agricultural and urban impacts associated with diminished rainfall in 2008-2009 are situated primarily within the Gouritz Water Management Area (WMA) (Figure 1.10). This constitutes the largest WMA in the Western Cape Province, with a total surface area of 53,139^2 km (RHP, 2007(ii)). It is also characterised by two main climatic regions - an arid Karoo zone drained by the Gouritz River, as well as a narrower coastal belt south of the Outeniqua Mountains, with annual rainfall ranging from below 200mm to more than 1,000mm (Statistics SA, 2010).

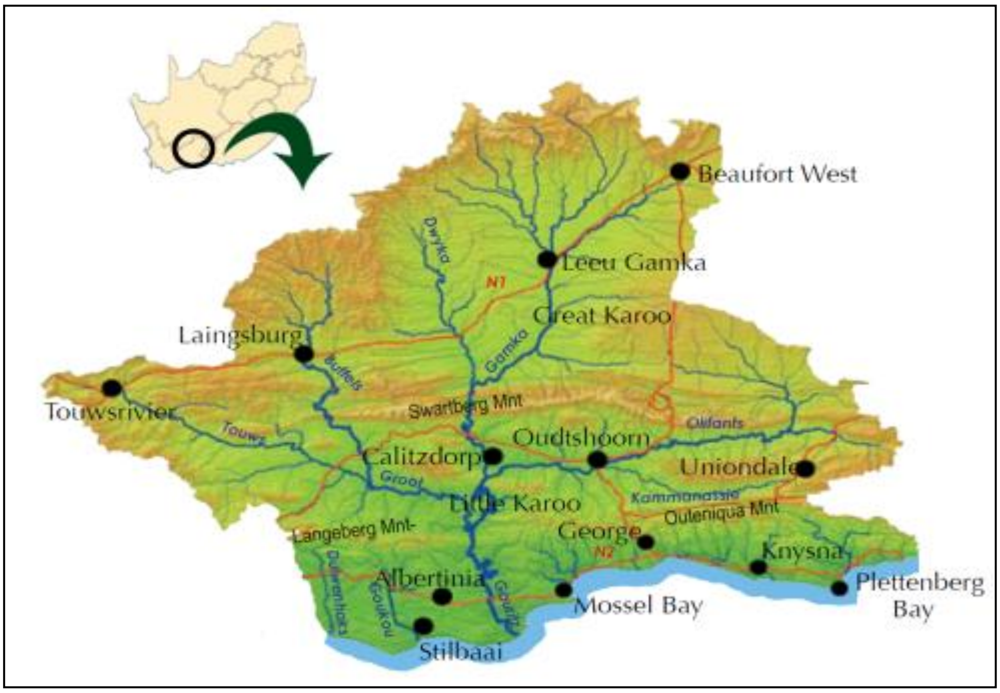


Figure 1.10: Gouritz WMA (RHP, 2007: ii)

By 2005, studies on available water within the Gouritz WMA and its utilisation already indicated an ongoing annual shortfall of 64 million m^3 water, of which 43 million m^3 were specifically attributed to water supply/usage imbalances in the eastern parts of Southern Cape (DEADP, 2011:281). As the Gouritz WMA is a closed basin, with 65% of all water availability from surface flows, it is especially vulnerable to episodes of reduced rainfall. This particularly applies to agriculture, given that 61% available water within the WMA is used for irrigation.

A detailed study of the Gouritz WMA's southern coastal belt extending from Stilbaai to Knysna (including Hessequa, Mossel Bay, George and Knysna) specifically highlighted the water supply challenges facing this area. This report identified a 'substantial demand for new housing developments, holiday residential estates and golf course estates, which has resulted in increased water requirements' (DWAF, 2007:60). The same report noted that towns within the coastal belt were experiencing 'serious periodic water shortages, mainly because of inadequate resources and insufficient capacity of their bulk supply infrastructure' (DWAF, 2007:ii).

Such conditions, documented well in advance of the 2008-2009 meteorological drought, signalled the WMA's marked vulnerability to reduced rainfall. They particularly applied to areas dependent on irrigated agriculture and robust grazing for livestock, as well as those characterised by recent urban growth, but with limited reservoir capacity.

Figure 1.11 illustrates the geographic extent of the areas affected by the 2008-2010 meteorological drought, reflecting the municipalities officially classified as drought-affected. It represents funding allocations across all spheres of government as well as the substantial contribution from PetroSA.

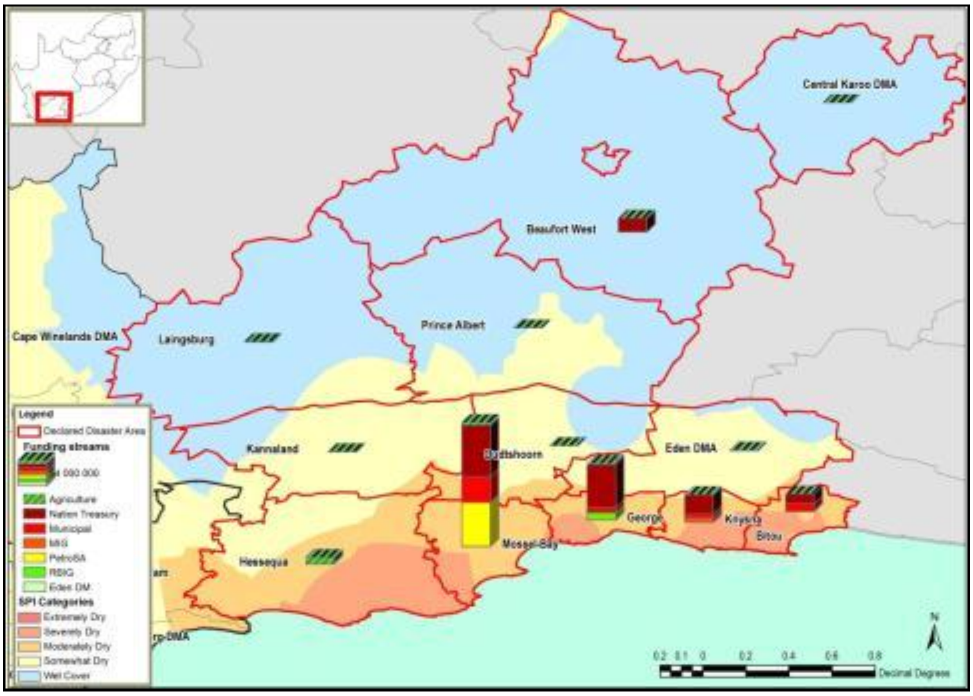


Figure 1.11: Municipalities classified as drought-affected, and associated SPI values (January 2009 – December 2010) with funding allocations for urban water supply infrastructure and agriculture

1.1.3 Development context for this study

There are three important risk drivers that are central to the 2008-2009 meteorological drought. They include climate variability, accelerated urban development (particularly in the coastal municipalities), and more proximal drivers associated with the global economic downturn (2008-2009) followed by FIFA World Cup (2010). These were identified recurrently through the course of the research as key contributory factors that intensified exposure to drought conditions and susceptibility to adverse impacts. They are also consistent with prevailing views on contemporary drought risk management, that recognise that the impacts of meteorological drought can be only 'partly attributed to deficient or erratic rainfall, as drought risk appears to be constructed over time by a range of drivers' (UNISDR, 2011:54).

Climate variability constituted a major contributory factor to the causal chain of effects that drove vulnerability and sensitivity to drought. From 2003-2008, six intense cut-off low systems passed through many of the areas that subsequently were drought-affected, bringing heavy rainfall and costly flood losses estimated at approximately R 221.6m (DiMP, 2010:84). For instance, agricultural losses sustained from two cut-off lows three weeks apart in **August 2006** exceeded R 103m (DiMP, 2010:86). These costs undermined agricultural capacity to withstand an even more damaging cut-off low in **November 2007** that resulted in agricultural losses of R 111.6m (ibid). For farmers in the Langkloof specifically, the November 2007 cut-off low resulted in widespread damage to and destruction of their farm dams. This loss of on-farm storage severely compromised the affected farmers' capacities to manage the **2009-2010 hydrological drought** that followed from the 2008-2009 meteorological drought.

While damage associated with the 2007 cut-off low compromised Langkloof farmers' capabilities to manage the 2009-2010 drought, study findings also indicate that the same weather system conferred protective benefits elsewhere. This specifically applied to water storage in the larger reservoirs, as well as enhanced recharge to groundwater, especially in rapidly growing municipalities such as George (Barrett, 2012).

Urban growth is also a recognised co-driver of hydrological drought (UNISDR, 2011:63) because it may generate water scarcity through increased demand under normal rainfall conditions as well as during meteorological drought episodes. The acute water shortages experienced in the Southern Cape municipalities illustrate the contributory role of increased water demand when it outpaces available supply.

Although accurate population statistics for the Southern Cape are still being updated, the area represents an important growth point, with Provincial Treasury reporting a population increase from 455,000–549,000 from 2001-2010 (Western Cape Provincial Treasury, 2010a:5). Such growth placed significant and recognised demands on municipal services, which (prior to 2009) had not been matched with expanded water supply infrastructure. This was despite acknowledgement of supply - demand imbalances by 2005 in almost all of the municipalities that were subsequently drought-affected. Unfortunately, rapid urban growth was not matched by conscious measures to reduce local water consumption, until advancing meteorological drought conditions in 2009 necessitated vigorous water demand management in the affected municipalities.

<u>Proximal economic drivers</u>

Meteorological and knock-on hydrological and agricultural drought conditions from 2008-2011 coincided with the global recession and the FIFA 2010 World Cup, hosted in South Africa. Although annual average economic growth across the Province for 2001-2009 was estimated at 4.3%, this dropped from 6.4% in 2007 to 4.3% in 2008 and below 0% a year later (Western Cape Provincial Treasury, 2010a:24). Similarly, the annual average growth rate for the Eden District Municipality declined from 8% in 2007 to 5.3% in 2008, and fell below 0% in 2009. This pattern was paralleled within the Central Karoo, with annual growth rates rising from 5.2% to 6% in 2007 and 2008 respectively, but then dropping precipitously to 0.2% in 2009 (Western Cape Provincial Treasury, 2010b:20).

These unfavourable economic conditions constituted an additional source of hardship for residents of the drought-affected areas of both the Central Karoo, and Eden District. They also constrained the range of possible financial responses available to mitigate the effects of reduced rainfall for farmers, as well as local businesses and affected municipalities.

Singly, each factor of reduced rainfall and economic recession constituted an intense shock to regional livelihoods. Economic growth rates fell to the lowest in more than a decade and annual rainfall dropped below 75% of the long–term mean in many areas. When coupled, these two processes together generated highly adverse conditions which constrained rapid recovery and which generated numerous 'knock-on' consequences (explained in more detail in Part VI).

This combination of effects is clearly illustrated by the experiences of orchard farmers located within the Langkloof area of the Eden District Municipality, who, only in 2011 reported 'recovery' from a sequence of events spanning 2007-2010. These included the effects of an intense hailstorm in 2006, destructive flooding in November 2007 (which destroyed farm dams and hence crucial water storage capacity) and subsequently reduced the 2009 harvest (due to the 2008 'hydrological drought' caused by the lack of dam storage). Adverse effects to production continued into 2010, partly attributed to unseasonal flowering in 2009 (due to higher temperatures earlier that year during a critical phenological stage of the fruit trees), which further compromised the harvest. These production losses, attributed partly to floods and also to drought, occurred simultaneously with the global, provincial and local economic downturn.

Such case examples illustrate the complexity of managing fast-paced economic, climatic and other threats that are generated at multiple scales, and that can be mutually reinforcing. Such complexity challenges the siloed or one-dimensional views on 'risk management' that are hazard-specific and assume a predictable causal chain.

1.1.4 Institutional arrangements for the research and terms of reference

This study, commissioned by the Provincial Disaster Management Centre (PDMC) of the Western Cape, seeks to provide a comprehensive review and analysis of the Western Cape drought that occurred in the Eden and Central Karoo Districts between January 2009 and January 2011.

Specifically, the research team was required to:

- conduct a comprehensive post-event study and analysis of the January 2009-January 2011 Western Cape drought
- produce a comprehensive written report reporting the findings of the study, including examination of technical and engineering interventions that alleviated its severity
- identify further research gaps and opportunities for studies on droughts, floods and water security, that could be incorporated into a 5-year strategic drought management plan.

This research was directed and guided by the PDMC's Directorate: Disaster Operations, through the leadership of the Deputy Director, Recovery. As with previous successful post-event studies, the research team worked closely with the PDMC to formulate a Project Steering Committee and to finalise the research methodology. During the course of the project, SU/DiMP met regularly with the Project Steering Committee to ensure satisfactory progress monitoring and to timeously address implementation concerns.

1.2 Conceptual Framework for this Study

1.2.1 Meteorological, hydrological and agricultural drought

The conceptual framework for this research was informed by prevailing approaches to drought as well as contemporary views on disaster risk management. Specifically, the research adopted the framework applied globally by the UNISDR and developed by the National Drought Mitigation Centre, University of Nebraska-Lincoln, USA (UNISDR, 2009a). This framework, illustrated in Figure 1.12, incorporates the concatenating consequences of reduced rainfall (meteorological drought), reflecting effects agriculturally, hydrologically and socioeconomically. However, as the study progressed, the research team was required to amend the framework in order to accommodate the contribution of crucial vulnerability drivers that caused drought risk conditions to accumulate and escalate before the emergency was detected (see Parts V and VI).

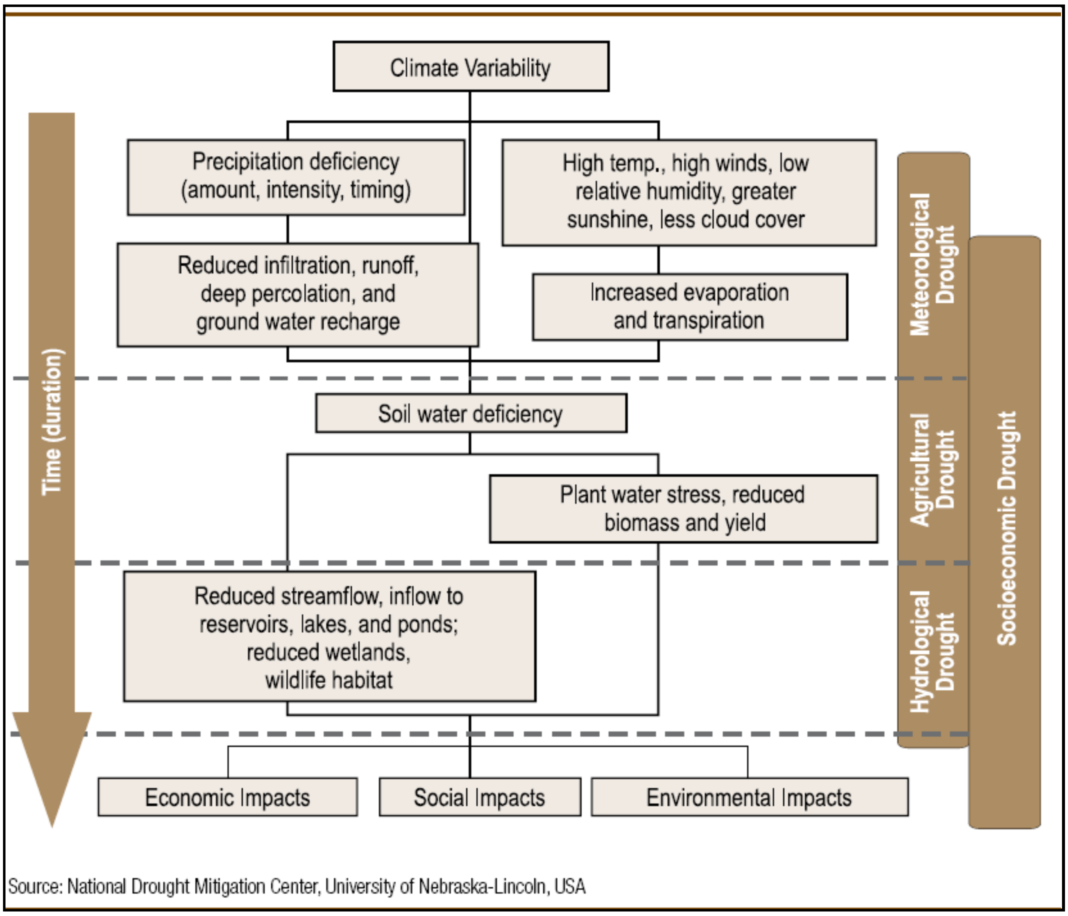


Figure 1.12: Relationship between meteorological, hydrological, agricultural and socio-economic drought (UNISDR, 2009a)

For the purpose of this research, the following definitions were applied, derived from UNISDR's (2011) *Global Assessment Report (GAR).* Specifically:

Meteorological drought refers to a precipitation deficit over a period of time.

Agricultural drought is indicated where soil moisture is insufficient to support crops, pastures and rangeland species.

Hydrological drought occurs when below-average water levels in lakes, reservoirs, rivers, streams and groundwater adversely affect non-agricultural activities, such as tourism, recreation, urban water consumption, energy production and ecosystem preservation (UNISDR, 2011:57).

The study was also guided by current definitions applied in a recent Water Research Commission publication by Schulze *et al*., (2011), citing UNDP, (2004) and Schmidt-Thomé (2006) that defines *hydrological drought* as a "substantial reduction in streamflow, i.e. of surface and subsurface water resources, in a specified area, again when compared with long-term expected conditions" and *meteorological drought* as a "reduction in rainfall supply over an extended period (from months to years) compared with the long-term average expected conditions". It also sought to incorporate current approaches to agricultural drought management advanced by the Department of Agriculture, provided below. Specifically, the research team sought to characterise the drought's main meteorological, hydrological, agricultural and socioeconomic effects for the areas identified as affected.

"**Drought:** This is a prolonged, abnormally dry period when there is insufficient water for users' normal needs. Agriculture suffers first and eventually everyone feels the impact. No definition of drought is all-inclusive."

"**Disaster drought:** A farming condition where production and the availability of natural and cultivated pastures, fodder production and the water supplies in a specific area have deteriorated to the extent where the natural agricultural resources and livestock production are seriously affected and where livestock mortalities are expected to occur if livestock numbers are not further drastically reduced and survival rations supplied to the remaining animals.

A disaster drought is the result of absolutely abnormal unfavourable climatic conditions, of which subnormal rainfall over one or more rainy season(s) is the major casual factor, (broadly defined as less than 70% of normal precipitation).

It must be obvious that a disaster drought condition is not the result of exceeding the long-term grazing capacity and/or carrying capacity of an area or a farm, and that a timely, gradual stock reduction, as the condition deteriorates, has been applied to the situation where no further feed reserves are available"…

"**Agricultural drought:** Agricultural drought occurs when there is not enough soil moisture to meet the needs of a particular crop or grazing at a particular time."

"**Socio-economic drought:** Socio-economic drought (sometimes called famine drought) occurs when the demand for economic goods exceeds supply as a result of a weather-related shortfall in water supply."

Source: Department of Agriculture (2008). Agricultural Drought Management Plan (ADMP): A discussion document. Pp. 55-56.

Box 2: Examples of drought definitions outlined in the Agricultural Drought Management Plan (2008)

1.2.2 Managing risks of urban water scarcity in a variable climate

While drought has typically been viewed as a rural, agricultural concern due to its adverse effects on rain-fed agriculture, the acute water shortages experienced in Beaufort West and the coastal towns of the Southern Cape could not be attributed only to atmospheric conditions. Rapid urban growth along the Garden Route had markedly increased water consumption, placing additional demands on existing water supplies. During the course of the study, it became clear that limited water availability in many urban areas was due both to increased local demand as well as to reduced rainfall. This required reconceptualising the framework presented in Figure 1.12 to include inadequate urban water demand management as a key *vulnerability factor* that amplified the *risk* of acute water shortages during meteorological hazard conditions.

In this context, and specifically related to the acute urban water shortages experienced, the study was informed by the established disaster-risk literature. This argues that any level of *disaster risk* faced by a household, community or area is shaped by *both* hazard and vulnerability conditions, and can be understood as "*the likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery*" (IPCC, 2012:558).

1.3 Temporal Focus of the Study

Although the study terms of reference specifically refer to a two-year drought (from January 2009-January 2011), the research team extended the time-frame back to 2007 for analytical reasons. Evidence gathered from meteorological data and field research indicated that drought-risk factors could be traced as early as November 2007, and even earlier to 2006 in the case of agricultural impacts.

Specifically:

- Rainfall data provided by the South African Weather Services (SAWS) showed evidence of reduced rainfall in the latter months of 2008 in both the Central Karoo and eastern areas of the Eden District Municipality. This was assumed to generate lagged impacts on ground and water availability in 2009.

- Field research findings in November 2011 indicated that some farmers noted drought duress as early as 2008, while others attributed their increased drought vulnerability to severe weather/flood damage that occurred in 2007.

- Field research, combined with a review of dam storage levels, indicated a widely shared view that the drought in Eden was not over until heavy rains in June, 2011.

- As noted earlier, the Gamka Dam in Beaufort West only began to refill in June 2011, from being recorded as totally empty in September 2010.

The January 2009 interventions to address severe water shortages in Sedgefield are widely viewed as the starting-point of the two-year drought response operation. However, these actually represent reactive 'emergency responses' to hydrological drought impacts that can be traced to moderately diminished rainfall in 2008. In addition, even prior to 2008, there was evidence of escalating water consumption in some areas, traceable to 2000, and associated with urban expansion. As this constituted a relevant risk factor for later urban water shortages, the research team extended the time-frame to 2000 in selected sites, to investigate possible risk accumulation factors such as variable rainfall and rising water consumption.

1.4 Methodology

1.4.1 Overview

The spatial and temporal scales of the drought, along with its diverse rural and urban impacts, necessitated a complex research methodology. The research team acknowledged the importance of an approach that was sufficiently robust to accommodate both quantitative measures of rainfall deficit at district and municipal scale as well as 'knock-on' social consequences over time. Moreover, recognising the drought's wide-ranging effects, its protracted time-line and numerous, 'knock-on' consequences, the geographic scope of this research extended across the Gouritz WMA. As a result, the methodology incorporated a wide range of data sources, as well as qualitative and quantitative research methods.

Significantly, the research involved four distinct phases:

Phase I (October-November 2011) involved key informant interviews, collection of relevant reports and review of official documentation related to the management of the drought. It also included the completion of a DRS MPhil research project on the water emergency in George.

Phase II (November-December 2011) included extensive primary data gathering across the Eden and Central Karoo District Municipalities. This identified important issues and themes that were subsequently investigated through additional data sources.

Phase III (December 2011-February 2012) involved detailed further investigation of the themes identified in field research and the causal chains that traced drought hazard condition and exposure through to recorded impact. This phase was also reflected by in-depth analysis for the three 'sentinel sites' selected to represent livelihood zones with differing drought exposures. Geospatial representation of dam and agricultural impacts was undertaken during this stage.

Phase IV (February-April 2012) involved integrating all findings and generating a consolidated report.

1.4.2 Methodological innovation: selection of sentinel sites for in-depth analysis

The research process involved complex data-handling due to the disparate datasets provided by six municipalities and two provincial departments at local and provincial scales and reconciling these with agrometeorological data provided at national scale. While geospatial representation of some data was possible at provincial or district scale, this did not afford insights into chains of cause and effect that led to social impacts at local level. Nor did it allow for 'drought impacts' in one area to be connected with sequential impacts in another location. This was illustrated by the movement of casual labour from the Langkloof to George in 2009-2010 due to limited work opportunities in drought-affected orchards. In addition, geospatial analysis of the 2008-2010 meteorological drought did not automatically enable causal associations between other weather extremes (such as cut-off lows) that drove the risk of acute water shortages due to collapsed farm dams. Revealing these chains of cause and effect generated valuable insights from post-event analyses.

The research methodology addressed this need for in-depth local analysis of differing drought exposures and impacts by incorporating a 'sentinel site' methodology for three localities: George, Beaufort West and Uniondale. Respectively located in the southern, northern and eastern areas identified as drought-affected, each represented a different livelihood zone and drought risk profile. In each site, a more detailed examination of historical rainfall, water consumption and the adopted risk management measures was undertaken. Figure 1.13 reflects the spatial extent of the area studied, highlighting the three sites where more detailed research was undertaken.

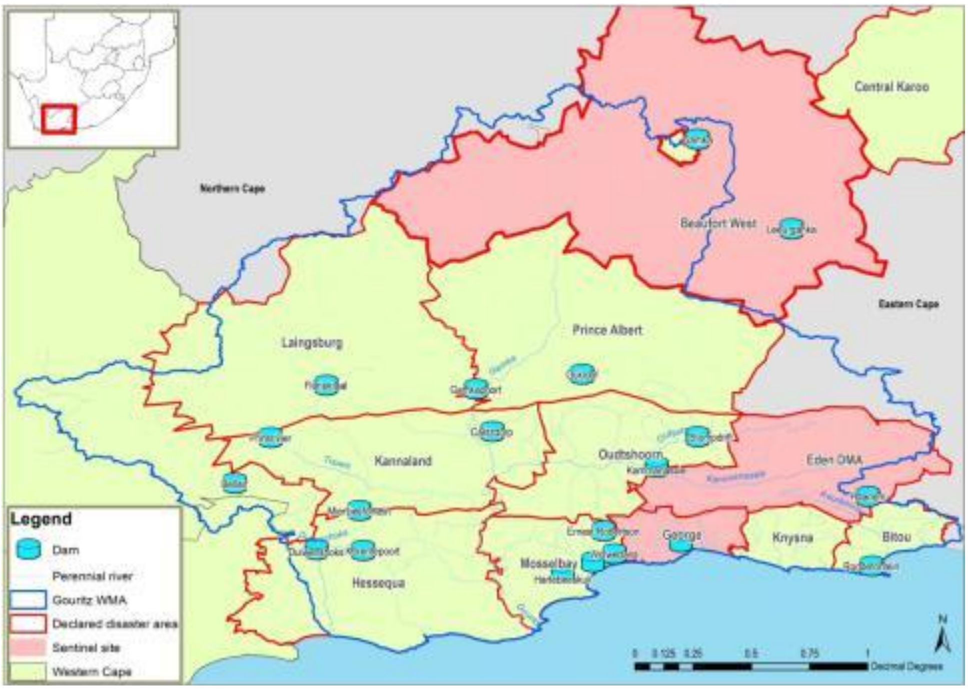


Figure 1.13 Areal extent of the 2009-2011 drought study, with outline of the Gouritz WMA (blue boundary) and three sentinel sites (Beaufort West, the former Eden DMA and George Municipality)

1.4.3 Further innovation: development and application of a *risk progression* analysis framework

The research team also developed and applied a *risk progression* framework that systematically classified the advancement and de-escalation of the drought over time. This staging incorporated the largely unrecognized risk accumulation phase until 2008, which was characterised by increasing water demand and, from 2008, declining rainfall. It also acknowledged a risk 'de-escalation' phase that emerged in 2011, and that was reflected by restoration of normal rainfall and improved demand management. Each risk progression stage combined three identifiable indicators – a drought hazard severity indicator (i.e. SPI), an impact indicator (i.e. dam level as % FSC) and capacity indicator (i.e. implementation of demand management measures). The stages were also aligned with gazetted local disaster declarations (Annex 2), as these constituted the legal instruments that activated access to government relief.

1.4.4 Composition of the research team and field research component

The scope of the research required a skilled trilingual team (English, isiXhosa, Afrikaans) with experience in post-disaster impact assessment, capacity to work across the biophysical and social vulnerability disciplines and who had knowledge of the policy frameworks that guide disaster risk management in South Africa. The research team consisted of nine people. These included five disaster risk researchers, a community resilience specialist, a senior hydrometeorological adviser and a disaster loss analyst. Altogether, 32 person-days were spent in the field, primarily in the Eden and Central Karoo District Municipalities.

1.4.5 Data collection

1.4.5.1 Secondary data sources

A wide range of secondary data sources was drawn upon in the course of the research. These included:

- The South African Weather Services (SAWS) for precipitation data and 1-24 month SPI values for 2010, 2009, 2008
- Department of Water Affairs (DWA) for reservoir data
- Agricultural Research Council for Normalized Difference Vegetation Index (NDVI), Percentage of Average Seasonal Greenness (PASG) and rainfall data
- Provincial Departments of Agriculture, Human Settlements, Social Development
- Local and District Municipalities in the affected areas
- Local and provincial newspapers and electronic media; industry newsletters for insights into dates and locations of occurrences.

1.4.5.2 Data collection of drought impacts

An extensive process was undertaken to collect, compile and integrate the indirect and direct impacts that were identified as drought-associated. This was undertaken through in-person and telephonic interviews, as well as through the detailed review of drought reports provided by government and nongovernmental informants. Although the research team compiled numerous anecdotal reports of hardship and loss consolidated information on livestock losses or diminished crop yields was, regrettably, difficult to obtain. All farms that were allocated agricultural relief were georeferenced to municipal scale to show the spatial distribution of assistance for agriculture between 2009 and 2011.

With specific respect to tracking the progression of hydrological drought conditions, the research team drew heavily on secondary data sources. This was due to the drought's spatial extent across two district municipalities (including 84 quaternary catchments alone in the Eden District) and temporal scope from 2008-2011. Fortunately, the research team was able to draw on reports compiled by the DWA's Hydrology Section in George, as well as those provided by the Eden District Municipality. These reports, along with those provided by Beaufort West's municipal engineer, reflected changes in river flow volumes, as well as groundwater supplies (Beaufort West). Similarly, the research team traced the reduction and replenishment of available water storage in selected reservoirs prior to and during the drought to identify factors that may have escalated or ameliorated water shortages.

1.4.5.3 Primary data collection methods in affected areas

Primary data were collected through semi-structured interviews, and focus group discussions in the affected areas. Those interviewed included representatives of governmental entities, such as municipalities affected by acute water shortages that received governmental assistance. They also involved farmers who requested but did not receive agricultural assistance and representatives of civil society organisations who provided food relief to unemployed farm labourers whose livelihoods also came under pressure.

Altogether, this involved more than 80 interviews and discussions in the field, specifically including:

- affected commercial and emerging farmers across the Eden and Central Karoo Districts
- local government officials, such as disaster managers, municipal managers and engineers
- low-income households in affected towns within the Central Karoo
- representatives of local business groupings, nongovernmental organisations and irrigation boards
- other governmental professionals, including: clinic sisters, school principals, community development workers.

Qualitative information regarding the impacts of the 'drought' was obtained using stakeholder focus group discussion sessions, individual interviews as well as extensive desk-top surveys of existing literature, including municipal records and research reports. During two weeks of intensive field research followed by several months of follow-up telephone calls over, one hundred interviews were conducted with a diverse range of stakeholders, from farmers to local businesses, scientists to community members, recording both factual information and anecdotal evidence. In this way casual chains became evident, providing deeper insights and clearly illustrating the interconnectedness of impacts and the knock-on consequences of the water crisis over time and space.

1.5 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 representatives of specific organisations.

1.6 Limitations of Research

Although every attempt has been made to accurately document the 2009-2011 drought, it was impossible to consult with all those affected. Similarly, given that risk factors which intensified the impact of reduced rainfall were already accumulating well in advance of 2009, it was simply not possible to document the event in depth. In addition, the research team recognises that this report does not address all areas that were drought-affected, including those in the Eastern Cape.

A major challenge for this research was the non-uniform usage and diverse interpretations of the term 'drought'. While 'drought' has been widely used in agriculture, it has been less frequently applied in urban settings. The research team found numerous instances where limited water availability was reframed as 'drought' rather than as 'water shortage' or 'water scarcity'. In addition, there was a limited appreciation that low reservoir levels did not represent a 'warning of impending drought', but rather trailing indicators of reduced rainfall a year earlier (often combined with the lagged effects of high water demand).

A further limitation in this report is the absence of detailed indirect and secondary losses that could be directly attributed to the drought and associated urban water shortages. For instance, although the agricultural sector came under sustained pressure, records of stock losses and reduced crop yields could not be obtained. Similarly, the drought's coincidental occurrence with the global economic recession meant that attribution of hardship during this period to atmospheric conditions alone is not tenable.

The challenge of this study, then, was to acquire adequate and sufficiently robust quantitative data in order to substantiate 'stories' or hearsay recorded in the field. For example, it was extremely difficult to find evidence of the social impacts of the drought. The research team, apart from undertaking intensive field studies among communities in the Beaufort West and the Oudtshoorn areas, also interviewed service providers who had provided social relief during the water-stressed period, but who unfortunately had not kept adequate records or drafted detailed reports. Insights gleaned from these interviews and brief reports, although providing evidence of social impacts, failed to capture the true or unequivocal extent of household-level hardships and the knock-on consequences for these households subsequent to the drought.

Such constraints also applied to reproducing the institutional links that either enabled or limited an effective response. This may have resulted in unintended misinterpretation of the information collected.

1.7 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 risk context for the drought, specifically the accumulation of rainfall deficits, dam levels and vegetation changes recorded from 2009-2011. This section will also incorporate relevant information related to the economic recession, which coincided with the drought.

Part III addresses the institutional arrangements related to the drought, specifically institutional capacities for risk reduction and emergency management.

Part IV focuses on specific response made by municipalities and the Provincial Department of Agriculture.

Part V elaborates the risk factors that contributed to the drought's severity.

Part VI describes reported and documented impacts associated with the drought, but which were exacerbated by other risk factors.

Part VII recommends directions for change – with a specific emphasis on urgent implementation priorities, conclusions and recommendations

Accompanying annexes provide examples of data-collecting instruments and summary tables, as well as a list of people contacted.

PART II: DROUGHT RISK CONTEXT

2.1 Overview

Although the distinctions between agricultural, hydrological and meteorological drought are well-documented (UNISDR, 2009a:8), field research for this project indicated uneven understanding of these different drought forms. Moreover, findings from interviews indicated limited appreciation that diminished rainfall (i.e. 'meteorological drought') in a preceding year actually served as an 'early warning' for lagged hydrological drought and associated water shortages in the following year.

This chapter begins by introducing the Standardised Precipitation Index (SPI), which the World Meteorological Organisation (WMO) adopted in 2009 as the global standard to measure meteorological droughts (WMO, 2009a). It continues by describing the meteorological drought, along with its magnitudes for 2008, 2009 and 2010, spatially represented by the SPI and percentage of annual rainfall. Due to the drought's widespread impacts on agriculture, the chapter then provides maps that represent the PASG values for the same period. Also recognising that hydrological drought is often a follow-on impact from reduced rainfall, river flow and reservoir levels in selected areas are presented. In addition, this section revisits the regional forecasts provided and climate advisories issued by the Department of Agriculture, Forestry and Fisheries (DAFF).

The chapter concludes by presenting information on local economic performance in the drought-affected areas from 2000-2007/8, and subsequent contraction associated with the global economic recession in 2008-2009.

2.2 Meteorological drought – application of the SPI

2.2.1 Introducing the SPI

The SPI is an index based on the likelihood of rainfall for any time scale using the long-term rainfall record. This means that a continuously negative SPI signals the beginning of a meteorological drought, while a positive SPI indicates that the meteorological drought has ended (WMO, 2009b). The SPI "compares rainfall over a period – normally 1-24 months – with long-term mean precipitation at the same location" (Guttman, 1994; Edwards and McKee, 1997; in UNISDR, 2011: 58). Calculation of SPI values for a particular location generally requires at least 20-30 years (preferably 50-60 years) of monthly rainfall data for that site.

The values adopted by the SAWS are shown in Table 2.1.

Table 2.1: Drought Probability, using the SPI (Source: SAWS)

SPI Value	Dryness Category	% Time in Category
> 0	Wet	50
- 0.99 to 0	Mild dryness (somewhat dry)	34.1 (3 yr return period)
- 1.49 to – 1.0	Moderate dryness (moderately dry)	9.2 (10 yr return period)
- 1.99 to -1.5	Severe dryness (severely dry)	4.4 (20 yr return period)
≤ - 2.0	Extreme dryness (extremely dry)	2.3 (50 yr return period)

Table 2.2 provides an example of applying the SPI to one location, over different time-periods (in this instance, Beaufort West).

Table 2.2: Example of applying the SPI to one location (i.e. Beaufort West)

A specific SPI value, like ...	... is comparable to...
a 'moderately dry' 6-month SPI for July-December 2008 in Beaufort West	9-10% of the lowest rainfall values recorded for all July-December periods in Beaufort West (over the past 50 years or more)
a 'severely dry' 12-month SPI for January-December 2008 in Beaufort West	4-5 % of the lowest rainfall values recorded for all January - December periods in Beaufort West (over the past 50 years or more)
an 'extremely dry' 24-month SPI for January 2008-December 2009 in Beaufort West	2.3 – 2.5% of the lowest rainfall values recorded for all 24-month January - December intervals in Beaufort West (over the past 50 years or more)

2.2.2 SPI Values in the 2008–2010 drought

Figures 2.1 to 2.3 present the annual SPI determinations for the Western Cape from January-December from 2008 to 2010. These show that the eastern areas of the Western Cape were already **moderately dry** during 2008, and experiencing 12-month meteorological drought conditions comparable with a **ten-year return period**. Reduced rainfall in 2009 intensified these pre-existing meteorological conditions, resulting in **extremely dry** conditions associated with a **50-year return period** in Hessequa, Mossel Bay, George, Knysna and Bitou.

During 2010, moderate to severely dry conditions were also indicated for the south-western tip of the continent, primarily affecting the Overberg District Municipality.

Figure 2.1: SPI values: January-December 2008, Western Cape
(Data Courtesy of SAWS)

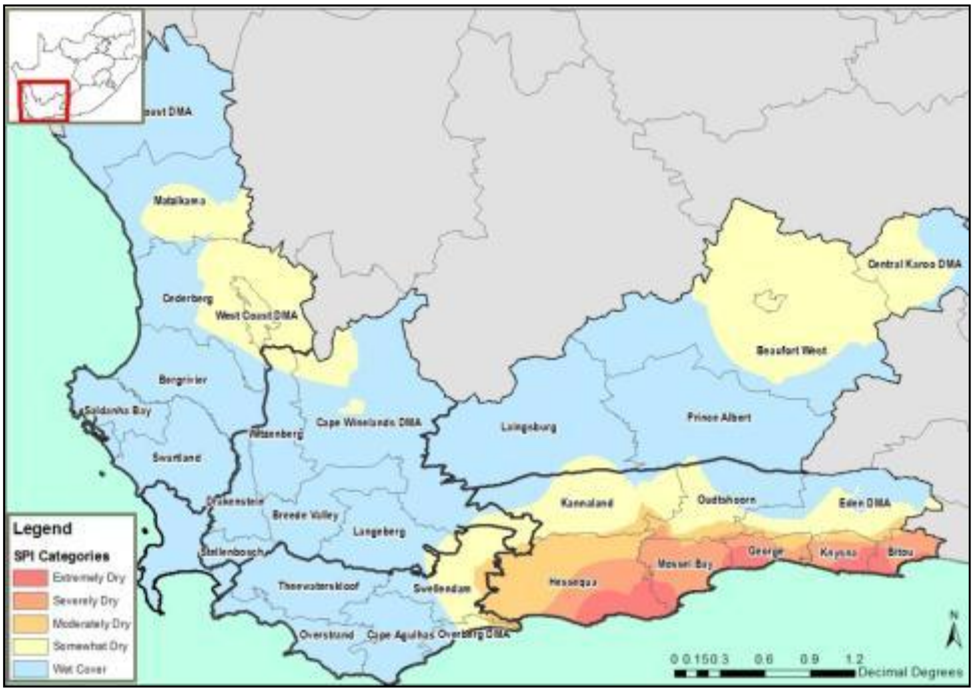


Figure 2.2: SPI values: January-December 2009, Western Cape (Data Courtesy of SAWS)

Figure 2.3: SPI values January-December 2010, Western Cape (Data Courtesy of SAWS)

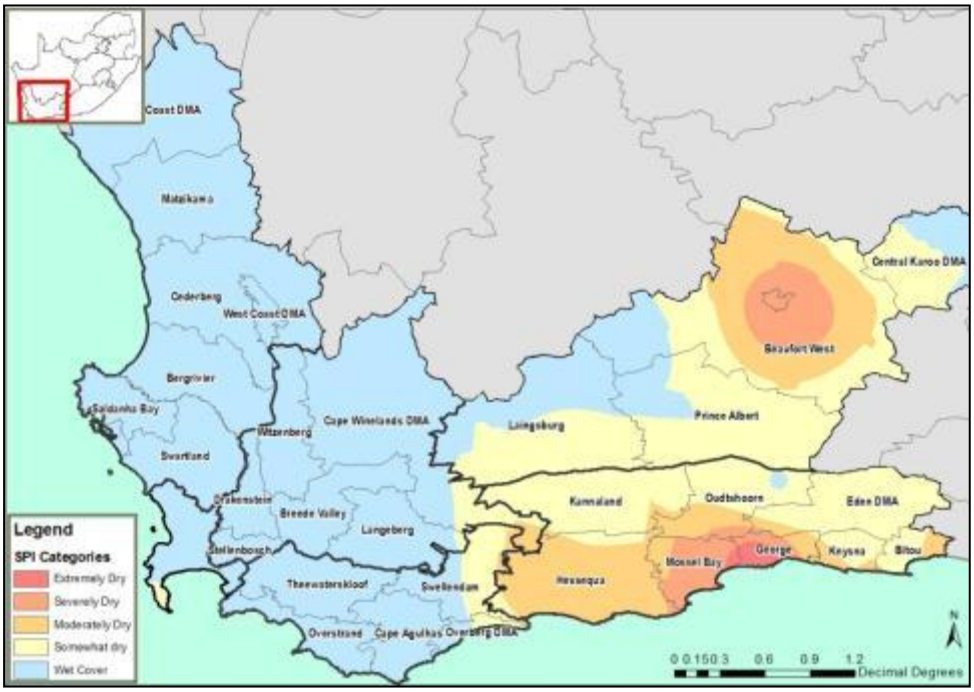


Figure 2.4: SPI values: January 2008-December 2009, Western Cape
(Data Courtesy of SAWS)

When 24-month SPI values are spatially represented for January 2008-December 2009 and January 2009-December 2010 (Figures 2.4 and 2.5), it is clear that several municipalities sustained prolonged severe to extreme dryness. For instance, parts of the Central Karoo, along with George and Mossel Bay local municipalities, recorded either severe or extreme dryness over a two-year period spanning January 2008 and December 2009.

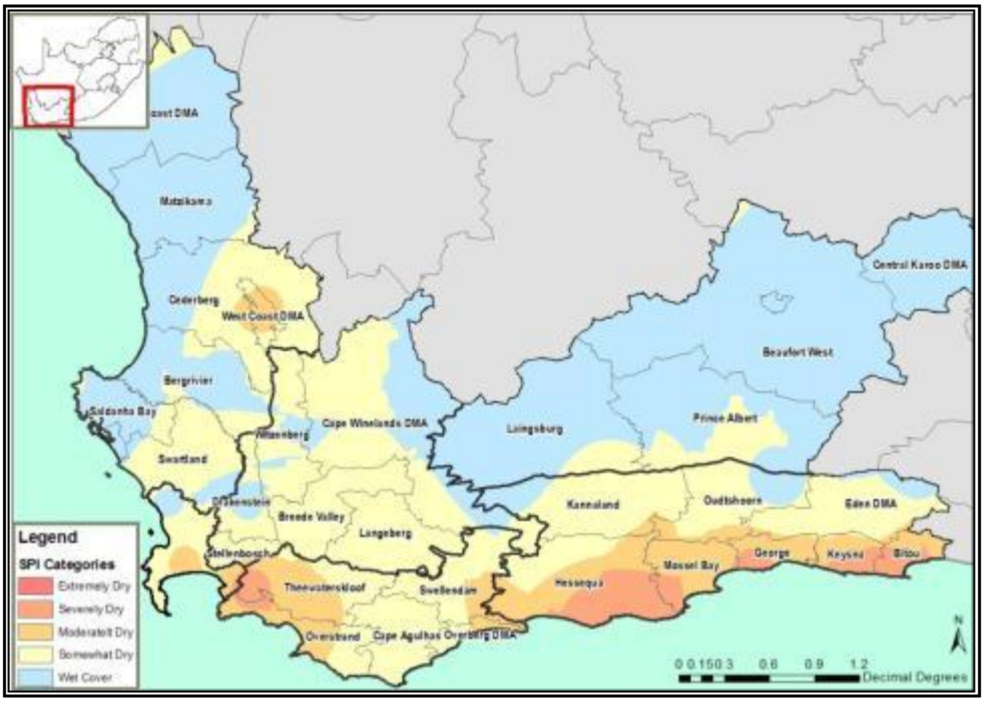


Figure 2.5: SPI values: January 2009-December 2010, Western Cape
(Data Courtesy of SAWS)

Given the very limited availability of water resources within the Gouritz WMA, this sustained period of significantly reduced rainfall generated both immediate and lagged effects on agriculture, as well as ground and surface water.

The SPI values for 2008-2010 are consistent with rainfall distributions reported over this period. Figures 2.6 to 2.8, directly accessible from the Agriculture Research Council's (ARC) '*Umlindi*' (*The Watchman)* website (www.arc.agric.za), indicate that rainfall values between 50-75% of the climate mean were recorded in many Western Cape areas subsequently identified as drought-affected.

Figure 2.6 (1 July to 31 December, 2008) shows diminished rainfall (shaded in yellow) in the eastern districts of the Western Cape, while Figure 2.7 (1 January to 31 December 2009) indicates that annual rainfall totals represented only 50-75% of the climate mean for the Southern Cape coastal municipalities. Figure 2.8 for January-December 2010 highlights improving rainfall patterns for the Southern Cape from the middle of that year as well as reduced annual rainfall for the Overberg District Municipality.

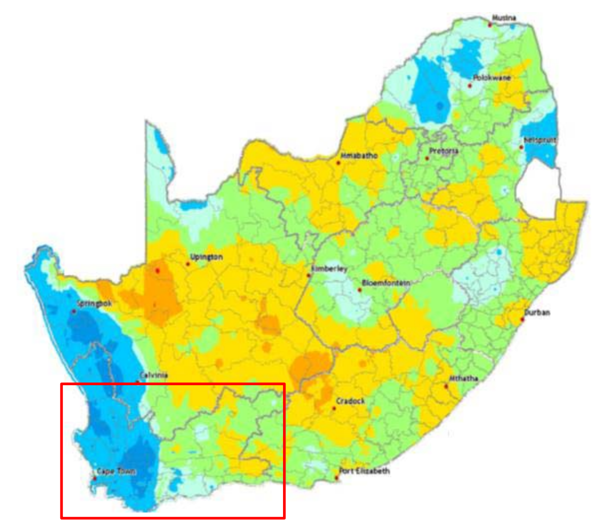


Figure 2.6:Total rainfall (% of long-term mean): 1 July-31 December 2008 (ARC, 2009: 9)

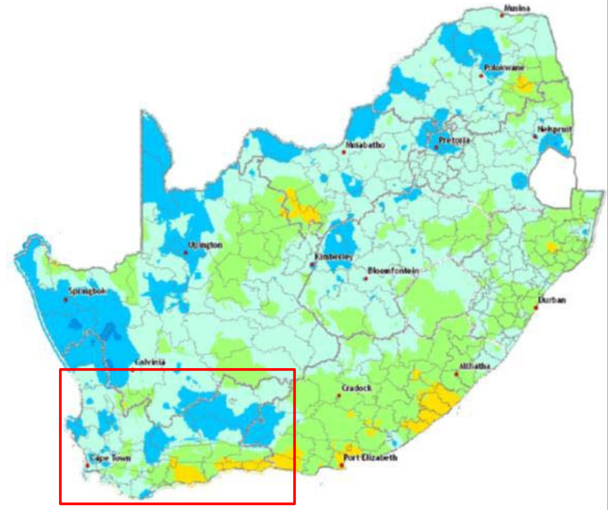


Figure 2.7:Total rainfall (% of long-term mean): 1 January-31 December 2009 (ARC, 2010: 11)

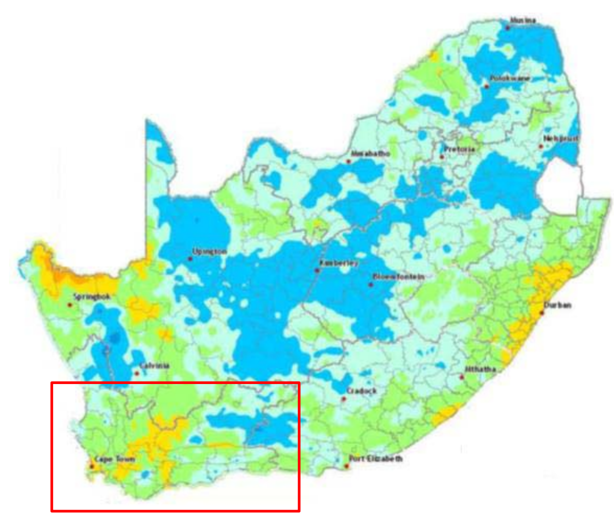
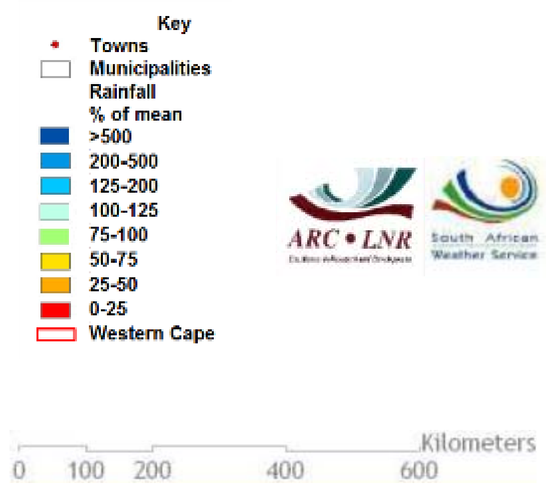


Figure 2.8:Total rainfall (% of long-term mean): January-December 2010 (ARC, 2009:1)



Key, scale bar & copyright holders for Figure 2.6 to 2.8

The duration and intensity of reduced rainfall from 2008 to 2010 is further indicated in Table 2.3. This reflects annual rainfall, sourced from the SAWS and the Beaufort West Municipality (Gamka Dam Station) from 2000-2010/11 respectively for Uniondale, George and Beaufort West. Rainfall findings suggest three years of successive dryness for Beaufort West and Uniondale, with the Gamka Dam Rainfall Station recording only 72.9%, 82.9% and 64.0% of annual rainfall respectively in 2008, 2009 and 2010. George also recorded 80.6% and 52.8% of its mean annual rainfall for 2008 and 2009.

It is significant that Uniondale received extraordinary rainfall in 2007 (174% of its annual mean rainfall) which, in principle, should have conferred protective benefits in additional surface water storage. However, the rainfall intensity associated with the November 2007 cut-off low damaged and destroyed numerous farm dams, immediately increasing the damaging consequences of the moderate meteorological drought in 2008.

Recorded rainfall for two stations in Beaufort West also illustrate the challenges in managing climate risks, with adequate falls reported from the Stolshoek rainfall station located near to the town, but poor rainfall over the Gamka catchment (Beaufort West's actual water supply source that augments groundwater supplies).

Table 2.3: Annual Rainfall 2000-2010/11: George -Airport Station (SAWS Station), Uniondale and Beaufort West -Gamka Dam (Municipal rainfall station) and Stolshoek (SAWS Station)

Year	Uniondale Rainfall (0030219 W)		George Rainfall (Airport Station 0028748 W)		Beaufort West Rainfall (Gamka Dam)		Beaufort West Rainfall (Stolshoek KNP 0092541 A)	
	Rainfall (mm)	% Av. Rainfall 32 yrs	Rainfall (mm)	% Av. Rainfall 32 yrs	Total Rainfall (mm)	% Av. Rainfall 10 yrs	Total Rainfall (mm)	% Av. Rainfall 32 yrs
2000	573.5	104.8	710	101.1	-	-	391.7	123.8
2001	533	97.4	747	106.4	323.5	107.7	306.5	96.9
2002	633.5	115.8	561	79.9	358.8	119.5	412.6	130.4
2003	577.1	105.5	825	117.5	240.3	80	234.3	74
2004	586	107.1	753	107.3	359.9	119.8	238.9	75.5
2005	364	66.5	457	65.1	229.5	76.4	250.2	79.1
2006	802	146.6	871	124.1	314.0	104.6	337.1	106.5
2007	954	174.4	951	135.5	336.6	112.1	282.6	89.3
2008	**452.5**	**82.7**	**566**	**80.6**	**218.95**	**72.9**	**245.9**	**77.7**
2009	**416.5**	**76.1**	**371**	**52.8**	**249.0**	**82.9**	**296.4**	**93.7**
2010	**445**	**81.3**	**665**	**94.7**	**192.25**	**64.0**	**322.5**	**101.9**
2011	682.5	124.8	-	-	480.5	160.0	499.6	157.9
Average (mm)	***547.1***	***100***	***702***	***100***	***300.3***	***100***	***316.4***	***100.0***

2.3 Agricultural Drought

Internationally, 'agricultural drought' refers to conditions where 'soil moisture is insufficient to support crops, pastures and rangeland species' (Wilhite and Buchanan-Smith, 2005; UNISDR, 2009a). However, there are many local interpretations of agricultural drought, including *seasonal drought, periodic drought, disaster drought, green drought* and *false drought* (DoA, 2005).

Figures 2.9 and 2.10, representing PASG[2] for 2009 and 2010 respectively, indicate vegetation responses to diminished rainfall in those years. Markedly reduced vegetation activity in 2009 along the Southern Cape shown in Figure 2.9 is consistent with diminished rainfall represented in Figures 2.2 and 2.7 for 2009, and flagged as 'potential drought'.

Similarly, the PASG values represented in Figure 2.10 correspond with severely dry SPI values and reduced rainfall volumes recorded for the Overberg in 2010 (reflected respectively in Figures 2.3 and 2.8). This low vegetation activity was also identified as indicating 'potential drought'.

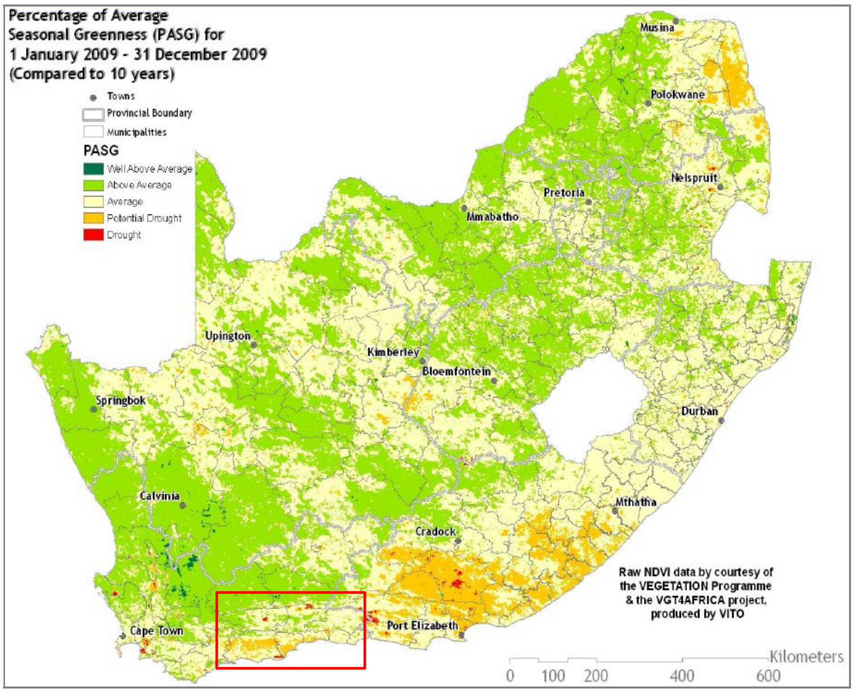


Figure 2.9: PASG 1 July-31 December 2009 (Compared to 10 years average)

[2] PASG is a measure of the accumulated seasonal greenness (NDVI ratio) up to a point, relative to the long-term, historical average of greenness for the same season. A PASG of 100% would suggest that vegetation conditions are normal relative to the long-term average (National Drought Mitigation Center, 2012)

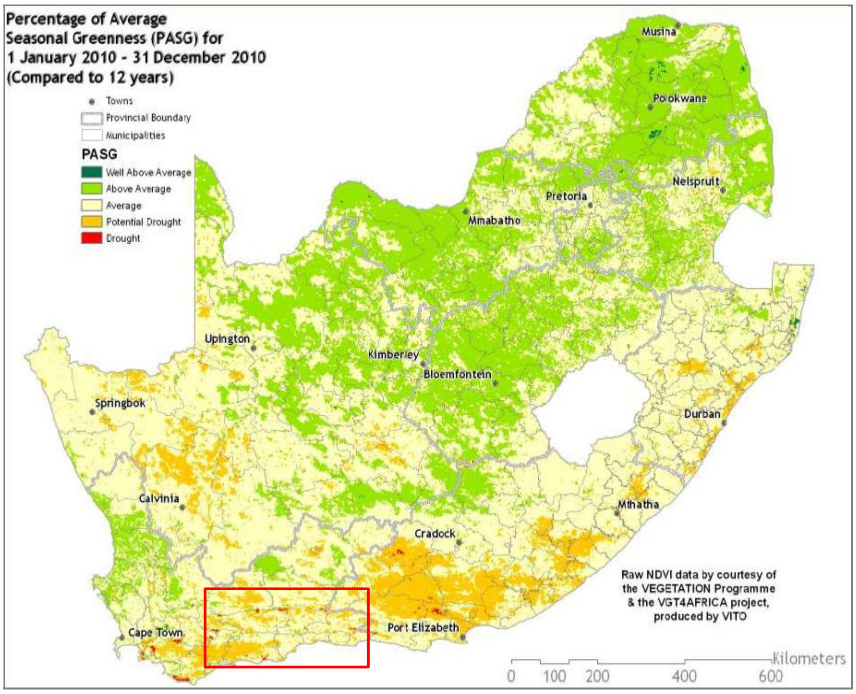


Figure 2.10: PASG 1 January–31 December 2010
(Compared to 12 years)

2.4 Hydrological Drought – or Demand-Induced Water Shortage?

2.4.1 Hydrological drought

'Hydrological drought occurs when below-average water levels in lakes, reservoirs, rivers, streams and groundwater, impact non-agricultural activities such as tourism, recreation, urban water consumption, energy production and ecosystem conservation' (UNISDR, 2011:57; after Wilhite and Buchanan-Smith, 2005; and UNISDR, 2009a).

While reduced rainfall (or snowmelt) (i.e. a meteorological drought) is a prerequisite for subsequent hydrological drought conditions, there are other non-meteorological factors that reduce ground and surface water availability. For instance, rapid urban growth and economic development are recognised drivers of increased water consumption (UNISDR, 2011:63) which, independent of meteorological drought conditions, usually reduce water availability. Increased water consumption, which results in lower than normal available storage, also heightens local vulnerability to subsequent meteorological drought episodes.

2.4.2 Hydrological drought – river flow indicators

Figures 2.11 and 2.12 indicate flows for the Knysna and Keurbooms Rivers, and related recorded monthly and cumulative volumes (maroon shading) with mean recorded flows for these rivers (turquoise shading). They suggest that cumulative 2009 river flows of $10m^3 x10^6$ recorded for Knysna were 63% lower than average flows of $27m^3 x10^6$. This was more marked in the case of the Keurbooms River which supplies Plettenberg Bay, where cumulative 2009 river flows of $20m^3 x10^6$ were 75% lower than average recorded flows of $80m^3 x10^6$.

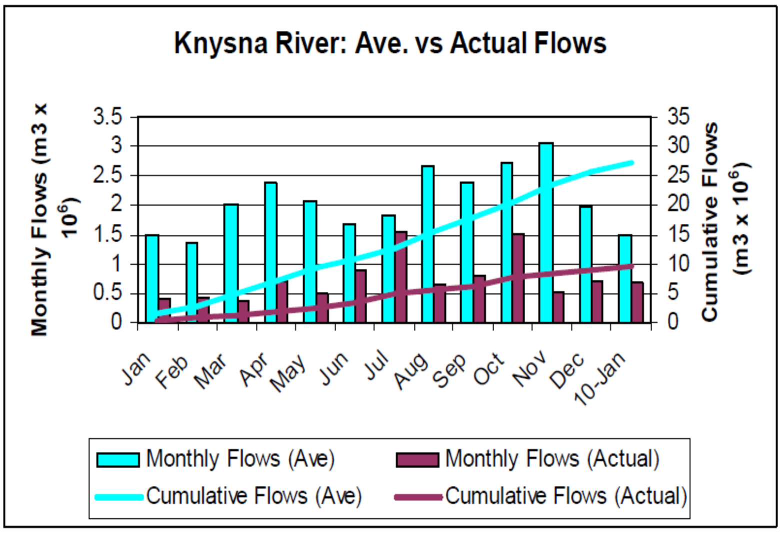


Figure 2.11: Monthly and cumulative annual flows 2009, compared to average flows: Knysna River (du Preez, 2010)

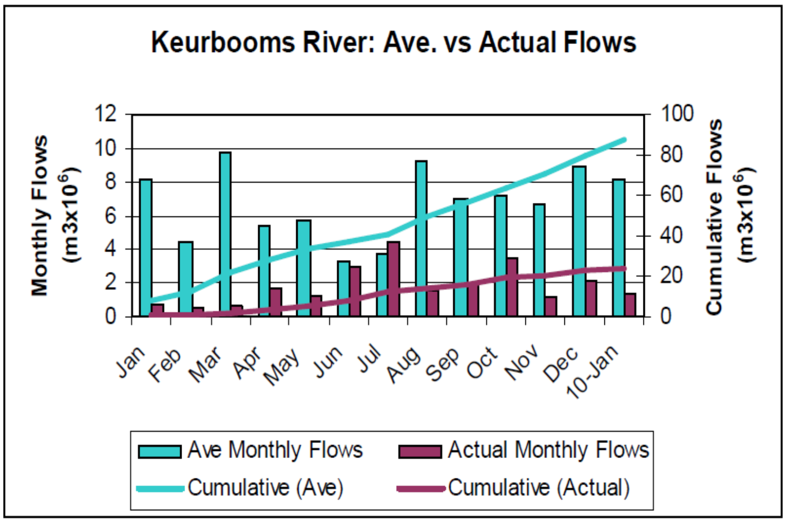


Figure 2.12: Monthly and cumulative annual flows 2009, compared to average flows: Keurbooms River, Bitou Municipality (du Preez, 2010)

2.4.3 Indicative storage levels – Garden Route, Gamka and Haarlem Dams

The drought-buffering role of water storage capacity was repeatedly underlined throughout the course of the research. However, there were differing views on the reason for declining water availability. For instance, in George and Mossel Bay, falling water levels that prompted local disaster declarations in November 2009 were *initially attributed to climatic conditions*. Subsequent research in George however (Barrett, 2012), revealed the important role of *rising urban water consumption* as a co-driver of diminished water availability.

A similar disaster declaration for Beaufort West in May 2010 activated relief assistance – although Gamka Dam levels fell faster than expected, resulting in the reservoir emptying completely by September 2010. It was only nine months later, in June 2011, that the Gamka Dam began to refill.

Figures 2.13-2.15 illustrate parallel trends in declining-then-restoring reservoir levels for George, Haarlem and Beaufort West during 2008-2011. They show water levels declining steadily from 2008 for both the Garden Route and Haarlem Dams, reaching approximately 25% FSC in early 2010. This trend reversed from June 2010, following winter rainfall. However, the Gamka Dam, Beaufort West, remained completely dry until the following year, with the dam refilling due to rainfall associated with a cut-off low weather system in June 2011.

While Figures 2.13 - 2.15 show the effect of reduced rainfall on stored water availability from 2009 - 2011, they also indicate a steady downward trend in minimum seasonal storage from 2000-on, despite mainly above-average annual rainfall values recorded during this period (refer Table 2.3). This suggests excessive annual drawdown from the dams in the years prior to the drought - a crucial vulnerability condition that amplified the drought's impacts.

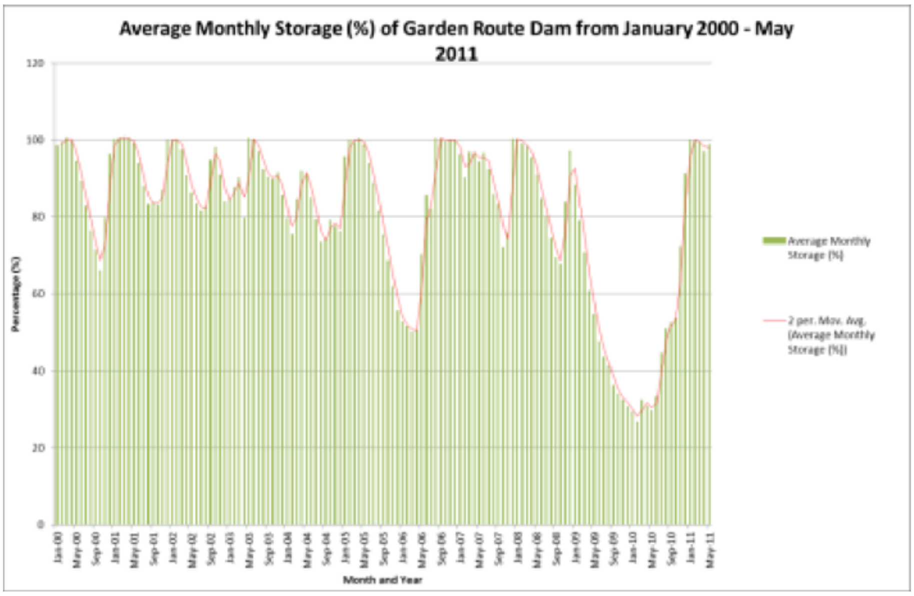


Figure 2.13: Water Availability (% full storage capacity: FSC) 2000-2010: The Garden Route Dam, George

Although diminished rainfall constituted an important hazard driver for low dam levels in George and Beaufort West, the chain of events that reduced available storage in the Haarlem Dam near Uniondale, was more complex, and illustrates the 'see-saw' challenges of managing climate risks in the Western Cape. In this instance, numerous drought-buffering on-farm storage dams were damaged or destroyed by floods that accompanied an intense cut-off low system a year earlier, in November 2007. This sudden *loss of on-farm storage capacity* due to severe storm and flood damage subsequently heightened local fruit farmers' vulnerability to 2008-2010 drought conditions, ultimately resulting in reduced fruit yields. The consequences of compromised fruit yields were also reflected in heightened livelihood security risks for seasonal workers (due to reduced labour needs), who were obliged to seek employment elsewhere.

Other indirect effects of this compromised on-farm storage were transferred to the residents of Haarlem, whose municipal dam the farmers turned to for emergency irrigation capacity in 2009 – and which itself, in 2010, dropped precipitously to 25% FSC - the lowest level ever recorded.

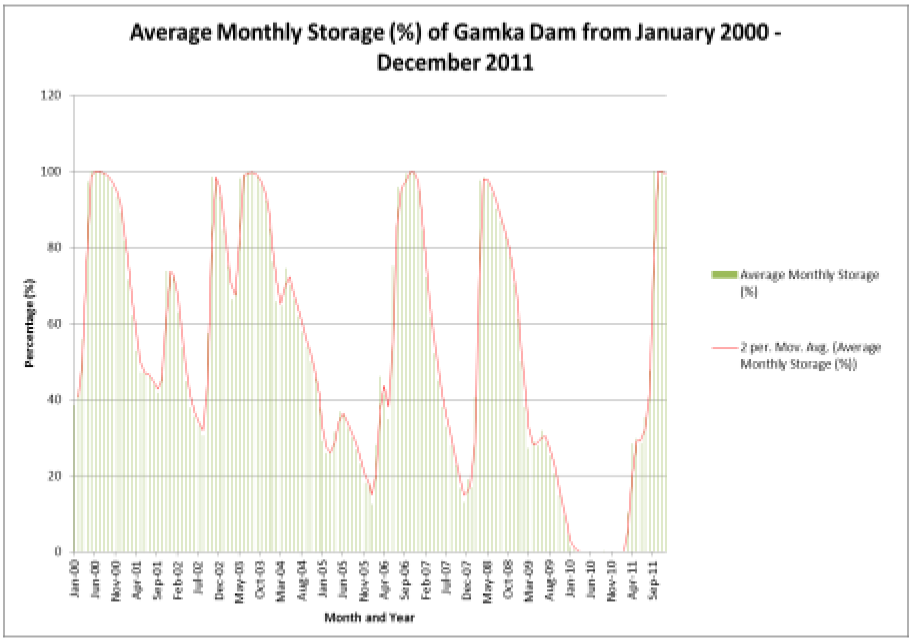


Figure 2.14: Water Availability (% full storage capacity: FSC) 2000-2010: The Gamka Dam, Beaufort West

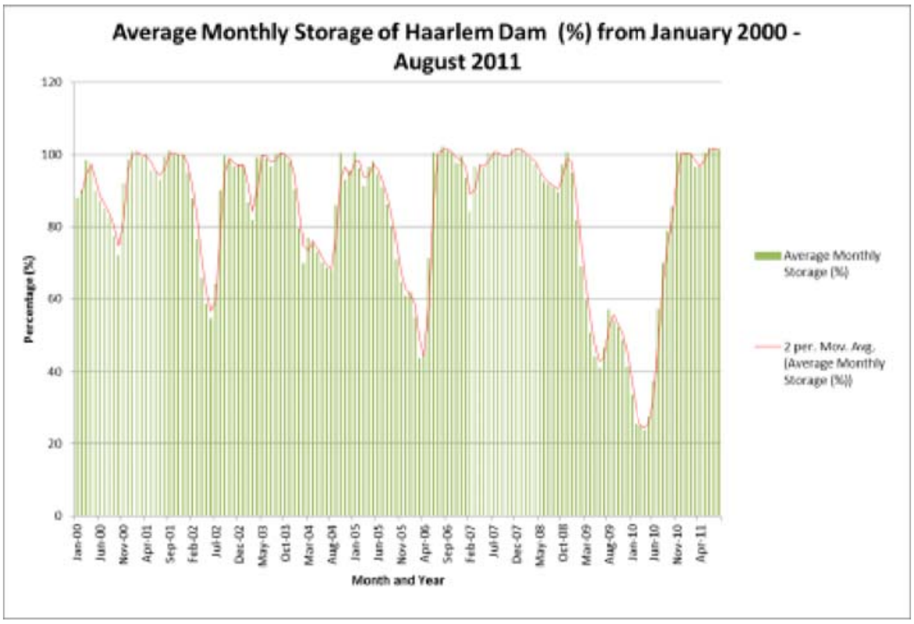


Figure 2.15: Water Availability (% full storage capacity: FSC) 2000-2010: The Haarlem Dam, Uniondale

2.4.4 Declining groundwater – Beaufort West

Declining groundwater supplies became evident in Beaufort West, and reached critical levels during the drought. Figure 2.16 illustrates diminishing capacity in the Noorde Einde Aquifer, normally recognised for its rapid recharge capacity. From November 2008 to December 2010, groundwater levels within this aquifer progressively dropped from 13 metres to 36 metres below ground level.

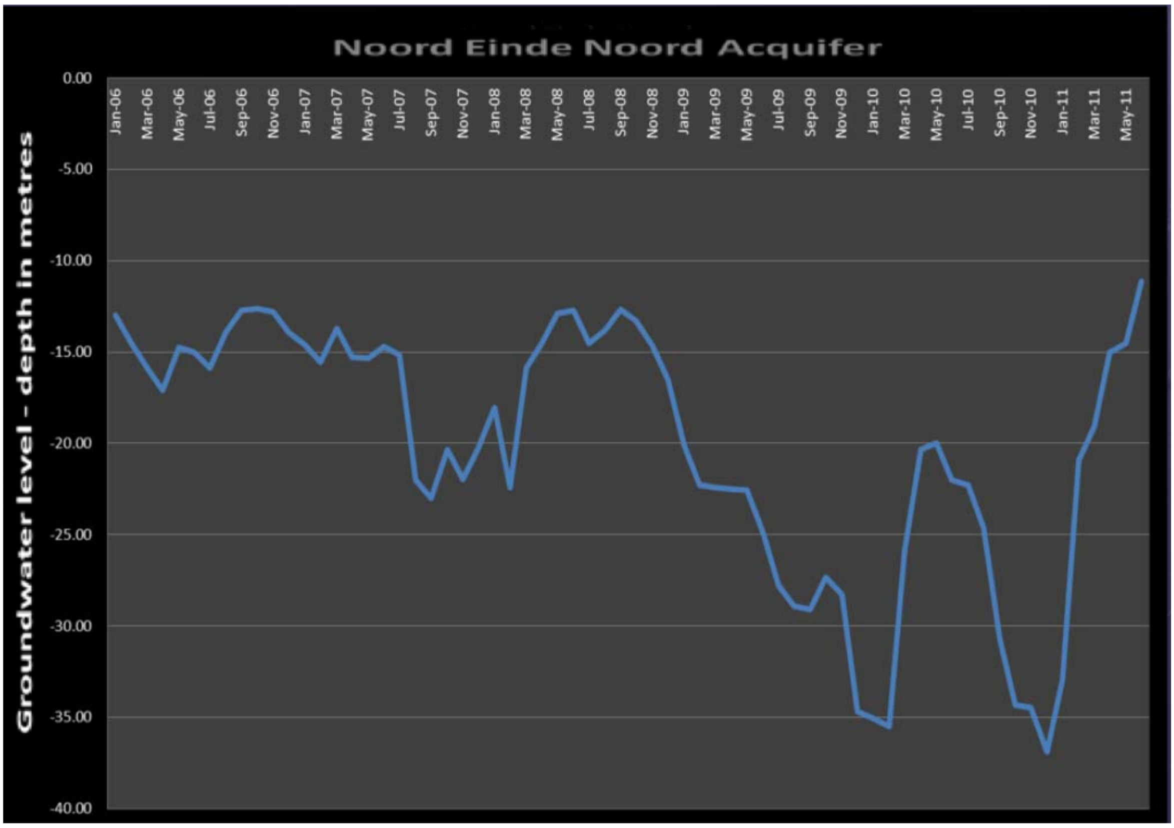


Figure 2.16: Noord einde Aquifer (Beaufort West) January 2006–May 2011 (Smit, 2012)

2.5 Meteorological Drought Warning

2.5.1 Sequence of detected and undetected warnings

Insights derived from the 2008-2011 drought illustrate the complexity of warning processes at different stages of the drought's progression. They also foreground the need to differentiate between warnings for meteorological, hydrological and agricultural drought. Similarly, they indicate important differences between warnings that signal escalating water-shortage risks (that may be demand-driven) and those associated with hydrological drought (that are attributed to reduced rainfall).

Field research and documentary evidence in this study identify two periods which signalled *early-stage* and then *advancing* meteorological drought conditions.

2.5.2 Early-stage meteorological drought

Early-stage meteorological and associated hydrological drought conditions were identifiable by December 2008-January 2009. These were signalled by moderately reduced rainfall in 2008 (SPI values described in section 2.2.2), and further indicated by 2009 forecasts of reduced rainfall (see section 2.2.2). They were also indicated by reduced stream flows that were directly associated with the diminished rainfall. In some areas, reduced flows were further exacerbated by increased river abstraction by farmers attempting to compensate for reduced rainfall, and who had already detected early-stage meteorological and agricultural drought conditions.

The January 2009 drying of the Karatara River, the primary water source for Sedgefield in Knysna, explicitly signalled the early stages of an emerging meteorological and hydrological drought. However, the process of risk accumulation in the months before the Sedgefield water emergency, illustrates the 'creeping', incremental nature of meteorological drought. Prior to the January 2009 Sedgefield emergency, there was little expectation of reduced rainfall in the Southern Cape.

Detecting accumulating dry conditions

The possibility for early detection of hydrological and agricultural drought risk conditions was evident from the Agricultural Research Council's (ARC) January 2009 issue of Umlindi (ARC, 2009). This public-access source (**www.arc.agric.za**) indicated that during 2008, significant areas in the east of the Western Cape had received only 50-75% of annual rainfall. In the absence of heavy falls in early 2009, this constituted an important opportunity for 'meteorological early warning' of future knock-on hydrological and agricultural drought conditions.

Forecasts of future dry conditions

Similarly, the December 2008 Agricultural Disaster Risk Management statement from the *National Agrometeorological Committee (NAC) Advisory on the 2008/09 Summer Season* communicated the following long-range SAWS forecast for March-April-May 2009. Specifically this noted 'below-normal rainfall totals are also expected over the south-western Cape' (DoA, 2008b).

Despite evidence of widespread *moderate dryness* across eastern areas of the Western Cape (reported by the December 2008 12-month SPI values and percentage of mean rainfall distributions), combined with *forecasted below-normal rainfall* totals for March-May 2009, there was no official warning of an impending meteorological drought for 2009. During the course of field research for this project, no informants from either the PDMC or Eden Disaster Management Centre (EDMC) or farmers interviewed, reported using these sources (the climate advisories provided by NDA or the monthly agro-ecological and meteorological information accessible in *Umlindi*).

2.5.3 Escalating and advanced-stage meteorological drought

Awareness of the value of accurate meteorological information for drought risk management became evident by August 2009. This was significantly enabled by the establishment of structured monthly drought management meetings that communicated SPI (past dryness), combined with monthly-quarterly forecasts – and related these to reservoir water levels. This information became indispensable for drought risk management planning across affected municipalities (refer 3.3.4 for detail).

2.6 Economic Co-risk Drivers

The occurrence of the 2009-2010 meteorological drought coincided with the global economic crisis, which generated the most severe domestic economic recession faced by South Africa since 1992. This was measurably characterised by a 1.8% contraction of national GDP, as well as the loss of 870,000 jobs (National Treasury, 2010). Falling employment was most marked in unskilled and semi-skilled occupational categories, with 149,000 fewer agricultural jobs in 2009, compared to 2008. This represented a 19.5% reduction in national agricultural employment (National Treasury, 2010a:32).

In the context of this study, the contraction of the national economy was mirrored by declining trends in economic growth within the two drought-affected district municipalities. Figures 2.17 and 2.18 reflect the economic growth rates for the Eden and Central Karoo District Municipalities from 2002-2009. While the districts recorded favourable annual growth rates of 5.8% and 3.6% respectively from 2001-2008, they did not escape the impacts of the global recession. In 2009, the Eden District's economy contracted by 1.7%, while the Central Karoo economy was reportedly 'stagnant' with a negligible growth rate of 0.2% (Western Cape Provincial Treasury, 2010).

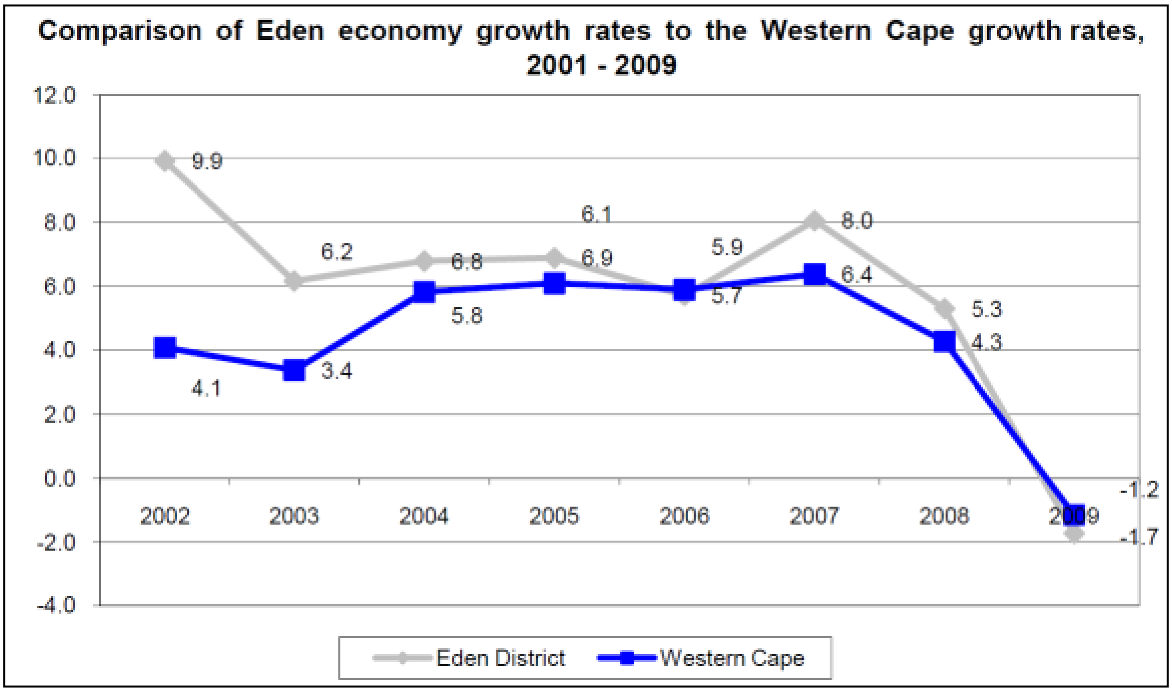


Figure 2.17: Regional Development Profile: Eden District (Western Cape Provincial Treasury 2010a:24)

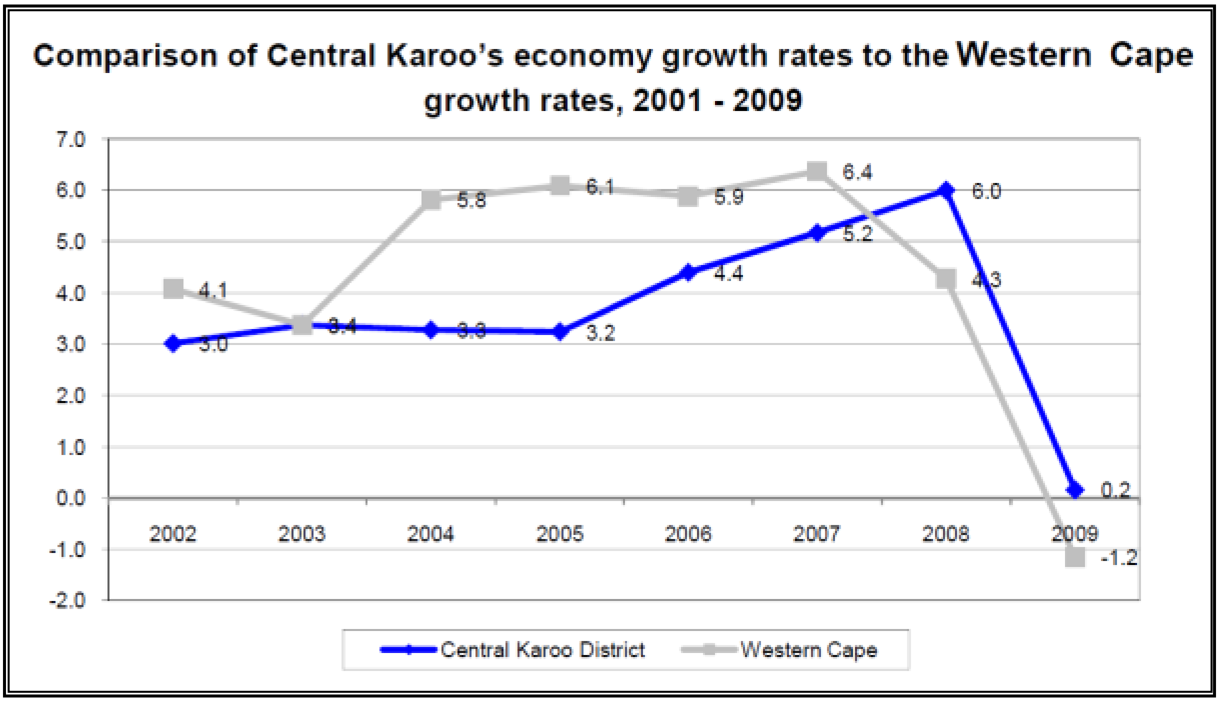


Figure 2.18: Regional Development Profile: Central Karoo District (Western Cape Provincial Treasury 2010b:20)

The convergence of extremely difficult economic conditions with an unforeseen meteorological shock imposed additional stresses on the drought-affected areas, and constrained the range of risk-management options available to minimise either threat. Although it is not possible to attribute agricultural job losses separately to drought or conditions of economic duress, or to other factors, it is significant that the Western Cape's agricultural labour force shrank by 51,000 (29.7%), from 172,000 to 121,000 jobs between January-March 2010 and January-March 2011 (Statistics SA, 2011). This reduction represented the largest year-on-year first-quarter reduction in the agricultural workforce for any province for 2010-2011, given that a total of 55,000 agricultural jobs reportedly were lost nationwide over this period (ibid).

2.7 Conclusion

The period 2008-2011 reflected exacting meteorological, hydrological and agricultural drought conditions across the Eden and Central Karoo District Municipalities. These were indicated by measurable reductions in rainfall, stream flow, groundwater level and vegetation conditions. They were also not limited to a single annual cycle, and spanned up to three years. The coincidence of the drought with the global economic recession, whose impacts were most intense in 2008 and 2009, strongly constrained the range of response options available to manage the consequences of the drought.

PART III: INSTITUTIONAL RESPONSE

3.1 Introduction

The institutional response to prolonged meteorological drought conditions in Eden and the Central Karoo required the cooperation of all spheres of government. It also actively engaged the private sector and civil society organizations and spanned at least two years (2009-2011).

Although local water demand had been rising steadily in the Southern Cape, it is the research team's view that this mounting vulnerability to meteorological drought had been weakly addressed prior to 2009. This was in part due to heavy rainfall generated by recurrent cut-off low systems between 2004 and 2007. Although the severe weather events generated significant flood damage, they also conferred protective benefits to ground and surface water reserves by repeatedly refilling depleted storage against the general trend of rising consumption.[3] These unrecognized benefits of heavy rainfall events masked rising urban and agricultural vulnerability to meteorological droughts generated by the increasing and poorly regulated local water demand. As a result, the urban water shortages that rapidly unfolded in 2009 across the Southern Cape were unexpected.

The first indicator that signalled an impending hydrological drought occurred in January 2009 when the Karatara River that supplies Sedgefield in Knysna ran dry, partly due to lower than average 2008 rainfall. Fortuitously, the Sedgefield water emergency also drew attention to low - then declining - dam levels in other Southern Cape municipalities. Water supply conditions continued to deteriorate in 2009, due to markedly reduced rainfall in winter 2009 as well as during the 2009-2010 summer months.

This progressive dryness across the Southern Cape and Central Karoo resulted in wide-ranging efforts to reduce urban water demand, as well as to increase supply through emergency interventions. In 2010, extremely modest social relief (R 1,000/household/month x three months) was provided to 45 farm-workers and their families, while agricultural relief in the form of fodder was made available to selected drought-affected farmers. With the onset of rain from late 2010-2011, intense drought conditions in the Southern Cape were relieved - although progressively dry conditions became apparent in the Overberg District.

This chapter describes the phasing of the 2008-2011 drought and the details the governmental expenditure on emergency assistance during this event. It outlines the institutional mechanisms for coordinating the response, followed by interventions that addressed imbalances in water supply and demand, along with support to farmers and poor households.

3.2 Tracing the drought's sequence

3.2.1 Stage identification and classification

The study team proposes that the time-frame for the drought be extended from 2009-2011 (as given in the Terms of Reference) to 2008 to 2011. The team also proposes the application of a *risk progression* framework that systematically classifies the advancement and de-escalation of the drought into five distinct phases. This new staging incorporates the largely unrecognized *risk accumulation* phase in the years prior to and including 2008, which was characterised first by rising water demand and then by declining rainfall. It also acknowledges a risk *'de-escalation'* phase that emerged in 2011, reflected in the restoration of normal rainfall along with improved water demand management. However, the team has set aside use of the term 'recovery', given

[3] Extreme rainfall, is one example of an 'extreme climate or weather event' (Seneviratne *et al*., 2012: 116) which cannot be relied upon to reset an underlying trend (refer Glossary).

both districts' recurrent experience of damaging weather events and substantial losses (DiMP, 2010:82-83).

The proposed stages and their description are provided below for the Southern Cape and Central Karoo respectively. Each stage combines three identifiable indicators – a drought hazard severity indicator (i.e. SPI), an impact indicator (i.e. dam level as % FSC) and capacity indicator (i.e. institution of demand management measures). The stages have also been aligned with gazetted local disaster declarations (Annex 2), as these constituted the legal instrument for accessing subsequent government relief.

Risk accumulation: Refers to the incremental (and largely undetected) accumulation of hazardous (i.e. declining rainfall) risk factors, combined with exacerbating vulnerability conditions (i.e. increasing water demand and adverse economic conditions) that prevailed in 2008.

Risk escalation: Refers to the acceleration of risk factors to the point that they are detected and causally linked to an adverse consequence (i.e. acute water shortage). In the case of the Southern Cape drought, this phase was also characterised by the establishment of initial coordination mechanisms and structures – recognizing the urgency for response.

Risk intensification: Refers to the occurrence of recognizable first-, second- and third-order impacts and multiplier effects that indicate cross-linkages between socio-economic and environmental conditions (i.e. rapidly declining dam levels, reduced household and livestock access to water, compromised vegetation cover, farm job losses). This phase was associated with concerted and focused emergency measures by multiple organizations and individuals to contain further progression of water shortages and associated impacts.

Risk stabilization: Refers to deceleration of the occurrence of the most wide-reaching adverse impacts, mainly through a combination of focused emergency measures (that either increased water supply and/or reduced demand). While exposure to the drought hazard had not decreased, the consequences of exposure were minimised by focused interventions.

Risk de-escalation: Refers to continued reduction in adverse impacts, plus reversal of hazard conditions (i.e. restoration of rainfall), and down-scaling of emergency response. This phase was indicated operationally by dismantling of emergency structures and mechanisms and the restoration of water to storage systems and normalization of flows within the abstraction systems.

Table 3.1: Phases of the 2008-2011 Southern Cape Drought (Eden)

Phase	Dates	Classification	Description
I	2008: January-December	Risk accumulation	Declining annual rainfall, combined with increasing water demand. 12 month SPI – Moderate
II	2009: January-October	Risk escalation	Poor rainfall, declining dam levels. Sedgefield's water source depleted (January 2009) GRD at 30% FCS (October 2009) 12 month SPI (January-December 2009) Severe – Extreme
III	Nov 2009-Apr 2010	Risk intensification	Poor rainfall. Nov 2009: Local disaster declarations: George, Mossel Bay, Knysna Emergency measures DWA domestic water restrictions introduced in Hessequa, George, Knysna, Mossel Bay and Bitou Local Municipalities (January 2010) GRD 26% FSC (February 2010)
IV	2010: May-December	Risk stabilization	June 2010: Local disaster declaration extension for Eden District (Bitou included). Demand measures institutionalized DWA domestic water restrictions reinforced, George, Knysna, Mossel Bay and Bitou (July 2010) DWA domestic water restrictions reinforced, George, Knysna, Mossel Bay and Bitou (December 2010) Rainfall restored. GRD levels reach 90% (December 2010) 12 month SPI (January 2010-December 2010) Mild
V	2011: January-June	Risk de-escalation	Substantial rainfall in many areas. Favourable dam levels maintained. DWA domestic and industrial use water restrictions for Hessequa, George, Knysna, Mossel Bay and Bitou lifted (April, 2011) Water demand monitored.

As noted earlier, the acute water shortage in the coastal town of Sedgefield represented the defining event for the 2009-2011 drought emergency. This was signalled in January 2009 when Knysna officials informed the Eden District Municipality and the PDMC that Sedgefield faced a water crisis. In response, the PDMC requested the South African National Defence Force (SANDF) as well as Departments of Transport and Public Works to transport desperately-needed water from George to Sedgefield. This was followed by the rapid installation (i.e. within 14 days) of a Water Irrigation Network emergency water supply infrastructure from the Hoogekraal River to Sedgefield.

Simultaneously, the Western Cape Premier informed the Premier's Coordinating Forum (PCF) of an impending water emergency in Knysna and established a water task team to investigate. By April 2009 the task team had finalised its report. In the months that followed, provincial coordination structures were activated to streamline emergency responses. These measures included numerous and progressive water tariffs and restrictions across all affected municipalities.

The November 2009 declarations of local disasters respectively for George, Mossel Bay and Knysna unlocked access to funding for emergency urban water supplies. The urgency for these measures was underlined in an Eden District Municipal Water Crisis Management Progress report (15 January 2010) which noted that George and Knysna had less than three months' water supply in storage, with Mossel Bay, Bitou and the Eden DMA faring only slightly better. Water security conditions continued to deteriorate, so that by early March 2010, only Oudtshoorn was adequately supplied, while all other Eden municipalities were acutely water-stressed.

Fortunately, in June 2010 and definitely by January 2011, improving rainfall resulted in the GRD reaching almost FSC, and by May 2011 it was possible to convene a Drought Debriefing session in George to 'conclude' the emergency.

Table 3.2: Phases of the 2008-2011 Central Karoo Drought (Beaufort West)

Phase	Dates	Classification	Description
I	Jan-Dec 2008	Risk accumulation	Declining annual rainfall, combined with increasing water demand. 12 month SPI – Moderate
II	Jan-Oct 2009	Risk escalation	Poor rainfall, declining dam levels. Demand measures implemented. 24 month SPI (Jan 2008-Dec 2009) Severe – Extreme
III	Nov 2009 - Dec 2010	Risk intensification	Poor rainfall. DWA domestic water restrictions introduced (Jan 2010) Local disaster declaration Beaufort West (May 2010) Gamka Dam empty (Sep 2010) DWA domestic water restrictions intensified (Nov 2010) 12 month SPI Mild (Jan-Dec 2010)
IV	Jan-May 2011	Risk stabilisation	DWA domestic and industrial water use restrictions lifted (April, 2011) 24 month SPI Mild (January 2009-December 2010)
V	June-Dec 2011	Risk de-escalation	Rainfall in many areas. Gamka Dam begins refilling (June 2011). Water demand monitored.

In Beaufort West, as early as January 2008, engineers had identified deteriorating water supply conditions due to reduced rainfall, resulting in the Municipality introducing water restrictions. Continuing rainfall failure during 2008-2009 within the Gamka Dam catchment prompted the Municipality (in April 2009) to further escalate water restrictions to reduce consumption. In June 2009, it became necessary to increase tariffs once more due to the protracted dry spell.

Although these measures were intensified again in January 2010, the town's water supply continued to be depleted, and by September 2010 the Gamka Dam in Beaufort West was recorded as empty. This prompted severe water load-shedding from November 2010 and the regular distribution of bottled water to every household within the municipality. In January 2011, Beaufort West received relief funding from the National Treasury for South Africa's first water reclamation plant, which commenced operations that month. On 15 May 2011, restrictions were finally lifted, and in June 2011, the Gamka Dam began to refill after substantial rainfall in its catchment.

The droughts of the Eden district and the Central Karoo were not completely in-phase. While favourable winter rainfall was recorded in the Southern Cape during June and July 2010, the Gamka Dam ran completely dry in September of that year, and only began to refill in mid-2011.

3.2.2 Local disaster declarations

Between November 2009 and June 2010, five local disaster declarations were made (summarised in Table 3.4 below). These declarations, primarily intended to address increasing water stress within urban areas, also facilitated access to agricultural relief for farmers in both districts. Although there was no official declaration marking the end of the emergency, June 2011 is widely viewed as signalling the end of the drought, both in the Eden District and the Central Karoo. This month marked the first heavy rainfall in the Eden district and the refilling of the Gamka Dam in Beaufort West. Ironically, this rainfall accompanied a powerful cut-off low that resulted in devastating floods in Bitou, George, Hessequa, Kannaland, Knysna, and Mossel Bay, once more underlining the climate risks faced by residents within the Eden District.

Table 3.3: Local disaster declarations (November 2009 - June 2010)

Date	Title of Declaration	Source
20 Nov, 2009	George Municipality: Declaration of a Local Disaster (P.N. 435/2009) Mossel Bay Municipality: Declaration of a Local Disaster (P.N. 438/2009)	Province of the Western Cape, Provincial Gazette 6677
27 Nov, 2009	Knysna Municipality: Declaration of a Local Disaster (P.N. 447/2009)	Province of the Western Cape, Provincial Gazette 6680
28 May, 2010	Central Karoo District Municipality: Declaration of a Local Disaster	Province of the Western Cape, Provincial Gazette 6751
11 Jun 2010	Eden District Municipality: Declaration of a Local Disaster (P.N. 236/2010)	Province of the Western Cape, Provincial Gazette 6757

The eventual drought response reflected a complex, coordinated effort across all spheres of government for two districts that extended until 2011. The complexity was amplified by the simultaneous occurrence of the global economic recession, along with preparations for and actual hosting of the FIFA World Cup. That an intense drought response intervention across two districts was successfully implemented in such complexity was an impressive achievement for those involved. Figure 3.1 summarises actions taken at key points during the drought, and relates these to changing dam levels in the Gamka, Garden Route and Haarlem Dams.

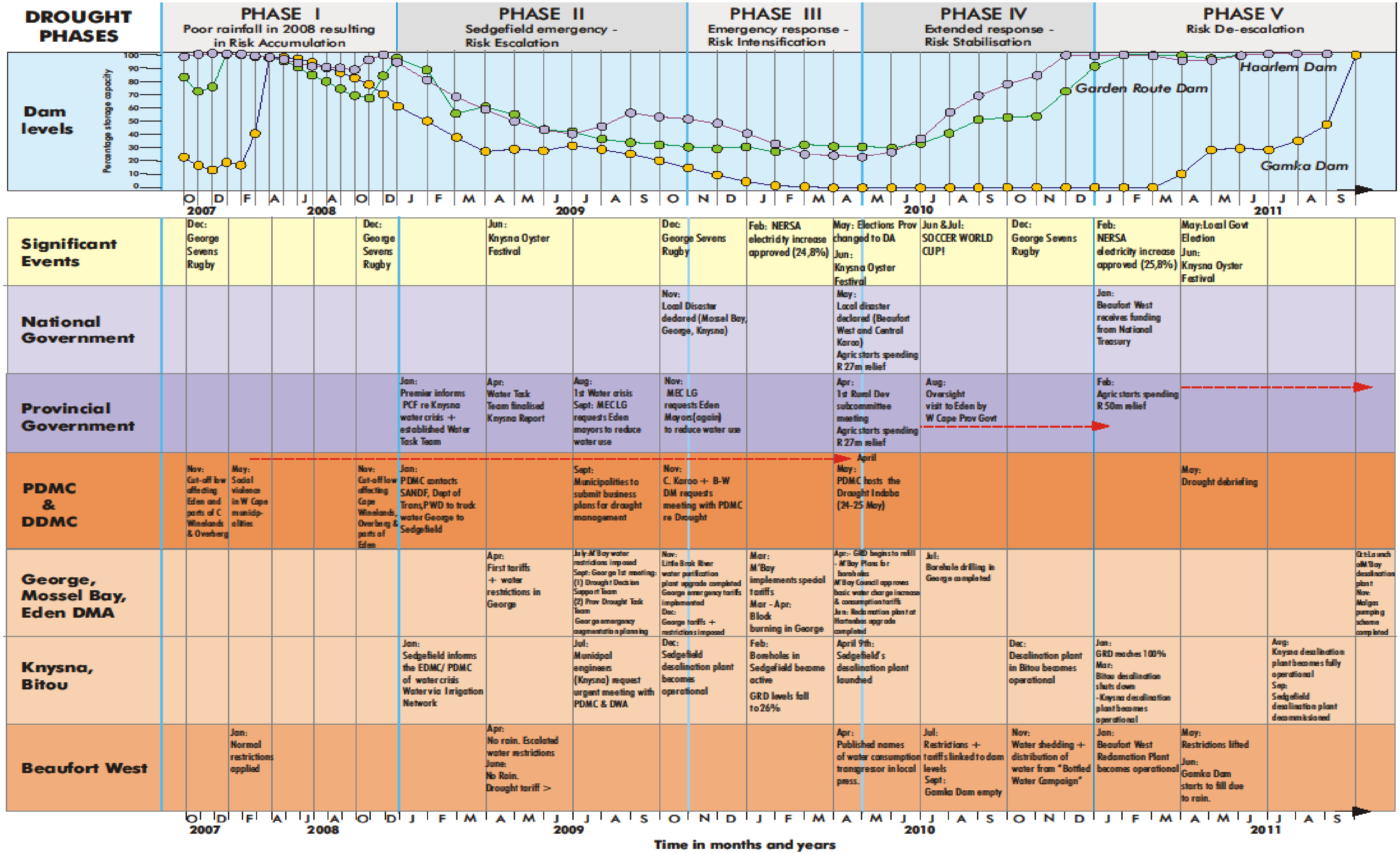


Figure 3.1:Drought response actions (National and Provincial government, PDMC, DDMC & municipalities) and changing dam levels in the Gamka, Garden Route and Haarlem Dams (2007-2012)

3.3. Scale of funded relief

Altogether, R 572.04m was allocated for drought relief and response. Of this, R 495.0m (86.5%) was directed to improving urban water supply infrastructure, while R 76.9m (13.44%) was allocated for agricultural relief. Table 3.3 reflects the allocation of funds for urban water supply infrastructure and partial distribution of funds allocated for agricultural relief (i.e. to February 2012).

Table 3.4 summarises allocations across all spheres of government, and includes the substantial contribution from PetroSA for desalination and effluent treatment plants in Mossel Bay.

Table 3.4: Summary of funding allocations for drought emergency assistance 2009-2010, by type of assistance and municipality

Municipality	Urban infrastructure	Agriculture relief*	Social distress relief**	Total (Rand)
Beaufort West	28 600 000	420 084	0	29 020 084
Bitou	36 750 000	796 393	0	37 546 393
George	116 388 429	3 185 187	0	119 573 616
Hessequa	0	14 343 612	0	14 343 612
Knysna	57 862 072	1 023 615	0	58 885 687
Laingsburg	0	678 428	0	678 428
Mossel Bay	255 400 000	6 012 102	0	261 412 102
Oudtshoorn	0	137 859	0	137 859
Prince Albert	0	50 400	0	50 400
Uniondale		1 615 309	0	1 615 309
Total	**495 000 501**	***28 262 990**	****135 000**	**523 398 491**

**** R76.9m was allocated to assist farmers in distress, but only R28.3 was spent in the first financial year. As the balance was 'rolled-over' to 2012/13, it is not reflected in this table.***
***** Although social relief was allocated to families in George and Uniondale, this could not be differentiated by municipality***

Table 3.5: Summary of funding allocations for urban water supply infrastructure 2009-2010, by funding source

Municipalities	Funds in ZAR						
	National Treasury	Municipal Budgets	MIG	PetroSA	RBIG	Eden DM	Total
Beaufort West	28 600 000	0	0	0			**28 600 000**
Bitou	20 000 000	15 550 000	0	0		1 200 000	**36 750 000**
George	90 000 000	11 188 429	0	0	15 000 000	200 000	**116 388 429**
Knysna	40 100 000	8 350 000	9 212 072	0		200 000	**57 862 072**
Mossel Bay	108 500 000	54 200 000	0	92 500 000		200 000	**255 400 000**
Total	**287 200 000**	**89 288 429**	**9 212 072**	**92 500 000**	**15 000 000**	**1 800 000**	**495 000 501**

Altogether, the National Treasury provided R 287.2m, or 58.0% of all funding for municipal water supply infrastructure. This was complemented by municipal co-funding, estimated cumulatively to be R 89.3m (18% of total costs). PetroSA's contribution added a further R 92.5m (18.7% of total expenditure), specifically for Mossel Bay. Smaller amounts from the Regional Bulk Infrastructure and Municipal Infrastructure Grants totalled R 24.2m, while the Eden District Municipality contributed R 1.8 m, primarily for awareness raising.
While Mossel Bay received the largest National Treasury allocation for all municipalities (R 108.5m), Hessequa farmers were allocated the highest amount of agricultural assistance (R 14.3m). A more detailed description of these allocations is detailed in Table 4.8 and Annex 4.

National funding for municipal responses was secured in three steps. The November 2009 declaration resulted in the generation of R 53.85m primarily for George, Mossel Bay and Knysna. Following the May 2010 declaration, a further R 14.5m was secured for Beaufort West and extension of the disaster declaration to cover the entire Eden District. Relief funding for agriculture was also authorized after the May 2010 declaration. The final allocation of R 92m for Mossel Bay's desalination plant was facilitated through the *Adjusted Estimates of National Expenditure 2010* (National Treasury, 2010b).

Figure 3.2 graphically represents Steps 1 and 2 of the drought funding process across provincial and national spheres. It illustrates the absolute necessity of enabling horizontal risk governance relationships between the Disaster Management Centre and Treasury within both provincial and national spheres, as well as vertical relationships between the PDMC and NDMC. The Western Cape's recurrent experience of severe weather-related disasters since 2003 has provided numerous opportunities to institutionalize the processes for disaster-related funding. This expedited the resource mobilization process, and was further enabled by municipal and provincial officials with many years of experience in compiling the documentation needed for emergency funding – and working together in times of disaster.

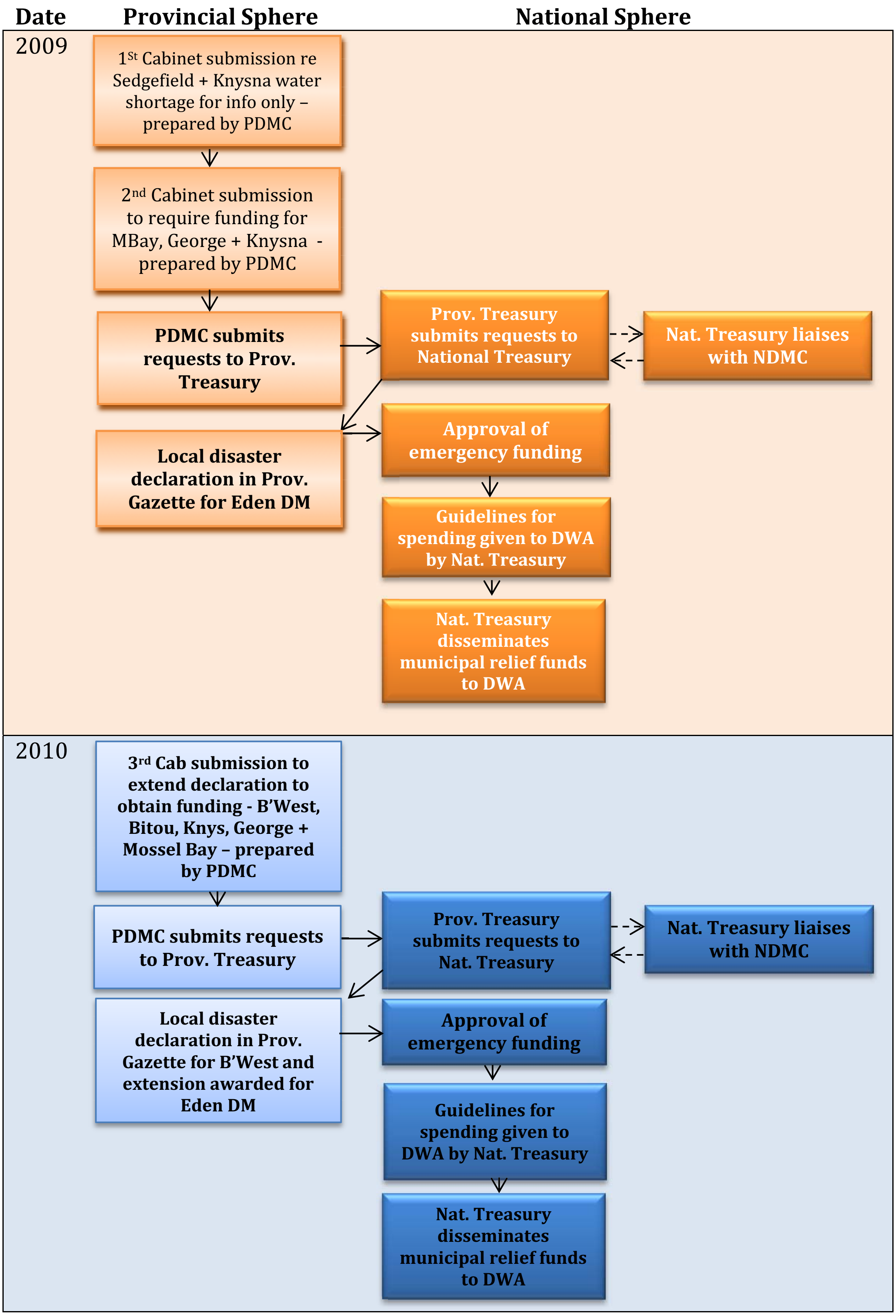


Figure 3.2: The drought funding process across provincial and national spheres

3.4 Institutional Mechanisms Activated

3.4.1 Overview

The 2009-2011 emergency required streamlining efforts of all spheres of government, as well as the alignment of actions by provincial departments. The effectiveness of the response was significantly enabled through the proactive leadership of the Western Cape MEC for Local Government, Environmental Affairs and Development Planning, Mr Anton Bredell, as well as the Department of Water Affairs' Chief Director for the Western Cape Region, Mr Rashid Khan.

Specifically, in September 2009, and then again in October, the MEC for Local Government formally requested all mayors in drought-affected areas to reduce municipal water consumption by 30%. Similarly, the Acting Director General of the Department of Water Affairs intensified water demand measures, by approving the implementation of 40% water restrictions effective from 1 January 2010 for Hessequa and Beaufort West (Government Gazette, 2010a) as well as Mossel Bay, George, Bitou and Knysna (Government Gazette, 2010b). To protect urban water supplies through the sustained dry spell, a 60% water use restriction was also applied to farmers, primarily in Mossel Bay from 15 July 2010 (Government Gazette, 2010c).

Such effective intergovernmental relations were also enabled through the establishment of two multi-stakeholder mechanisms that convened at least monthly during the course of the operation. In addition, the availability of experienced disaster management expertise at district and provincial centres and competent personnel in technical departments at provincial and municipal levels (especially skilled engineers) was essential - along with access to updated monthly climate, agricultural and water risk management information for timely decision-making.

3.4.2 Establishment of dedicated drought operations coordinating structures

The impetus for a dedicated institutional framework for coordinating drought response can be traced to an explicit request in July 2009 from municipal engineers in Knysna for an urgent meeting with the PDMC and the DWA. This meeting, convened on 26 July, subsequently resulted in a broader drought management consultation in George in August which led to the establishment of two coordinating mechanisms in September 2009. These were:

- Provincial Drought Management Meetings (convened monthly in George)
- a Drought Decision Support Team (convened monthly in Cape Town, but one week prior to the Provincial Drought Management Meetings).

The monthly Provincial Drought Meetings provided an inclusive forum for transversal decision-making, and included; municipal managers of drought-affected municipalities, representatives of PetroSA and key provincial departments (Agriculture, Treasury and Social Development) as well as municipal engineers and representatives of the DWA. The South African Weather Services also attended many of these meetings.

This forum combined two initial consultative groups respectively, namely Strategic and Technical Task Teams. The Technical Task Team included the municipal engineers from affected municipalities, while the Strategic Task Team consisted of representatives of Provincial Departments and Municipal Managers from the affected areas.

The Drought Decision Support Team was instrumental in fast-tracking decision-making in the larger forum and was composed of representatives of the Provincial Departments of Agriculture, Local Government (including Municipal Infrastructure Grant (MIG)), Environmental Affairs and Development Planning and Treasury. The National Department of Water Affairs (through its regional office in Bellville) played a particularly crucial role, as did representatives of the Provincial Disaster Management Centre (PDMC) and Eden/Central Karoo District Disaster Management Centres. This forum offered an invaluable strategic decision-making mechanism that processed information quickly. It also advanced the response across sectors and municipalities in a coordinated way. The Drought Decision Support Team's leadership by Dr

Hildegarde Fast, Head of the Provincial Department of Local Government, further enhanced the stature and credibility of this forum.

The final Provincial Drought Management and Drought Decision Support Team meetings were convened in Beaufort West in early 2011, concluding in March 2011, as conditions stabilised in Beaufort West. Figure 3.3 graphically represents the key departments and other entities involved in the response. It also illustrates the key roles of both the PDMC and Eden/Central Karoo District Disaster Management Centres.

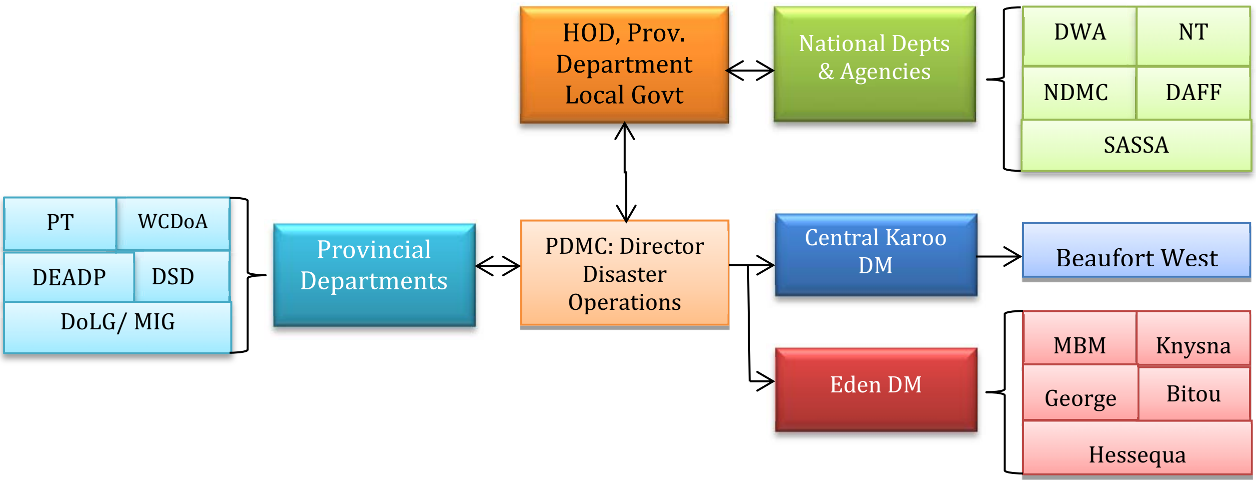


Figure 3.3: Key governmental role-players in the 2009-2011 Western Cape drought operation

Abbreviations for governmental entities shown in Figure 3.3

PT	Provincial Treasury	NT	National Treasury
WCDoA	Western Cape Dept of Agriculture	DAFF	Dept of Agriculture, Forestry and Fisheries
DEADP	Dept of Environment and Development Planning	DWA	Dept of Water Affairs
DSD	Dept of Social Development	SASSA	South African Social Security Agency
DoLG/MIG	Dept of Local Government/Municipal Infrastructure Grant	MBM	Mossel Bay Municipality
PDMC	Provincial Disaster Management Centre	NDMC	National Disaster Management Centre

3.4.3 Role of the Provincial and District Disaster Management Centre

The engagement of the Provincial DMC and EDMC was central to the drought operation. They discharged numerous support functions during the course of the drought. These included facilitating stakeholder communication and coordination, mediation and resource mobilization.

The PDMC facilitated and coordinated emergency meetings during the drought, which were convened in George. The PDMC also liaised with Provincial and National Treasury as well as the Development Bank of Southern Africa (DBSA) for funding for drought-related interventions, while engaging with the Departments of Water Affairs (DWA) and Agriculture. It also provided regular information updates to the Member of the Executive Council (MEC) (Local Government, Environmental Affairs and Development Planning), the Premier and the Cabinet.

As the operation progressed, the PDMC facilitated broader stakeholder discussions. This was reflected in the first Rural Development sub-committee meeting in April 2010 to address the impact of the drought on farm workers, followed from 24-25 May 2010 by the Drought Indaba - a think-tank hosted by the PDMC in collaboration with the DWA.

Both the PDMC and EDMC also assisted in mediating discussions between Mossel Bay Municipality and the Petroleum, Oil and Gas Corporation of South Africa (PetroSA) to reduce the latter's water consumption to lower abstraction from the Wolwedans Dam. Similar needs for mediation applied to Eden's golf estates whose high water demand also needed to decline during this period of heightened water scarcity.

The PDMC later engaged with National State and Provincial departments and other role players to provide relief funding, provided situational updates to the MEC, the Premier and the Cabinet and facilitated the disaster declaration process. The PDMC obtained approval from the National Treasury via the National Disaster Management Centre (NDMC) to redirect emergency funds allocated for the August 2006 floods, an amount of R 11.4m, to assist Knysna Municipality with emergency interventions in Sedgefield.

3.4.4 Access to accurate, updated monthly climate, agricultural and water risk management information

A crucial element that underpinned the effectiveness of cross-sectoral decision-making, was the provision of monthly climate, agricultural and water management information.

Meteorological drought monitoring – the role of SAWS

The South African Weather Service (SAWS) was an essential role-player in the drought management process from 2009-2011. It was the SAWS forecast in August 2009 that projected an imminent dry spell over the Eden District (Figure 3.4). This forecast, combined with past SPI values on already accumulated dryness, indicated a sustained meteorological drought risk, characterised by below average rainfall and elevated temperatures during the summer 2010, presenting a clear rationale for the subsequent disaster declaration. Such information was provided monthly in the course of the drought operation, and insured uniformity of understanding about the severity of the conditions for decision-making purposes.

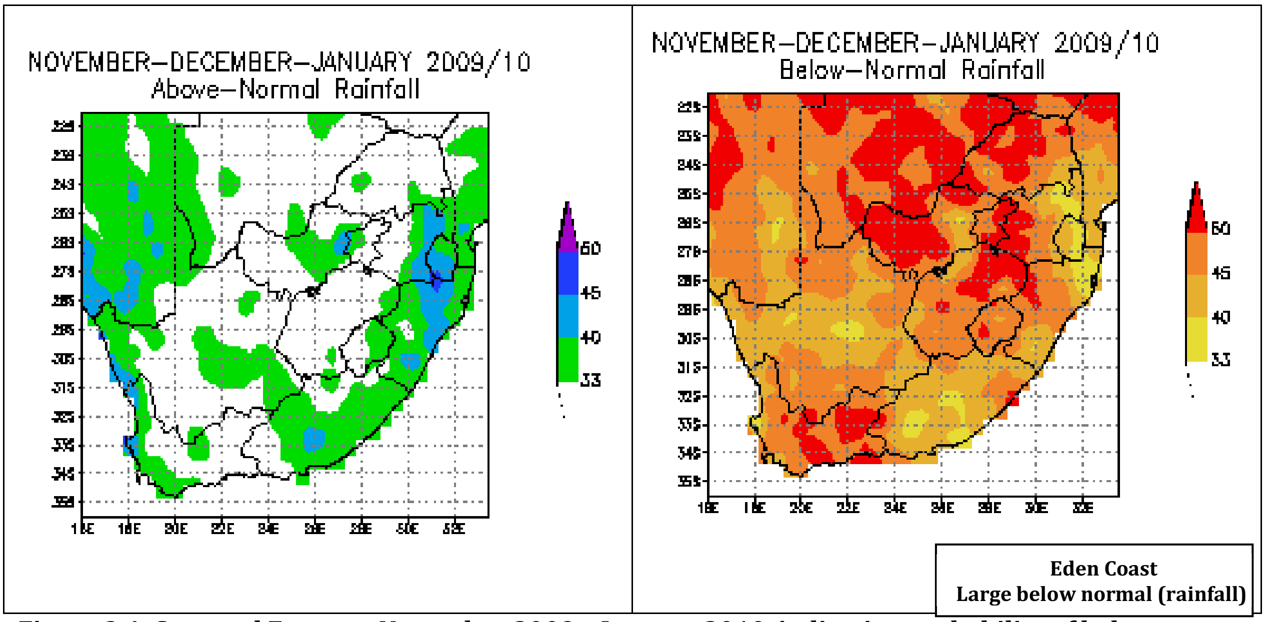


Figure 3.4: Seasonal Forecast November 2009 – January 2010, indicating probability of below average rainfall. Title (Source: SAWS presentation, George, 25 August 2009)

During the course of the drought operation, both the National Department of Water Affairs and Provincial Department of Agriculture also developed innovative urban water supply and agriculture risk-rating tools that provided invaluable guidance on the changing status of available storage – and that flagged conditions warranting urgent attention. Unfortunately, since

2012, these essential monitoring services have been discontinued, despite their crucial role in informing risk management decisions during the drought.

Water Supply Risk Rating

An informative supply risk-rating and monitoring system was developed by the Technical Services Department of the Eden District Municipality during the course of the drought operation. Water supply information on high-risk towns and cities was consolidated and shared monthly at the provincial drought meetings, and allowed for early identification of intensifying risk conditions.

The reports usefully summarised regional drought and water supply indicators (including recorded rainfall, dam levels, river flow volumes and projected rainfall conditions). They also provided an update on the status of drought-affected municipal water supplies (including consumption data).

Table 3.6: Urban Water Supply Risk Rating and Accompanying Criteria (Source: du Preez, 2010)

Risk Level	Assessment Criteria
High	- Towns with **less than three months of water supply in storage** - Towns predominantly dependent on river and/or groundwater abstraction systems for water supply with a **high risk of experiencing insufficient flow volumes** during prevailing drought conditions
Medium	- Towns with **three to six months of water supply in storage** - Towns predominantly dependent on river and/or groundwater abstraction systems for water supply with a **medium risk of experiencing insufficient flow volumes** during prevailing drought conditions
Low	- Towns with **six to twelve months** of water supply in storage - Towns predominantly dependent on river and/or groundwater abstraction systems for water supply with a **low risk of experiencing insufficient flow volumes** during prevailing drought conditions
Sustainable water supply	Towns with a sustainable water supply of more than twelve months

Values for each indicator were consolidated monthly into a composite and colour-coded risk-rating scale, consisting of four water supply risk levels (based on dam storage levels, as well as stream-flow and availability of groundwater sources). The colour-coded rating categories are shown below, along with accompanying assessment criteria. Such information was transparently communicated as shown in Figure 3.5, and signalled the changing water supply status of the drought-affected municipalities. It provided a useful mechanism for managing water shortages at municipal scale, and was instrumental in informing decisions that averted major hardship.

Figure 3.5 illustrates the colour-coding risk-rating system for 30 June, 2011. It shows that George and Mossel Bay had a sustainable water supply of longer than twelve months, while the green-shaded municipalities had six to twelve months of water in storage. The orange-coloured shading for Dysselsdorp, De Rust and Zoar signalled that these towns (located respectively within Oudtshoorn and Kannaland) were classified as ‘medium risk’. This was due to the availability of only three to six months of water supply in storage.

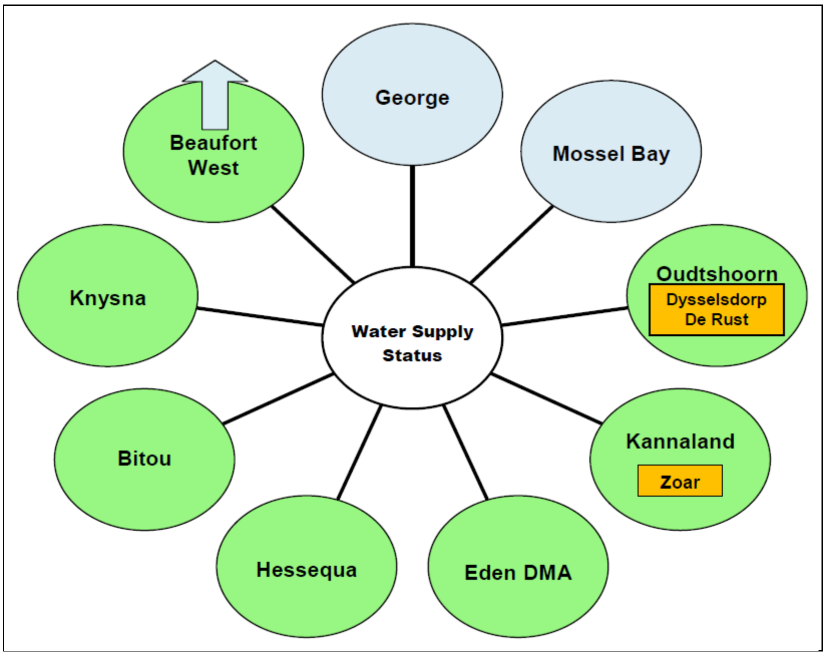


Figure 3.5: Water Supply Status Report:
Urban Areas 30 June, 2011 (du Preez, 31 October 2010)

Agricultural Risk Rating

In 2010, a comparable agricultural drought risk-rating approach was developed by the Provincial Department of Agriculture. This sought to consolidate values on seven risk categories applied to the 84 individual quaternary catchments that comprise the Eden District Municipality. The seven risk categories constituted; 1) percentage of mean rainfall, 2) % dam FSC, 3) changing status of rural labour, 4) adequacy of domestic water supplies, 5) adequacy of stock water supply, 6) soil moisture condition and 7) run-off as a fraction of mean annual runoff. These data, sourced from individual farmers within each catchment, were then consolidated into a composite score to identify areas where conditions were improving or deteriorating. This catchment-level information was further complemented by a monthly assessment of the storage levels of major irrigation dams.

Illustrations of the application of these monitoring indicators are shown in Figures 3.6 and 3.7, compiled for March 2010. Figure 3.6 indicates that of the eleven major irrigation dams in Eden and the Central Karoo, seven were at less than 25 % of FSC (63.6% of all dams monitored), while two dams only (the Gamkapoort and Buffeljags) recorded more than 50% FSC.

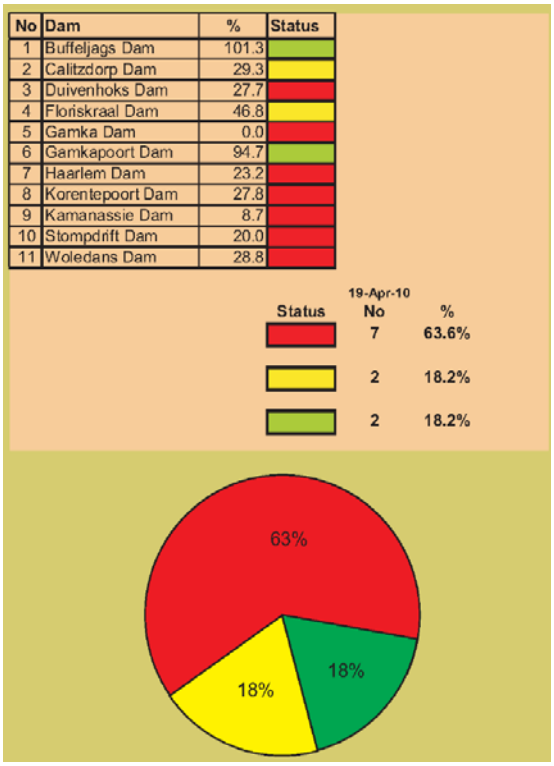


Figure 3.6: Rural and agricultural water status: Major irrigation dams (19 March 2010) (WCDoA, 2010)

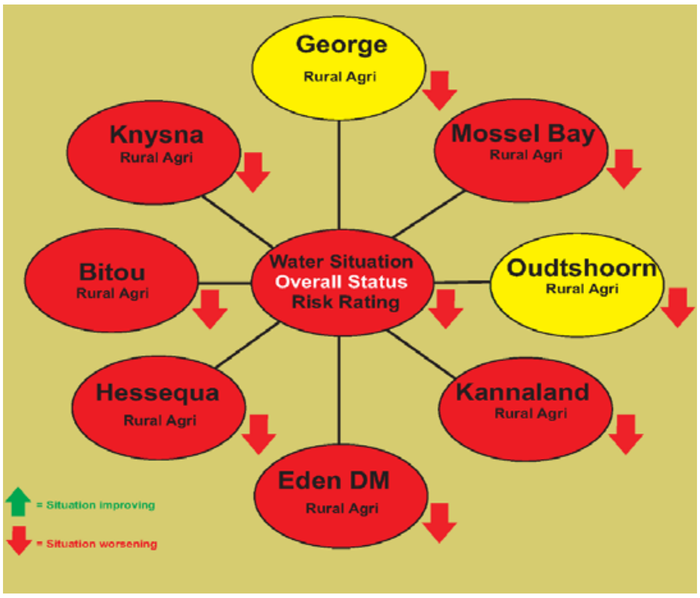


Figure 3.7: Rural and agricultural water status (19 March 2010) (WCDoA, 2010)

Figure 3.7 above indicates deteriorating agricultural conditions across almost all of the Eden District Municipality in early 2010. This is signalled by the downwards-pointing red arrows for all municipalities, which indicates a worsening of agricultural conditions compared to the previous month (i.e. February 2010).

3.4.5 Technical support by the DWA

The DWA took the lead in the process of increasing abstraction from groundwater resources. This support from the Groundwater Section of DWA was wide-ranging, and included technical guidance, engagement in multi-stakeholder processes, and facilitation of legal/administrative/regulatory processes. Specific activities related to these areas of engagement are listed below.
Technical guidance on groundwater matters:

- Provision of strategic guidance on groundwater resource occurrence and quality across the drought affected areas
- Provision of hydrogeological maps and data
- Promotion of groundwater use by Municipalities
- Provision of guidance to Municipalities on groundwater monitoring and wellfield management
- Communication with Municipal-appointed groundwater practitioners and progress reporting to Departmental Management
- Establishment of monitoring stations.

Engagement in multi-stakeholder processes

- Provision of inputs at Provincial drought meetings
- Preparation of material for groundwater presentation at the Drought Indaba (24-25 May 2010)
- Initiation, co-ordination and conducting a Beaufort West Drought workshop to identify emergency options (24 Nov 2010).

Facilitation of legal/administrative/regulatory processes

- Guidance to the Department on groundwater use restrictions
- Assistance with drought relief funding applications to National Treasury
- Facilitation of negotiations for access to property for groundwater development at Beaufort West.

The Department was also tasked by the National Minister and MEC to hold bi-weekly drought management meetings and to develop a strategy to verify and validate water abstractions. DWA, however, faced considerable obstacles in conducting water audits to determine abstraction rates, due to the inadequate supply of water meters and monitoring equipment.

Despite such constraints, the DWA played a crucial role in co-facilitating and coordinating emergency meetings, liaising with Provincial and National Treasury, as well as the Development Bank of Southern Africa (DBSA). It was also instrumental in facilitating the disaster declarations and for providing 'hands-on' support to municipalities and other governmental departments. DWA's involvement in the operation ensured that regular status updates were provided to the MEC for local Government, as well as the Premier and Provincial Cabinet.

3.5 Institutional response: Provincial departments

While the majority of funding support was released for emergency municipal water supplies through the Department of Water Affairs, modest assistance was also made available for agriculture. The knock-on consequences of the drought for farm labour also prompted intervention by the Provincial Department of Social Development (DSD).

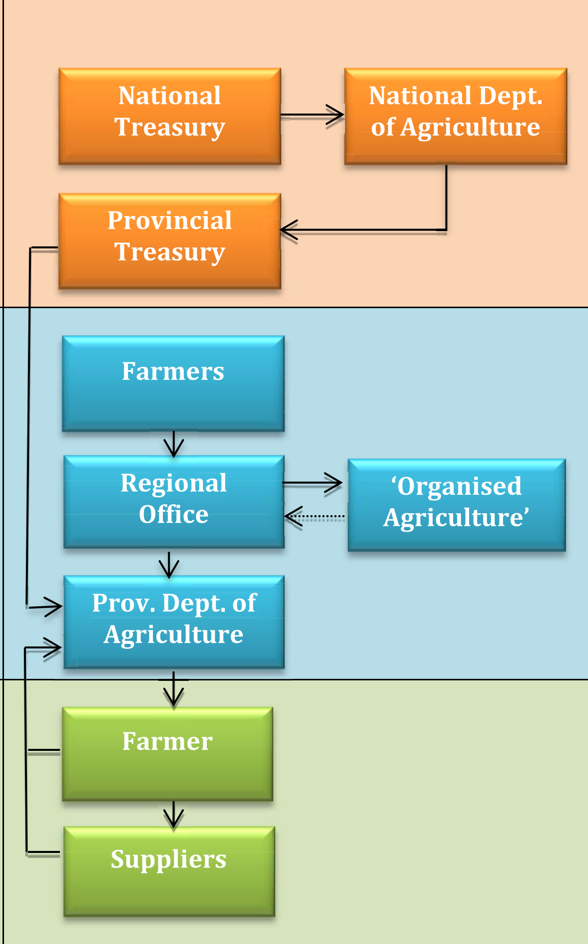
3.5.1 Provincial Department of Agriculture

In August 2010, the Western Cape Minister of Agriculture and Rural Development requested R 26.9m for drought relief from the National DAFF. An additional request for R 50m followed in November 2010. These two requests generated a multi-year relief mechanism formally described as the "2010/11 to 2011/12 Eden Drought". Unfortunately, due to the late finalization of the Framework for Drought Aid by DAFF on 23 December 2010, the distribution of fodder relief was delayed until February 2011. By early 2012, approximately R 33m had been allocated for fodder relief to drought-affected farmers, although R 4.7m of this had not actually been redeemed. Table 3.7 below summarises the funding awarded for agricultural relief for the 2009-11 drought (R 76.9m), along with expenditure to February 2012 (R 28.3m) and remaining unexpended balances (R 48.64m).

Table 3.7: Summary table: 2010/2011 to 2011/12 Eden Drought

Funding allocated, disbursements and balances	R
August 2010 request	26,900,000.00
November 2010 request	50,000,000.00
Total agricultural relief approved	**76,900,000.00**
Amount allocated for agricultural relief Feb 2012	32,989,342.30
Value of non-redeemed fodder vouchers	4,726,352.40
Actual expenditure to Feb 2012 (after including value of non-redeemed fodder vouchers)	**28,262,990.00**
Unexpended agricultural relief balance to Feb 2012 (but distribution continuing in 2012)	**48,637,010.00**

Figure 3.8 illustrates and describes the funding sequence from National Treasury to fodder suppliers that enabled approved farmers to access drought relief in the form of livestock fodder.



Funding Dissemination	The National Dept. of Agriculture requested funding from National Treasury at the request of the Provincial Dept. of Agriculture (supported by Organised Agriculture, the PDMC and Provincial Treasury). This request was accompanied by a disaster declaration obtained from the PDMC (if available) and status report incorporating factors such as rainfall, dam levels, availability of domestic and stock water supply, soil moisture and run-off. National Treasury approved the request. Funds were released to the Provincial Dept. of Agriculture via the National Dept. of Agriculture and Provincial Treasury.
Farmer Registration Process	Farmers were required to complete a registration form to apply for relief. These registration forms were collected from the farmers by representatives of the Dept. of Agriculture's regional office, with the assistance from Organised Agriculture. Organised Agriculture also collected the claim forms from farmers to purchase fodder. These claim forms were then forwarded to the Provincial Dept. of Agriculture, responsible for verifying the claims, and then preparing authorising letters for farmers to 'buy' fodder from various suppliers.
Spending Process	Depending on the type of farming, (i.e. large or small-scale), farmers were expected to contribute a percentage of the fodder's total cost. Farmers took the authorising letter and their own contribution to suppliers, who supplied them with fodder to the value of what was stipulated in the authorising letter. Either the farmer or the supplier then provided the Provincial Dept. of Agriculture with an invoice for direct reimbursement to the supplier.

Figure 3.8: Sequence and description of funding process for agricultural relief

3.5.2 Provincial Department of Social Development (DSD)

In 2010, deteriorating agricultural conditions prompted the Provincial Department of Agriculture to approach the DSD in the Western Cape to assist farm workers who had lost employment as a direct result of the drought. These job losses were the result of cost-cutting measures by farmers who were required to lay off workers due to adverse agricultural conditions.

In June 2010, DSD developed a project plan to support affected and vulnerable families who had lost their jobs due to the drought. The Department of Social Development agreed to assist those identified households with a bread-winner who had become unemployed or put on 'short-time', and whose income was drastically reduced. Families were screened by social development workers to assess their eligibility for relief. This identification and verification process was undertaken in cooperation with affected farmers, Agri-Western Cape, and the Department of Agriculture. Qualifying families were then provided with financial relief for three months as well as food parcels. Although originally 1,280 farm dwellers were believed to be affected, only 45 families eventually received relief between May and August 2010. The low number of families qualifying for assistance was partly due to an eligibility requirement that excluded entire families from other forms of financial relief if any family member was already receiving any form of government grant. For instance, the receipt of a modest child grant for one child within a family automatically disqualified the breadwinner from receiving any form of assistance from the Social Relief of Distress Programme.

Unfortunately, although the DSD applied for financial assistance from the national department and the National Treasury, both applications were unsuccessful. This resulted in minimal funding of only R 135,000 being allocated - sourced directly from the Department's suspense account. This constrained provision of funding resulted in an extremely modest relief effort.

3.6 Conclusion

The 2009-2011 drought emergency generated a complex operation that spanned two district municipalities and that secured R 572.0m for wide-ranging relief activities. It was also supported by five separate local disaster declarations.

The effectiveness of the response was significantly enabled through the establishment of two multi-stakeholder mechanisms as well as the availability of experienced disaster management expertise at district and provincial centres. Similarly, the involvement of competent personnel in technical departments at provincial and municipal levels was essential, along with access to updated monthly climate, agricultural and water risk management information for timely decision-making. The development and application of a water crisis risk-rating mechanism was central to management of the drought emergency over time and across multiple municipalities.

The Provincial Department of Agriculture also played a key role in supporting drought-stressed farmers, in cooperation with Agri-SA, and secured R 76.9m for relief. A significant portion of this allocation was unexpended by February 2012 and was subsequently 'rolled-over' for disbursement in 2012-2013.

PART IV: DROUGHT MANAGEMENT RESPONSES: FOCUS ON MUNICIPALITIES AND THE PROVINCIAL DEPARTMENT OF AGRICULTURE

4.1 Introduction

With declining available water supplies and unfavourable rainfall forecasts for October-December 2009, municipalities were tasked to draft drought management plans for their area in September 2009. These included the implementation of emergency water tariffs, monitoring of high water usage, awareness campaigns, and reprioritisation of municipal capital budgets in order to implement both short- and medium-term solutions. The coastal towns in the Eden District, dependent upon tourism for municipal income, were under particular pressure to fast-track responses. This was due to the rapidly approaching summer tourist season, along with the imminent arrival of thousands of visitors for the FIFA Soccer World Cup in June 2010. This was paralleled by growing attention to agricultural conditions across the Southern Cape, as water became increasingly scarce, pasture deteriorated and livestock came under pressure. This chapter describes measures adopted by municipalities to drastically reduce water consumption and increase local supply. It also documents the reach of the fodder relief scheme that sought to support more than 2,000 farmers in 11 municipalities.

4.2 Measures to reduce urban water demand

A wide range of strategies adopted sought to reduce local demand as well as increase water supply. Municipal efforts to reduce water consumption included: intensifying water restrictions and tariffs, increased focus on reducing leaks, monitoring, and concerted efforts to promote public awareness. Examples of some of the measures adopted are summarised in Table 4.1 below.

Table 4.1: Measures taken to reduce water consumption in Eden

Water demand measures	Examples
Restrictions and tariffs	In George, water restrictions were first introduced in April 2009 and then scaled-up on two later occasions. Consumers were prohibited from using potable water for irrigating sports fields, washing vehicles and cleaning hardened surfaces. Grey water only was permitted for watering gardens and swimming pools had to be filled from rainwater or other sources. Severe penalties were imposed for contravening these rules. Emergency tariffs were introduced to discourage water use and to ensure the financial sustainability of the water services during this period of severely restricted usage.
	Although Knysna introduced severe restrictions, the seasonal influx of visitors over the December 2009 summer holiday made it difficult to reduce consumption rates.
	In Oudtshoorn, where municipal supply is shared with farmers for irrigation purposes, restrictions were introduced in December 2009.
Repairs	There were many constraints in reducing water consumption due to unaccounted-for water losses, (such as leakages, illegal abstractions and lack of adequate monitoring infrastructure).
	George Municipality appointed a technician to monitor water use of all users, to detect excessive use and follow up personally with users to alert them to possible water leakages on private property. Numerous contraveners were also detected in the process. Indigent households were encouraged to report water leakages on their property, and a dedicated team effected repairs on indigent residents' properties.
	Bitou and Mossel Bay succeeded in monitoring urban water consumption and repairing leaks. In contrast, Beaufort West faced difficulties in monitoring leaks and illegal abstractions due to out-dated equipment (such as water meters) and infrastructure.

Water demand measures	Examples
	Several municipalities (including Mossel Bay, George and Knysna) installed low-pressure water systems, which proved effective in reducing consumption.
Awareness campaigns	Extensive efforts were made by all municipalities to promote public awareness on the need to reduce water consumption. This required close cooperation with local media, especially local newspapers.
	The George Municipality committed financial and human resources to a *Joint District Communications Team* which launched a highly effective district-wide public awareness campaign.
	Awareness was increased through other measures, including the publication of names of high water users in local newspapers (i.e. Beaufort West) and inclusion of neighbours' water consumption with residents' monthly water statements (Knysna).

Altogether, for the six municipalities listed below, daily water consumption fell by 41% during the 18-month period. This generated daily savings of 50Ml, equivalent to 1,500Ml/month across the six municipalities. This indicates the prospect of water savings of up to 18,000Ml/year – comparable to the 2011 FSC of two Garden Route Dams.

The benefits of rigorous water demand management were indicated by impressive reductions in municipal consumption illustrated below in Table 4.2. This indicates extraordinary water savings, particularly for Mossel Bay and Bitou municipalities that respectively dropped demand by 59.03% and 43.34% over an 18-month period from April 2008 – October 2010. Although Oudtshoorn also reduced its demand by 44.66%, this was not effected until mid-way through 2010.

Table 4.2: Reductions in Municipal Water Consumption (Ml/day)
April 2008 – October 2010 (du Preez; May 2010, October 2010)

	Water Consumption (Ml/day)(Month)			Ml reduced 2008 - 2010	% reduced 2008 - 2010
Municipality	**April 2008**	**April 2010**	**October 2010**	**Ml/day**	**%**
George	34.55	22.03	22.08	12.47	**36.10**
Knysna	15.0 *	9.81	10.00	5.00	**33.36**
Mossel Bay	29.95	14.78	12.27	17.68	**59.03**
Bitou	10.54	9.1	5.97	4.57	**43.34**
Oudtshoorn	23.8 *	23.88	13.17	10.63	**44.66**
Hessequa	8.0 **	8.95	7.94	0.06	**0.75**
Total	**121.84**	**88.55**	**71.43**	**50.41**	**41.37**

* Knysna consumption for December 2008
** Hessequa consumption reportedly doubled to 16 Ml/day during summer holiday periods

4.3 Measures to increase urban water supplies

4.3.1 Overview

In addition to focused efforts to reduce water demand, numerous projects were undertaken to augment municipal water supplies. These included the drilling of 78 boreholes to increase groundwater supplies, and the construction of four waste-water treatment or reclamation plants as well as four desalination plants. Tables 4.3 and 4.4 list the initiatives taken, primarily completed during 2011 – although Phase II of the Outeniqua Ultra Filtration Plant, pump station and pipeline came on-line from August 2012. Tables 4.5(i) - 4.5(v) summarise expenditures incurred for emergency municipal water supplies by municipality, and funding source.

Table 3.4: Boreholes per municipality, funded by National Treasury

Municipality	No of boreholes	Water produced – estimated yield	Cost (R)
Knysna	17 equipped; 28 drilled	3 Ml/day	R 10,150,000
Mossel Bay	4 equipped; 17 drilled	3 Ml/day	R 3,000,000
Bitou	6 equipped	3 Ml/day	R 4,400,000
George	3 equipped; 17 drilled	3 - 4 Ml/day	R 1,434,130 to equip R 1,880,570 to drill
Beaufort West	7 equipped, 10 drilled	41 L/s	R 10,500,000

Table 4.4: Urban water infrastructure co-funded by National Treasury as part of the drought relief

Municipality	Town	Date completed	Size (ML/day)	Cost of construction (ZAR million)
Knysna	Sedgefield (Desalination)	Dec-10	1.5	16.4
Mossel Bay	Mossel Bay (Desalination)	Oct-11	15	197.8
Bitou	Plettenberg Bay (Desalination)	Dec-11	2	32.2
Knysna	Knysna (Desalination)	Aug-11	2	
Beaufort West	Beaufort West (Reclamation)	Jan-11	1.1	28.6
George	George (Ultra Filtration Plant, * Pump station & Pipeline - Phase II)	Aug-12*	10	80.0
Mossel Bay	Little Brak (WwTW)**	Nov-09	15	60.0
Mossel Bay	Hartenbos (reclamation)	Apr-10	5	26.5
George	Malgas pumping station	Sep-11	19	31.8

* Phase I of the Outeniqua Ultra Filtration Plant was operational in 2010

** Wastewater Treatment Works

Table 4.5(i): Municipal emergency water supply infrastructure initiatives 2009 – 2011: Mossel Bay Municipality

Mossel Bay					
Funding Agent	Groundwater and RO treated effluent	Desalination	Further groundwater exploration	Public Awareness	Total
National Treasury	16 500 000	92 000 000	0	0	**108 500 000**
Municipal budget	15 400 000	35 800 000	3 000 000	0	**54 200 000**
PetroSA	22 500 000	70 000 000	0	0	**92 500 000**
Eden DM	0	0	0	200 000	**200 000**
Total	**54 400 000**	**197 800 000**	**3 000 000**	**200 000**	**255 400 000**

Table 4.5(ii): Municipal emergency water supply infrastructure initiatives 2009 – 2011: George Municipality

George							
Funding Agent	Effluent re-use	Malgas Pumping Station	Catchment Burn	Boreholes	Raise GRD Spillway	Public Awareness	Total
National Treasury	69 000 000	17 550 000	3 000 000	450 000	0	0	**90 000 000**
Municipal budget	11 188 429	0	0	0	0	0	**11 188 429**
RBIG	0	14 204 700	0	0	795 300	0	**15 000 000**
Eden DM	0	0	0	0	0	200 000	**200 000**
Total	**80 188 429**	**31 754 700**	**3 000 000**	**450 000**	**795 300**	**200 000**	**116 388 429**

Table 4.5(iii): Municipal emergency water supply infrastructure initiatives 2009 – 2011: Knysna Municipality

Knysna					
Funding Agent	Groundwater exploration	RO Plant	Pipe from Hoogekraal to Karatara	Public Awareness	Total
National Treasury	8 900 000	31 200 000	0	0	**40 100 000**
Municipal budget	1 250 000	6 600 000	0	500 000	**8 350 000**
MIG	0	5 212 072	4 000 000	0	**9 212 072**
Eden DM	0	0		200 000	**200 000**
Total	**10 150 000**	**43 012 072**	**4 000 000**	**700 000**	**57 862 072**

Table 4.5(iv): Municipal emergency water supply infrastructure initiatives 2009 – 2011: Bitou Municipality

Bitou				
Funding Agent	Groundwater Exploration	RO Plant	Public Awareness	Total
National Treasury	0	20 000 000	0	**20 000 000**
Municipal budget	3 400 000	12 150 000	0	**15 550 000**
Eden DM	1 000 000	0	200 000	**1 200 000**
Total	**4 400 000**	**32 150 000**	**200 000**	**36 750 000**

Table 4.5(v): Municipal emergency water supply infrastructure initiatives 2009 – 2011: Beaufort West Municipality

Beaufort West		
Funding Agent	RO Plant	Total
National Treasury	28 600 000	**28 600 000**
Total	**28 600 000**	**28 600 000**

4.3.2 Augmenting groundwater supplies

According to a recent report on South African groundwater supply (DWA, 2010), the Gouritz River WMA has an available groundwater supply of 279.9m cubic metres per year. This constitutes one of the smallest WMA groundwater supplies in the country.

The report explains that early drought interventions often include drilling boreholes to augment dwindling water supply - as groundwater is the last source to be directly affected. However, the same report also cautions that, as the replenishment rate of groundwater resources may also be affected over time, land-use planners should view groundwater as '*a precious and finite resource*' (DWA, 2010:8*).*

Altogether, in the course of the drought operation, 78 boreholes were drilled in the coastal municipalities and Beaufort West, with 48 of these being equipped. In addition, *Ladismith*, in the Klein Karoo, installed a new borehole to augment town water supply during the drought despite high water losses. *Hessequa* also drilled a water supply borehole in March 2010. Unfortunately, this was reportedly saline and could not be used for human consumption. Similarly, many of the boreholes drilled in *Mossel Bay* yielded brackish water. However, four of these were equipped.

Prior to the drought emergency, *Beaufort West* obtained groundwater supplies from 17 boreholes (from the Brandwag, Tweeling, Lemoenfontien and town well-fields, as well as two fountains). Ten additional boreholes were drilled in the Droë River and Hans River, with seven of these subsequently equipped.

4.3.3 Desalination plants

The first desalination plant to be commissioned was located in Sedgefield (December 2010). This was followed respectively in August and October 2011 by a 2Ml plant in Knysna and 15Ml installation in Mossel Bay. The 2Ml Bitou plant came on-line in December 2011. When fully operational, the four desalination plants potentially generate a cumulative yield of 20.5 Ml/day, of which 75% is attributed to the Mossel Bay facility.

All four plants came on-line between December 2010 and December 2011, although winter rainfall in 2010 and the June 2011 cut-off low had already eased the coastal municipalities' acute water shortages. The Bitou plant was reportedly operational from December 2011 – February 2012. However, operations ceased due to technical difficulties and an inadequate location. At the time of writing this report, none of the plants was in operation.

The total cost of establishing the four plants was R 272,962,072, with the Mossel Bay installation constituting 72.5% of all expenditure, due to its significant 15Ml daily capacity. PetroSA and the Mossel Bay Municipality jointly contributed R 105.8m to this R 197.8m installation.

4.3.4 Waste water treatment facilities and reclamation plants

Significant investments were applied to waste-water treatment works and reclamation plants. Mossel Bay's water supply was bolstered first by the renovation of the Little Brak waste-water treatment works – generating an additional 15Ml daily – from November 2009. Five months later, the Hartenbos reclamation plant came on-line, providing a further 5Ml/day, enabling a water 'quota-swap' between Petro-SA and the Mossel Bay Municipality. Through this arrangement, an increased allocation of water from the Wolwedans Dam was made available to the Municipality in exchange for treated water from the Hartenbos reclamation plant. On 4 August 2010, Phase I of the Outeniqua Waste Water Treatment Plant was completed in *George* - generating 1Ml high-quality water/day. This innovative project represented a first for South Africa. Five months later, in January 2011, in another 'first' for South Africa, a reverse osmosis reclamation plant opened in Beaufort West, providing 1.1Ml water daily.

4.3.5 Other interventions

George's water supplies were markedly improved when the Malgas pumping station came on-line in September 2011- providing the municipality with an additional 19Ml/daily.

4.4 Municipal responses – augmenting supply and reducing demand

The management of intensifying urban water shortages involved engineering solutions plus changes in public attitude and practice related to water consumption. These strategies necessitated legal interventions and budgetary adjustments, as well as intense public education and enforcement. The complexity involved in this process and its protracted nature are illustrated by the four case examples below.

4.4.1 Measures adopted in George Municipality

Along with other drought-affected municipalities, George had identified the need for augmented water supplies as early as 2005/2006, reflected in a Bulk Water Supply Planning Study. The report, and its 2007 Addendum (George Municipality, 2007) recommended several water supply strategies, that subsequently guided the municipality's response to the 2009-2011 drought. It profiled the need for strengthened water demand management, as well as a new dam on the Malgas River, Malgas River Pumping Scheme and raising the height of the Garden Route Dam (on the Swart River). A year later, the re-use of treated effluent was identified as an additional strategy (ibid).

This forward planning provided the basis for George Municipality's response from 2009-2011, to streamline emergency water supply priorities with medium/longterm supply augmentation plans. Box 3 describes how this forward planning helped to align the drought responses with longer-term risk reduction priorities.

"George Municipality commenced with the planning in 2008 for the raising of the GRD spillway, the Malgas Pumping Scheme, the Malgas Dam and the indirect re-use of treated effluent. At the time of the first disaster management meeting in August 2009, the Record of Decision (ROD) had been issued by the DEADP for the plant and infrastructure required for the indirect re-use of treated effluent and the associated pump station and pipeline. An application for a water use licence had been submitted to DWA the previous year for the Malgas Pumping Scheme. The George Municipality had also requested professional tenders for various projects on the 2009/2010 three-year capital budget, and consultants had been appointed for all the relevant projects. Had George *not had all the necessary plans in place*, the outcome of this severe drought could have been an extreme disaster for the town of George.

Conventional Resources and Indirect Re-use of Treated Effluent

The initial Bulk Water Resource Plan was reassessed and revised to reflect ease and speed of implementation of resources, while still being cost-effective. The schemes were reprioritised, with the first phase of the *Re-use of Treated Effluent* identified as the top priority, not being directly dependent on rainfall, runoff and/or river flow. The investigation of *groundwater potential* and the *Malgas River Pumping Scheme* were reprioritised as the next two most preferred options

Groundwater

During the 2005 study of the bulk raw water resources, a report was compiled that indicated limited groundwater resources in the George area. The potential was estimated between 2.5 and 3.0 Ml/day. Eden District Municipality provided R1.5m for the drilling of exploratory boreholes. Twenty boreholes were drilled, varying in depth, generally between 180m and 300m, and yields proved beyond initial expectations in the Table Mountain Sandstone, with the Cape Granite not yielding significantly. The quality of the groundwater was generally excellent, with high iron and manganese content that could easily be treated. Three boreholes were equipped, with a combined delivery of approximately 2,8 Ml/day. Disappointingly little information was available on groundwater in the region, and so all boreholes were fitted with loggers. Even if a borehole was not utilised, these loggers provide valuable information for future use.

On enquiry, it was found that *no information is available on existing boreholes* in the region. Users are not recorded on a register, and there is *no monitoring of extraction*. Thus the effect of the drought on groundwater is unknown. The boreholes that have been equipped will only be utilised in times of crisis until more information is available on the *sustainability of the groundwater* reserves."

SOURCE: (Basson, H.L. and Mooiman, L.C., 2010)

Box 3: Excerpted from: *Drought Crisis Management, Challenges and Solutions: Southern Cape, George*

Box 3 Aligning long-term augmentation plans with emergency response options: the role of forward planning in George

Table 4.6 and Figure 4.1 describe the specific steps taken in George during the two-year drought and urban water scarcity emergency. Table 4.6 illustrates the wide range of technical, budgetary and public awareness measures adopted by the municipality. Figure 4.1 tracks Garden Route Dam levels from November 2008 until May 2011, and relates these over time to the measures taken.

This figure illustrates the prolonged nature of the emergency and its associated demands on municipal officials. It specifically underlines the importance of locally available skilled engineering and local risk management capacity to expand municipal infrastructure in the form of additional boreholes and provision of a new waste-water treatment facility – along with local political commitment and administrative capabilities to reprioritise budgets, actively change public attitude and enforce changed consumption patterns.

Table 4.6: Sequence of Drought Management Interventions Taken in George Municipality 2009-2010 (Barrett, 2012)

Phase	Month	Action Taken	Government/Private - District/Provincial/National	Description
First Alert	Jan 2009	Authorities warned of low levels of rainfall in incoming months		Sedgefield ran out of water. Water had to be trucked from George to Sedgefield. Knysna also experienced severe water scarcity
Proactive Measures	Apr 2009	First restrictions imposed - strengthened twice	George Mun.	
	Oct 2009	Prayer for rain at Outeniqua Stadium	George Mun.	
	Aug 2009	Situation in Sedgefield. Meetings began & drought management plan was drawn up in George	George Mun., Eden District Disaster Management, Western Cape Disaster Management Centre, Department of Water Affairs, SAWS	- George Mun. called on the province to have GRD raised - Reports devised to engage National Disaster Management and the National Treasury - SAWS did a historical climatic analysis and DWA did a historical analysis of rivers
Emergency Management/ Impact Verification	Sep - Oct 2009	Mun's submitted business plans to address current needs request submitted for a Special Council Meeting to inform politicians (2 Oct) Application to Nat. Treasury to implement emergency water tariffs & for disaster funding: full drought report to Council (incl. the re-use plant) & request to declare George a disaster area	George Mun.	- Implemented emergency tariffs immediately. Installed low pressure water systems immediately. Monitored consumers with high water consumption and took appropriate steps to limit their water use - Committed financial and human resources to Joint District Communications Team (with a district-wide public awareness campaign). - Reprioritised the operational budget for law enforcement, public awareness, water flow control - Reprioritised capital budget and implemented short, medium-term solutions. Committed human financial resources needed to address crisis - Implemented emergency tariffs & flow reducing devices - Consumption targets set household use limited to 15kL/month
Classification & Declaration of Local Disaster	10 Nov 2009	Declaration of disaster	Acting Executive Municipal Manager, Eden District Mun., requests that the drought in Eden District be declared a local disaster	
Funding Mobilised	Dec 2009		National Treasury	
Proactive Measures	Dec 2009 - Jun 2010	Restrictions	George Mun.	- An increase in water tariffs. Current use of grey water only for garden irrigation and filling of swimming pools - Potable water prohibited for irrigation of sports fields, washing of vehicles and cleaning of hardened surfaces. If contravened, the person(s) is subject to fines/imprisonment
	Feb 2010	Increase Water Supply - drilling boreholes	George Mun.	
	Mar 2010	Increase Surface Runoff - controlled burning	George Mun.	
	May 2010	Increase Water Supply - Outeniqua Waste Water Treatment Works	George Mun.	Re-use of waste water, completion in May 2010

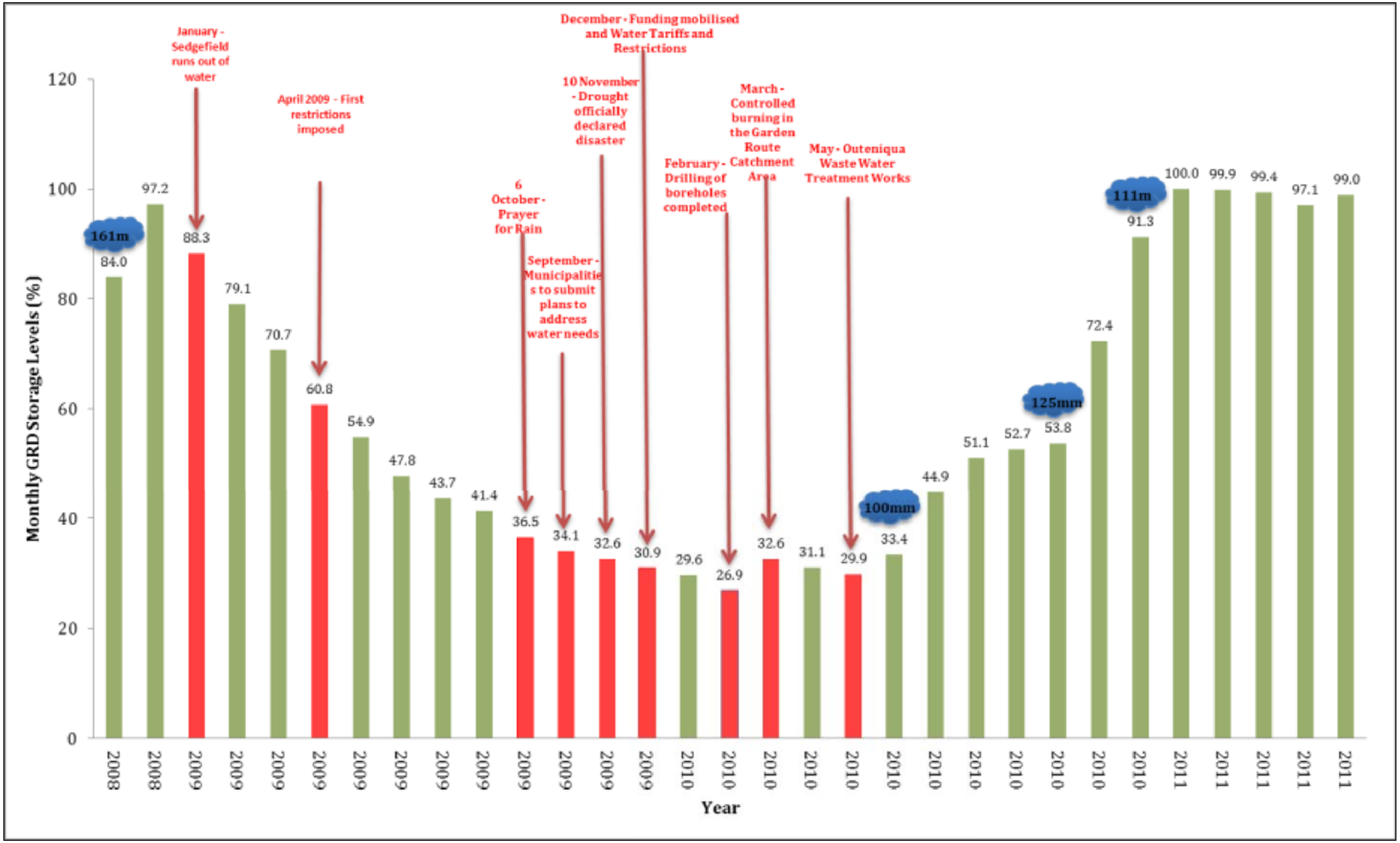


Figure 4.1: Monthly Garden Route Dam storage percentage (%) levels November 2008 – May 2011, with detailed management strategies timeline (Barrett, 2012)

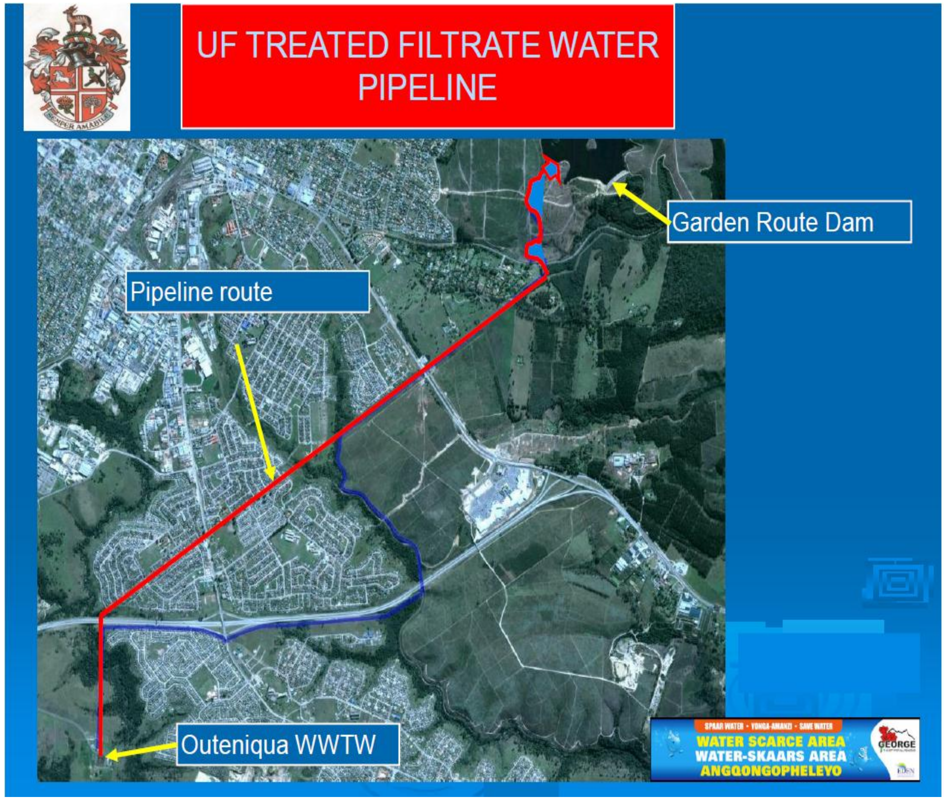


Figure 4.2: An aerial photograph indicating the engineering challenges of the Outeniqua WWTW, including its 7.8km pipeline to the GRD (Basson, 2010)

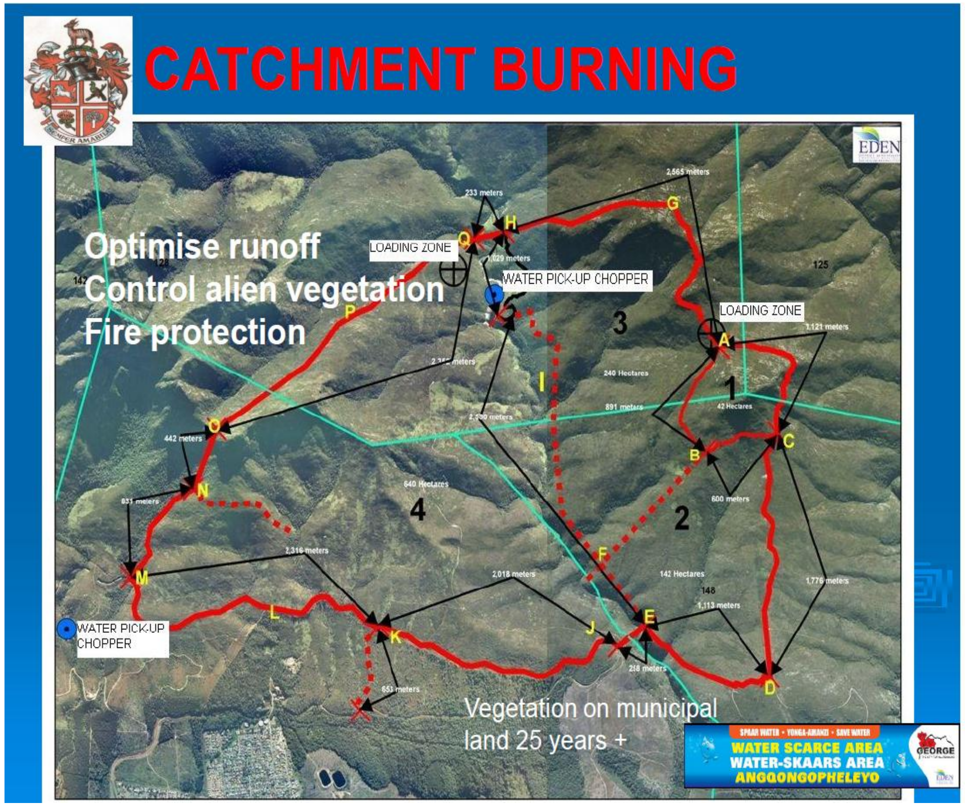


Figure 4.3: Pre-planning for Controlled Burning of the Swart River Catchment, to increase run-off March - April 2010 (Basson, 2010)

4.4.2 Impressive reductions in water consumption - Mossel Bay

Mossel Bay achieved particularly impressive water savings. In 2009, the municipality introduced *strict water restrictions*, lowering allowable household usage to 15kL/month, and ceased providing 6kL free water/month (except for indigent households). Defaulters were fined and programmable restrictors installed for repeat defaulters, the cost of which was covered by the fine.

The Municipality visited disadvantaged areas, including informal settlements and RDP-housing developments, and *rigorously repaired leakages and breakages* – reducing water losses by as much as 40%. It also implemented a programme to *replace all defective pipelines*, together with the zone metering and *monitoring of night flow* from the reservoir. *Meters were replaced or installed* where previously absent to ensure better monitoring of consumption. An *aggressive alien vegetation clearing project* was undertaken in the Moordkuil catchment to increase run-off after rainfall events.

These measures were accompanied by a *proactive water saving campaign*. Household water bills were accompanied by restriction notices, while billboards advertised dwindling dam levels and local radio stations broadcast information. *A dedicated committee was established* to deal with the water emergency, and met weekly. The measurable results on daily water consumption of these combined efforts are shown in Figures 4.2 and 4.3.

Box 4: Reducing urban water demand: achievements by Mossel Bay Municipality

Figures 4.4 and 4.5 show the effectiveness of concerted water demand management implemented in Mossel Bay. Reportedly, average daily consumption declined from 26.82Ml in October 2008 to 12.27Ml during October 2010. This represented 'remarkable savings of 54%' (du Preez, 31 October 2010).

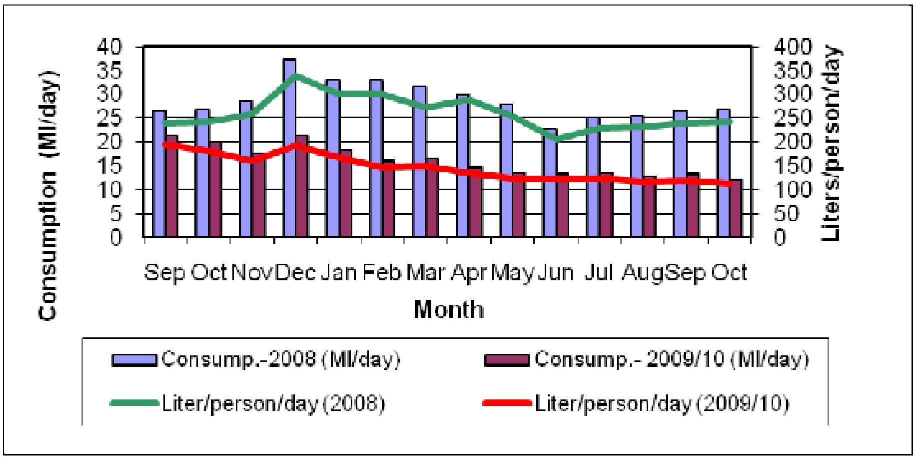


Figure 4.4: Monthly water consumption, Mossel Bay Municipality October 2008 – October 2010 (du Preez, 31 October 2010)

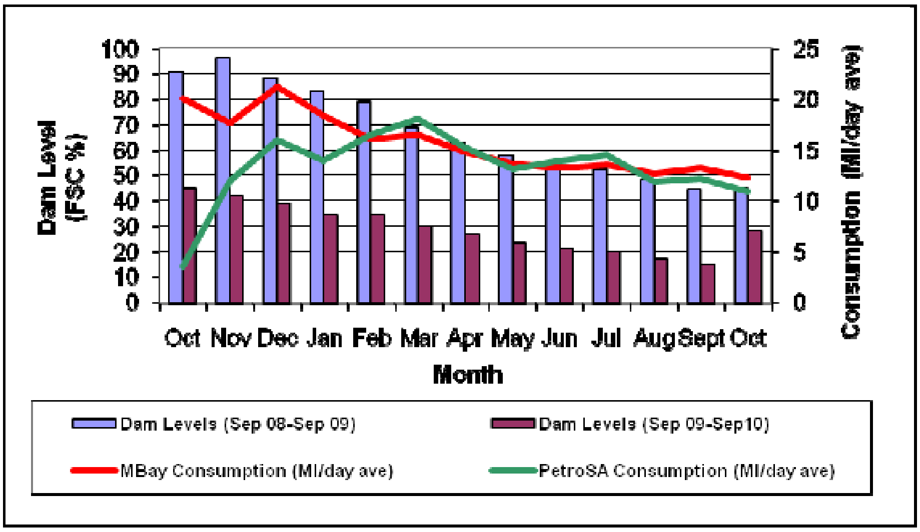


Figure 4.5: Monthly water consumption and dam levels, Mossel Bay Municipality October 2008 – October 2010(du Preez, 31 October 2010)

4.4.3 Emergency water measures in Beaufort West

While the coastal municipalities were able to contain the progression of increasing water shortages, *Beaufort West* within the Central Karoo District exhausted its water supply by November 2010. Table 4.7 below summarises the wide range of interventions implemented within Beaufort West to protect its diminishing water supply in 2010 and then provide emergency water services when both ground and surface water supplies failed between September-November 2010. The emergency measures culminated in staggered 36-hour water shedding periods, the provision of water supplies through Static and Roaming Tanks and even household-level distribution of bottled water.

Although the Municipality introduced new water tariffs as early as July 2008 to discourage high water consumption, restrictions became necessary in 2009. These austerity measures were gradually increased as the water crisis deepened and the Gamka Dam level dropped significantly. Figure 4.7 illustrates the steep and sustained decline in water demand from early 2009 until January 2011, when it reversed, due to the commissioning of a water reclamation plant.

Table 4.7: Timeline of emergency water management measures: Beaufort West 2009-2011

Date	Measure	Description
Apr 2009	Water restrictions	First introduced
Nov 2009	Water restrictions increased	Consumers fined R 150 for daily water consumption > 12kL
Jul 2010	Drought tariff coupled with Gamka Dam level	For instance, if consumers exceeded 15kL/day consumption, a **200% surcharge** was applied to their water accounts
Nov 2010	Water demand shedding introduced	Necessary as reservoirs had run dry. Water supplies to 700 households cut for 48 hours initially, then extended to 2,000 households for 36 hour stretches. The CBD, hospitals and industrial areas were not required to comply with water load shedding
	Bottled water distribution	120,000 x 5L bottles of water were distributed (20L/household every 48 hours). This constituted a major logistics exercise. Ninety temporary staff members were locally employed for this operation
	10 additional boreholes	
15 Jan 2011	Water Reclamation Plant commissioned	South Africa's first - 2Ml/day
	Walker Dam	6L/second

Figure 4.6: Examples of public awareness measures: Beaufort West, 2010 (Smit, 2012)

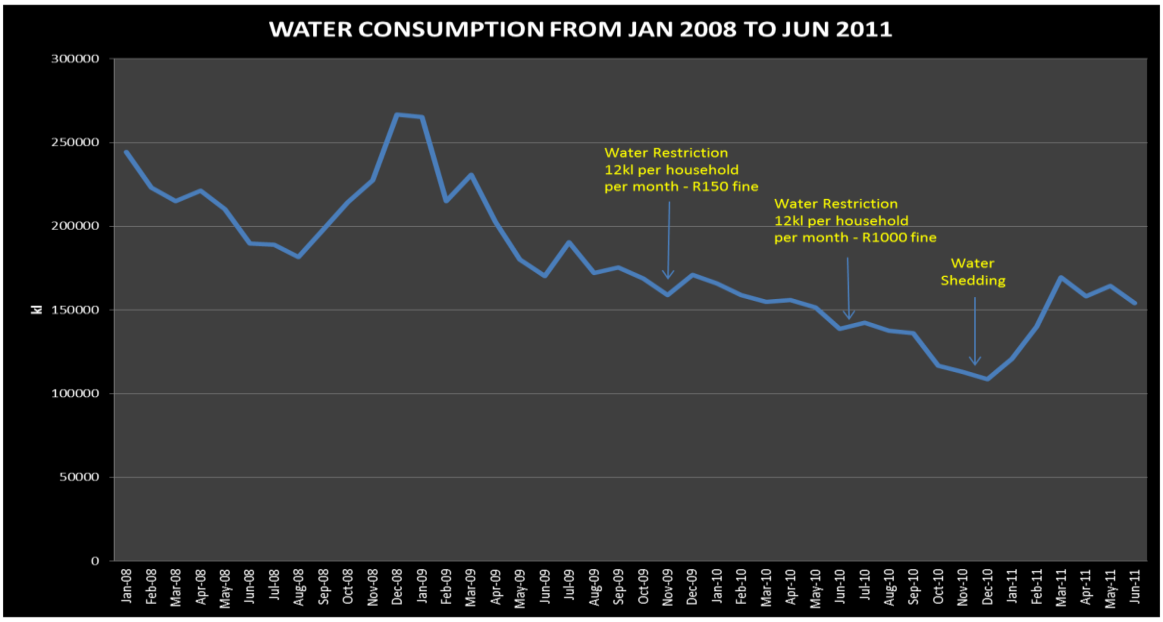


Figure 4.7: Evidence of Reduced Water Demand Measures – Beaufort West

4.5 Agricultural Relief – provision of fodder

4.5.1 Overall distribution of fodder vouchers

Altogether, 2,434 farmers were issued fodder vouchers across eleven municipalities in the Central Karoo and Eden Districts, equivalent to approximately R 33m. Of these, 83.2% redeemed their fodder vouchers, although 16.8% did not. Table 4.8 presents the allocation of fodder vouchers by municipality and district, also representing the numbers of farmers who redeemed their vouchers – along with those who did not. 409 farmers did not obtain fodder relief valued at approximately R 4.7m (14.33% total allocation) compared with 2,025 farmers who accessed R 28.3m (85.6% total allocation).

Table 4.7 that follows indicates marked unevenness in the uptake of fodder vouchers, however, with ninety percent of farmers in eight municipalities utilising the programme. Notably, as seen in Table 4.9, **100%, 92.1% and 33.6%** of all farmers approved for fodder relief respectively in Kannaland, Oudtshoorn and Eden DMA did not redeem their fodder vouchers in the first phase of the relief programme.

Table 4.8: Total fodder relief vouchers distributed by municipality (Rand values 2010)

Municipality	Vouchers redeemed		Vouchers not redeemed		Total cost to Central Government?	
	Cost (R)	No. of farms	Cost (R)	No. of farms	Cost (R)	Total farms
Beaufort West	420 084	64	49 867	9	469 951	73
Laingsburg	678 428	81	22 752	4	701 180	85
Prince Albert	50 400	5	2 458	2	52 858	7
Total CKDM	**1 148 913**	**150**	**75 076**	**15**	**1 223 989**	**165**
Bitou	796 393	78	63 626	10	860 019	88
George	3 185 187	200	279 161	22	3 464 348	222
Hessequa	14 343 612	912	755 366	60	15 098 978	972
Knysna	1 023 615	62	24 028	3	1 047 643	65
Mossel Bay	6 012 102	413	497 982	36	6 510 084	449
Kannaland	0	0	438 563	46	438 563	46
Oudtshoorn	137 859	10	1 692 479	116	1 830 338	126
Eden DMA	1 615 309	200	900 071	101	2 515 381	301
Total EDM	**27 114 077**	**1 875**	**4 651 276**	**394**	**31 765 353**	**2 269**
Total (R)	**28 262 989.87**	**2025**	**4 726 352.40**	**409**	**32 989 342.20**	**2434**

Table 4.9: Fodder relief vouchers redeemed/not redeemed: % of total relief allocation (Data: WCDoA)

Municipality	Vouchers redeemed as a % of the total		Vouchers not redeemed as a % of the total	
	% Cost	% No. of requests	% Cost	% No. of requests
Beaufort West	89.4	87.7	10.6	12.3
Laingsburg	96.8	95.3	3.2	4.7
Prince Albert	95.4	71.4	4.6	28.6
Bitou	92.6	88.6	7.4	11.4
George	91.9	90.1	8.1	9.9
Hessequa	95	93.8	5	6.2
Knysna	97.7	95.4	2.3	4.6
Mossel Bay	92.4	92	7.6	8
Kannaland	**0**	**0**	**100**	**100**
Oudtshoorn	**7.5**	**7.9**	**92.5**	**92.1**
Eden DMA	**64.2**	**66.4**	**35.8**	**33.6**

The proportionate financial value of fodder relief provided during the drought is spatially represented in Figure 4.8. Orange-shading indicates the Rand value of vouchers redeemed, while green-shaded circles represent the Rand value of vouchers that were not redeemed. The map highlights the extent of relief assistance required in Eden's coastal municipalities (912 farms in Hessequa alone, valued at R 14.3m). However, it also suggests significant constraints to relief access for inland farmers, with virtually all approved farmers in Kannaland and Oudtshoorn not redeeming their vouchers.

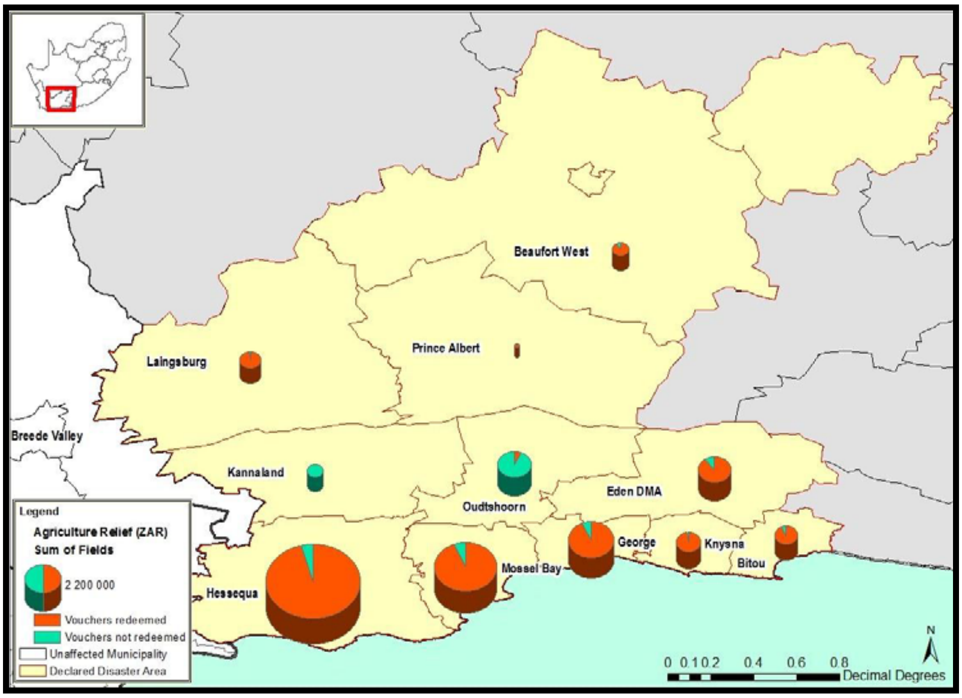


Figure 4.8: Proportionate financial value of fodder relief, spatially represented, by vouchers redeemed/non-redeemed – Eden and Central Karoo District Municipalities 2010

4.5.2 Access to fodder relief for large-scale and small-scale farmers

As findings from field research in Kannaland, Oudtshoorn and Haarlem indicated that emerging and small-scale farmers were financially unable to cross-fund their fodder allocation (i.e. 30% and 10% for large-scale and small-scale farmers respectively), the research team examined the distribution of non-redeemed vouchers more carefully. 165 of the 409 farmers who did not redeem their fodder vouchers were classified as 'small-scale farmers'. This represents 40% of those farmers *who did not access the fodder relief scheme*. This percentage rose to 69.6%, 63.8%

and 45.5% for Kannaland, Oudtshoorn and Eden DMA respectively – signalling particularly high levels of vulnerability for small-scale livestock farmers in these areas. Regrettably, it was not possible to trace the respective outcomes of accessing/not accessing fodder relief in highly vulnerable farm communities, and the relative protection it conferred to livestock assets.

Figure 4.9 shows the spatial distribution of farms where vouchers were not redeemed, and compares the relative non-uptake of relief between large- and small-scale livestock farmers.

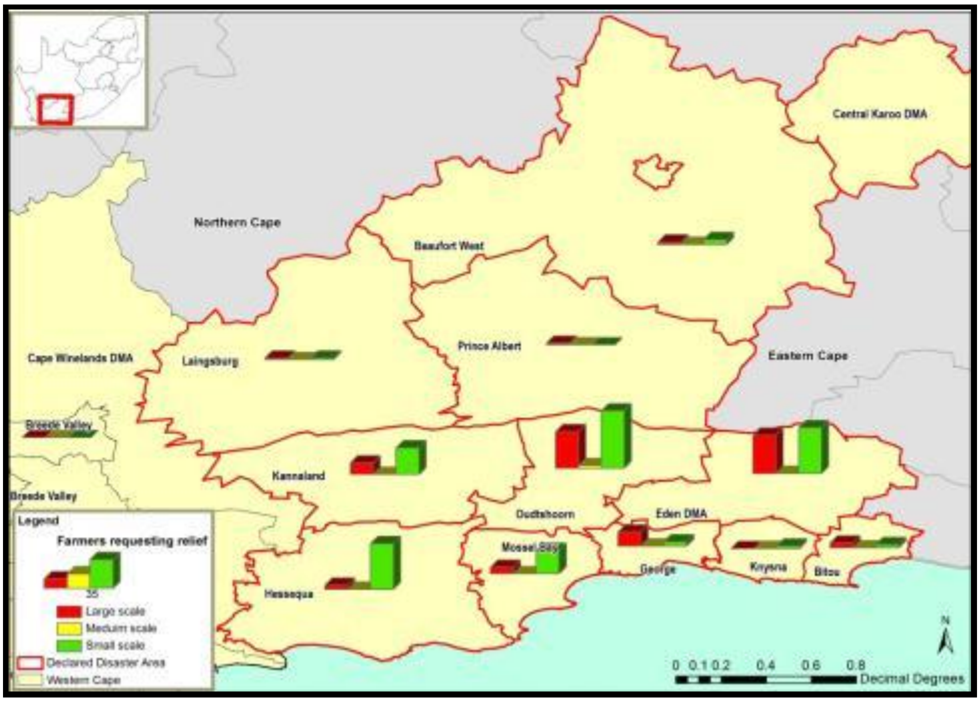


Figure 4.9: The distribution of farms where relief vouchers were not redeemed, and differentiating this by large- and small-scale livestock farmers.

Detailed, tabulated information on the distribution of small, medium and large livestock farmers who were authorized to receive fodder relief is available in Annex 4.

4.6 Conclusions

Focused municipal response to the drought emergency resulted in numerous achievements in some areas. Impressive reductions in municipal water demand in particular were achieved between April 2008 and October 2010, with daily water consumption reportedly declining by more than 41% for Bitou, George, Mossel Bay, Knysna, Oudtshoorn and Hessequa Municipalities over this period. These decreases resulted from a focused suite of interventions, including increased tariffs, water restrictions, repairs to leaking infrastructure and intensive public awareness campaigns.

Energetic efforts by district and municipal engineers ensured a remarkable expansion of local water supplies.

2,434 farms were also approved for fodder relief – primarily in the Eden District, where more than 900 farms in Hessequa alone, were allocated fodder relief vouchers. Unexpectedly, 409 farms did not access the fodder relief, notably in Kannaland, Oudtshoorn and Eden DMA. Furthermore, 40% of these were small-scale livestock farmers, many of whom were located in areas with very limited access to water and were unable to cross-fund their proportion of the fodder allocation.

PART V: DROUGHT RISK DRIVERS

5.1 Introduction

The UNISDR's 2011 *Global Assessment Report on Disaster Risk Reduction (GAR)* stressed the need for greatly strengthened drought risk management because of the increasing and wide-ranging impacts of drought (UNISDR, 2011:54). It further noted that 'the impacts of drought can only be partly attributed to deficient or erratic rainfall, as drought risk appears to be constructed over time by a range of drivers. These include: poverty and rural vulnerability; increasing water demand due to urbanisation, industrialisation and the growth of agribusiness; poor soil and water management; weak or ineffective governance; and climate variability and change'(Ibid).

Many of these factors prevailed in the 2009-2011 drought that affected the Southern Cape and Central Karoo. This chapter identifies some of the key drought risk drivers that increased exposure to meteorological, agricultural and hydrological drought, along with examples of risk reduction measures adopted by farmers to minimise losses. It concludes with possible strategies suggested by farmers for reducing future adverse agricultural impacts.

5.2 Drought risk drivers identified

Table 5.1 summarises information on the main drought risk drivers identified during this study, specifically those related to:

- Increased water demand prior to the drought that outpaced available supply
- Under-recognition and investment in Integrated Water Resource Management (IWRM), including diversification of water supply options
- Limited capacity to understand and plan for concurrent drought and urban water scarcity risks
- See-saw variability in annual and seasonal rainfall.

Although this does not represent an exhaustive list of risk drivers, these factors were repeatedly identified in reports reviewed and corroborated through field research. While they are clustered separately, these factors were also often interlinked and mutually reinforcing.

Table 5.1: Drought risk drivers

Risk drivers for increased drought	Development risk factors that increase drought exposure	Examples
Increased water demand that outpaces supply	Rapid recent urban growth associated with tourism, internal migration, retirement, free basic service provision	- Mossel Bay – 64.8% population increase (2001-2007): annual population growth rate of 8.7%
		- George (no. of tourist beds increased by 4,750 between 2004 and 2006)
		- Van Wyksdorp - 2001 population 439 households; by 2011 population was 1,200 households due to low cost housing projects
	Urban water requirements compete with agricultural and industrial needs	- Petro SA and Ladismith cheese factory
Under-investment in IWRM	Limited availability of skilled personnel	- Prince Albert - Lack of skilled personnel resulting in limited water resource governance/regulation
	Management capacity of water infrastructure/services is limited	- National DWA vacancies: 47% hydrologists and 53% geo-technicians
	Anticipatory investment in new (appropriate) water infrastructure is severely limited	- Inadequate record keeping and water monitoring, for example: ○ Calitzdorp - Flood irrigation by "lei water" system (water initiative) ○ Beaufort West – Unaccounted-for losses at Gamka Dam: +/- 52% - Outdated infrastructure/technology, for example: ○ Klein Karoo -Obsolete infrastructure/technology for monitoring leaks, losses and illegal abstractions ○ Prince Albert - Reticulation system obsolete and decaying, resulting in leaks
	Limited access to, and implementation of alternative technologies	- High levels of 'Dead Storage' due to excessive siltation (for example Calitzdorp 17%) - Inability to use drip irrigation/micro-sprays due to high cost of electricity for pumping water
Social constructs of drought, water scarcity and drought management are limited	Agricultural differentiation of "types of drought" not automatically transferrable to urban areas	- Agriculture drought typologies: "seasonal drought" "skyn droogte", "rampdroogte" (disaster drought) are well-understood by farmers, but imprecisely defined - No equivalent or uniform definition for urban areas (indicated by request to SAWS for definition in August 2010)
	Limited awareness of the differences in water storage induced by excess demand and those generated by rainfall deficit	- Poor monitoring of water consumption
Climate variability and change (i.e. increased temperature, storm intensity, longer duration dry periods)	Effects of random, low frequency heavy rainfall mask inadequate water resource management actions	- Over-dependence on chance heavy rainfalls to regularly fill storage dams (George farmers) - Farm dam infrastructure and storage capacity destroyed during cut-off low events and remaining un-repaired (Haarlem, Barrydale) - Designed for 3 months' storage only (not for longer dry spells)

5.2.1 Increased water demand that outpaced available supply

Prior to the drought, numerous risk factors drove escalating (and often unmonitored) water demand that increased exposure to periods of rainfall deficit. These included recent, rapid urban growth associated with internal migration, expansion of services related to tourism and retirement, as well as free basic service provision.

5.2.2 Urban growth and expansion

In the years prior to 2009, several of the drought-affected municipalities experienced considerable economic growth. For instance, from 1996-2009, the municipalities of Bitou, Knysna and Mossel Bay respectively recorded average annual economic growth rates of 7%, 6.6% and 7.4% (John, 2012). These increases were also accompanied by sizeable population growth. Data in the 2007 – 2008 Local Government Year Book (Gaffney, 2008), indicated that the Eden District's population grew to half a million people, with George and Mossel Bay emerging as the most populous urban centres.

The scale of this increase is particularly illustrated by the example of *Mossel Bay that reportedly experienced a 64.8% growth in population between 2001 and 2007,* equivalent to an 8.7% annual growth rate (Nkhahle *et al*., 2010:35). This was attributed to economic growth noted earlier - associated with a tourism boom and retirement developments. During drought study fieldwork, interviewees noted that this growth 'boom' continued for approximately three years, until 2009. Tourism and retirement developments not only stimulated the real estate industry (with reportedly 286 Estate Agents operating during this period) but also engendered a rapid influx of people seeking labour opportunities.

Significant expansion of tourism was also noted in George where, between 2004 and 2006, *tourist beds within the municipality increased by 4,750* (Urban-Econ: George, 2009).

Sustained urban growth and its implications for municipal water demand also apply to Beaufort West. The Central Karoo town's population has more than doubled since 1970, increasing from *17,900 (Populstat, 2006) to 41,000* in 2009 (Beaufort West Municipality, 2010). This growth was also being accompanied by significant town expansion from 1945-2010, indicated by the dark shading in Figure 5.1(i). Unfortunately, this growth and expansion were not matched by investments to address identified needs for improved water supply development. For instance, the Gamka Dam (Figure 5.1(ii)), which provides 45% of town's water supply, was constructed in 1955 (Umvoto Africa, 2010). In Beaufort West, as with other drought-affected municipalities, a major drought risk driver was that the development of alternative water supplies had not kept pace with rising local demand.

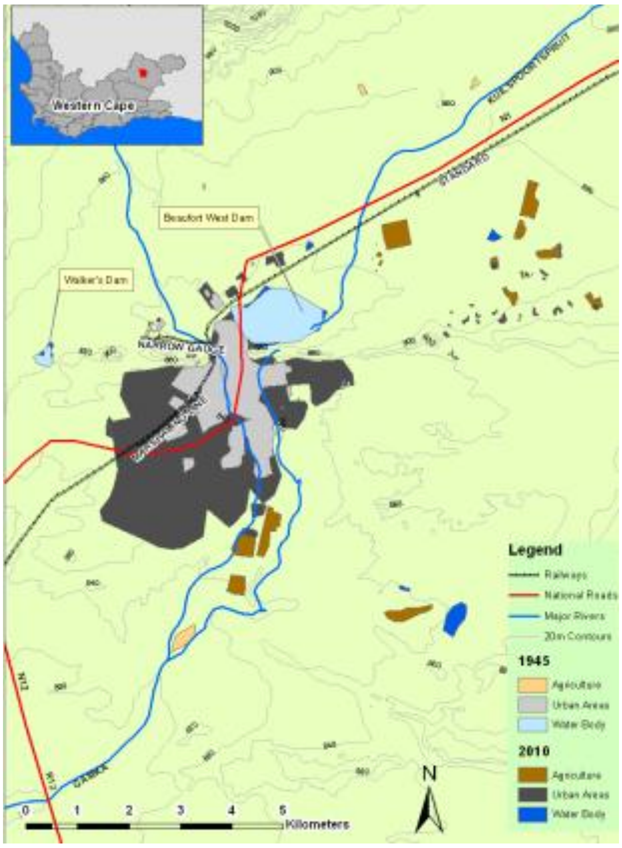


Figure 5.1(i): Steady town expansion of Beaufort West, 1945 – 2010.

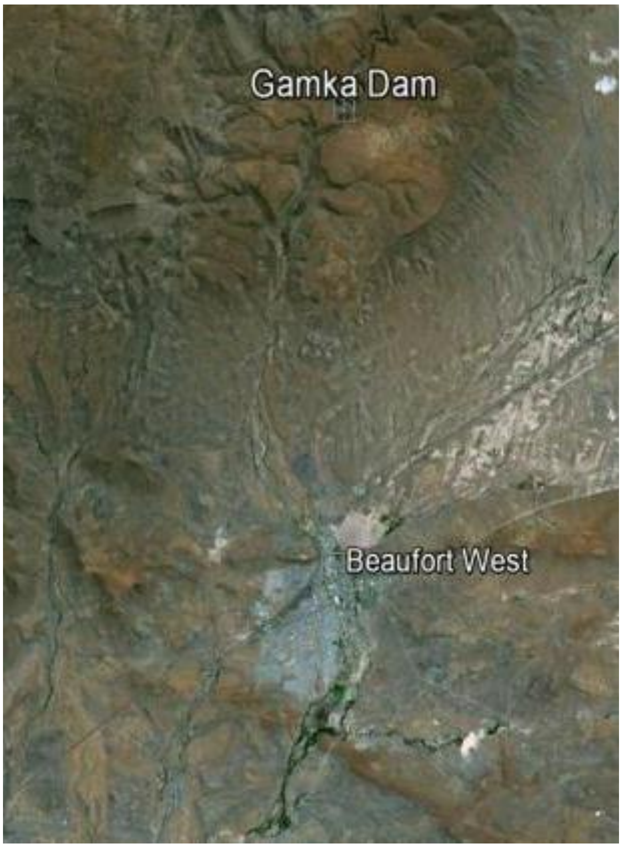


Figure 5.1(ii): The location of the Gamka Dam (GoogleEarth®).

5.2.3 Free basic service provision

A tension between *sustainable water resource management* and *basic water service provision* was also identified in the course of the study. The state's *Five-Year Local Government Strategic Agenda* specifically identified the provision of housing and basic services to previously disadvantaged communities as a key measurable municipal performance area. In response, there has been a steady growth in the provision of state housing, together with an expansion in both the number of new and the size of existing informal settlements across the drought study area.

Statistics provided by the Provincial Department of Human Settlements indicate the establishment/upgrade of numerous low-cost housing developments in the Western Cape during the past decade. Such developments, particularly along the N2 and R62 access routes, have increased local water requirements – along with urgent needs for strengthened water resource management capacity. Figure 5.2 illustrates the location of low-cost housing developments (including upgraded settlements and services) from 2003-2009 in the study area.

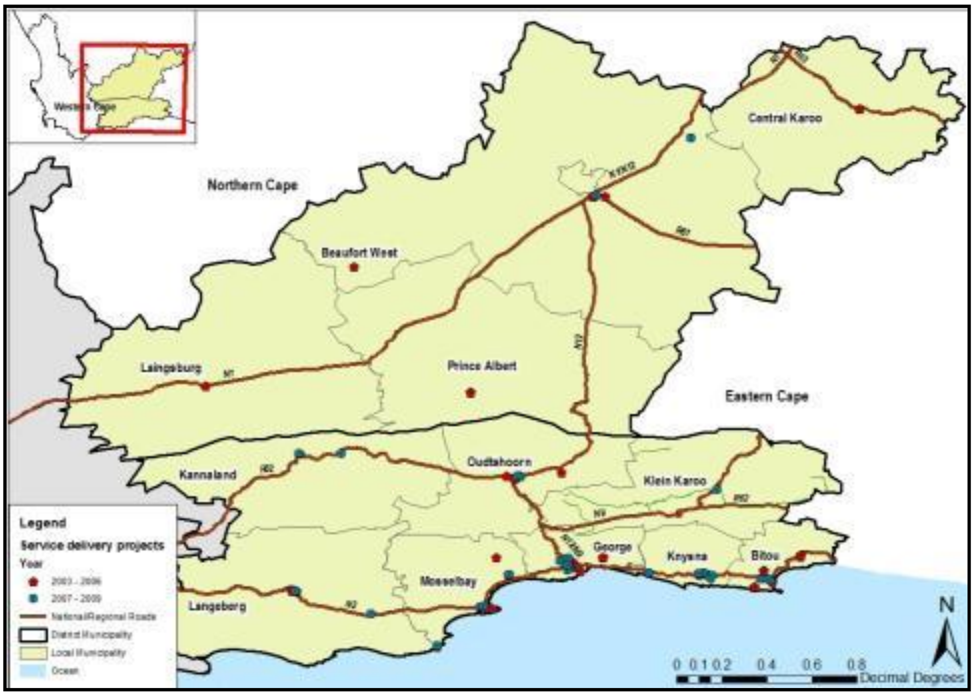


Figure 5.2 Location of state housing developments in the drought study area between 2003 -2009

This pattern of urban expansion prevailed in both inland as well as coastal areas. For example, respondents in Klein Karoo towns such as Zoar, Van Wyksdorp and Ladismith noted marked growth in Reconstruction and Development Programme (RDP) housing developments, which now provide previously disadvantaged households with running water and flush toilets. For instance, in 2001, Van Wyksdorp reported a population of only 439 (136 households). However, the *town's population has trebled in the last decade*, following the construction of RDP houses.

Such developments have had several consequences, for both under- and high-performing municipalities. First, successful service provision, such as the installation of flush toilets and running water to poor communities, has increased urban water demand, but without necessarily upgrading municipal water supply and monitoring infrastructure/services. The Western Cape Government's Annual Performance Report for 2008/9 (see Western Cape Department of Local Government, undated), for example, records a significant increase in the number of indigent households receiving free basic water in the Province between 2007 and 2009, rising from 324 000 to 335 000 households[4].

Second, numerous respondents noted that successful service provision had the unintended consequence of promoting further in-migration from under-served areas.

5.2.4 Effects of increasing urban water consumption: George 2000-2010

The impact of *increasing water demand* on exposure to hydrological drought in a rapidly growing municipality is clearly illustrated by Figure 5.4. It represents George's annual water consumption from 2000 to 2010, and illustrates how yearly water requirements grew by nearly 60% from 8,003Ml in 2000 to 12,650Ml in 2008 (Barrett, 2012:73)

[4] In 2007 it was estimated that there were over 32 000 indigent households in the Eden District, most located in these two towns. (Database of the Provincial Treasury: Socio Economic Profiles Local Government 2007).

Fortunately, George's 2008 consumption did not exceed the combined GRD and Swart River Dam's assured yield of 13.4Mm^3/year, plus 1.6Mm^3/year supply from the Kaaimans Pump Station (from 2008). However, Figure 5.2 illustrates the combined effect of rising consumption (red line) and declining rainfall (green line) on GRD storage levels in 2009 and 2010 (indicated by the blue-shaded bars).

Table 5.2: Annual water consumption: George Municipality (2000-2010)

Year	Annual Water Demand (Ml)
2000	8,003
2001	8,188
2002	9,164
2003	9,977
2004	10,105
2005	10,175
2006	9,975
2007	11,606
2008	**12,650**
2009	11,975
2010	7,741

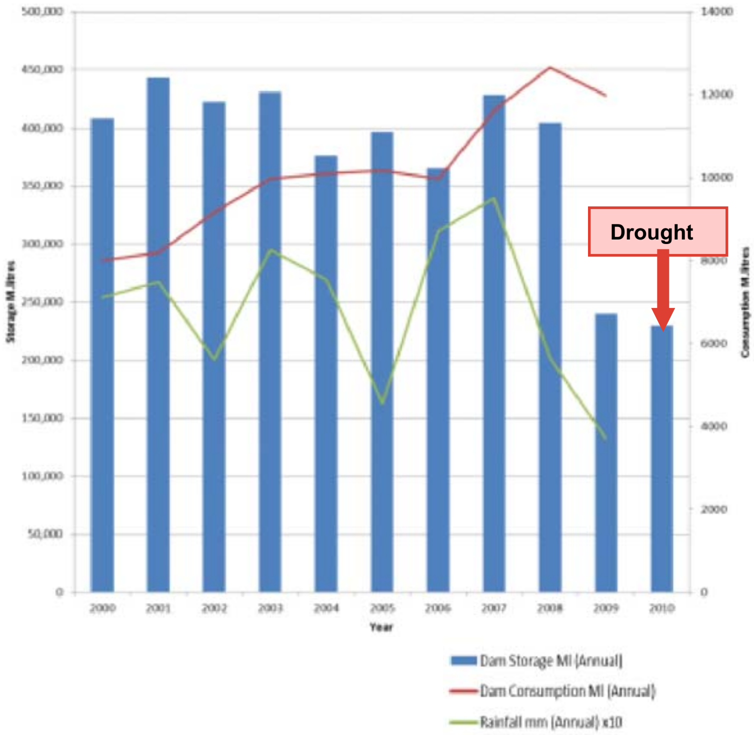


Figure 5.4: Annual rainfall, water consumption & Garden Route Dam storage levels (2000-2010) (Barrett, 2012)

5.2.5 Competition for scarce water resources: urban requirements, agriculture and industry

Agriculture: As the drought intensified, competition for dwindling water resources increased. For instance, in Hessequa, the Korente Vet and Duiwenhoks Dams provide water for both agricultural and municipal use, supplying Riversdale, Heidelberg, Slangrivier and Witsand. As dam levels began falling rapidly, the municipality implemented a drought management plan in September 2009 - restricting agricultural use to 80% of its pre-drought allocated quota (du Preez, 12 February 2010:24).

However, according to the Eden District Disaster Manager, unmetered and unauthorised water abstraction from rivers and boreholes by farmers constituted a difficult, on-going problem. This same sentiment was expressed by a water official with many years' experience in the Klein Karoo. In Box 5 below, an experienced engineer describes the difficulties involved in enforcing water restrictions in agriculture, and suggests that a 'formal structure of compliance officers over the whole spectrum of water use sectors should be instituted with training in advance should a future drought disaster occur'.

Disparity in compliance and prosecution resources

"Compliance with the restrictions as announced by the municipalities and the Department of Water Affairs: Compliance in the final instance is a matter of concern for Agriculture. Substantial manpower available in terms of Compliance Officers could be drawn from Traffic Officers duly trained in legal procedures. Contrary to this, compliance could not be enforced in agricultural areas where obvious gross transgressions were observed. They were also not reported. A formal structure of compliance officers over the whole spectrum of water use sectors should be instituted with training in advance should a future drought disaster occur.

Furthermore, the compliance was aggravated by a lack of understanding both from the technical side as well as the prosecution side and all the legal complications. In this regard, not one successful prosecution was executed and fined where a transgression was obviously to the detriment of the whole community and unlawful water use took place. One such example is the Wolwedans dam transgression which to this day has not been prosecuted and is still pending. The final remark, therefore, should be that a well trained, well briefed and well oiled transgression and compliance procedure should be in place and this should be announced at the announcement time of drought disaster restrictions".

Source: Gorra Water and WCoA

Box 5: The crucial need for compliance and prosecution measures in drought episodes – perspective of an experienced engineer

In Beaufort West, the depletion of both groundwater and supplies from the Gamka Dam resulted in the municipality drawing on water supplies from the irrigation dam located in the town, with negative consequences for local farmers who faced reduced supplies. Conversely, around Uniondale, farmers, whose irrigation supplies were exhausted, were obliged to draw from the Haarlem Dam, Haarlem's primary municipal water source. In Prince Albert, efforts to augment the town's declining groundwater supplies were reportedly thwarted when a local farmer drilled a new borehole nearby and began withdrawals, depleting groundwater sources.

Data provided by the Provincial Department of Agriculture and shown in Table 5.3 below indicate the following stock numbers for March 2010 for the affected municipalities. Table 5.3 shows that approximately 130,000 large livestock units were drought-exposed in the affected areas, with more than 175, 000 small stock units (excluding poultry) similarly exposed. Figures 5.3 and 5.4 represent this distribution graphically, indicating high livestock numbers in George, Heidelberg, Mossel Bay and Riversdale. These stock levels, however, are lower than pre-drought conditions, due to farmers having already implemented destocking measures.

Table 5.3: Total Stock Units for Affected Municipalities – March 2010

Town	Large stock units (LSU)						Small stock units (SSU)				Stock Total
	Beef	Breeding animals	Dairy	Donkeys	Horses	Total	Goats	Poultry	Wool	Total	
Calitzdorp	2 095	60	426	30	180	**2 791**	2 700	500	381	**3 581**	**6 372**
George	11 752	6 087	16 388	46	550	**34 823**	13 866	200 000	9 231	**223 097**	**257 920**
Heidelberg	5 504	929	19 423	18	264	**26 138**	3 018	4 000	3 180	**10 198**	**36 336**
Knysna	4 261	849	7 037	66	1 024	**13 237**	766	75 000	3 517	**79 283**	**92 520**
Mossel Bay	13 676	596	8 483	63	461	**23 279**	462	8 500	60 631	**69 593**	**92 872**
Oudtshoorn	4 126	240	2 025	20	278	**6 689**	5 200	12 000	2 045	**19 245**	**25 934**
Riversdale	6 460	1 943	10 082	16	230	**18 731**	3 028	20 000	9 271	**32 299**	**51 030**
Uniondale	2 269	821	520	118	182	**3 910**	44 996	3 000	15 133	**63 129**	**67 039**
Total	**50 143**	**11 525**	**64 384**	**377**	**3 169**	**129 598**	**74 036**	**323 000**	**103 389**	**500 425**	**630 023**

Data source: Provincial Department of Agriculture

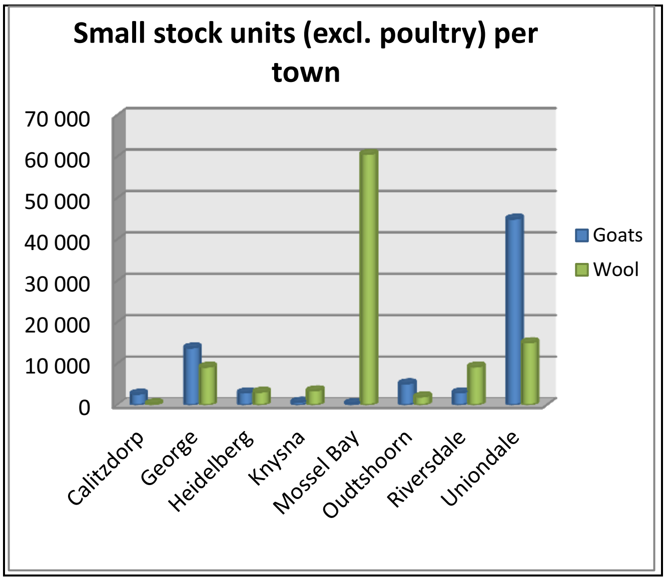


Figure 5.3: Numbers of small stock units (excl. poultry) per town in affected towns

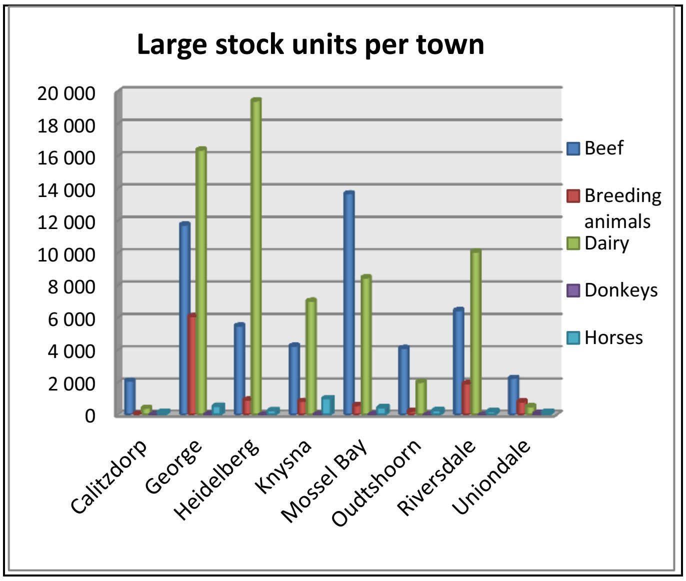


Figure 5.4: Numbers of large stock units in drought-affected towns

The daily water consumption requirement of different livestock types varies widely, ranging from 80 litres/day for dairy cows to 20 litres for goats (Dept of Agriculture, ND). This resulted in wide-ranging cumulative water requirements for the drought-affected areas, and associated impacts as these supplies diminished from the latter months of 2008. For the affected areas, the cumulative livestock water requirement was estimated at 437 Ml/day.

Industrial development: In Mossel Bay, due to PetroSA's contribution of substantial funding for the original construction of the Wolwedans Dam, the company was able to negotiate a water quota and reduced tariffs to accommodate its production needs. However, during the drought, the combined effects of a large urban population and PetroSA's production requirements generated water demand that initially drove dam levels downwards. Figures 5.5 and 5.6 illustrate the two-step water reduction in Mossel Bay's water demand from 2009 to 2010. Figure 5.5, for example, shows an impressive 49% reduction in average daily municipal water consumption from 29.95Ml/day in April 2008 to 14.78Ml/day in April 2010 (du Preez, 7 May 2010). However, the same graph shows how, aside from its 'shut-down' period in October 2009, PetroSA was unable to reduce its consumptive demands, despite the introduction of water restrictions in 2009 (ibid). Fortunately, PetroSA's consumptive trend stabilised later in 2010, as represented in Figure 5.6 which shows declining water demand by PetroSA – a downwards adjustment that was sustained.

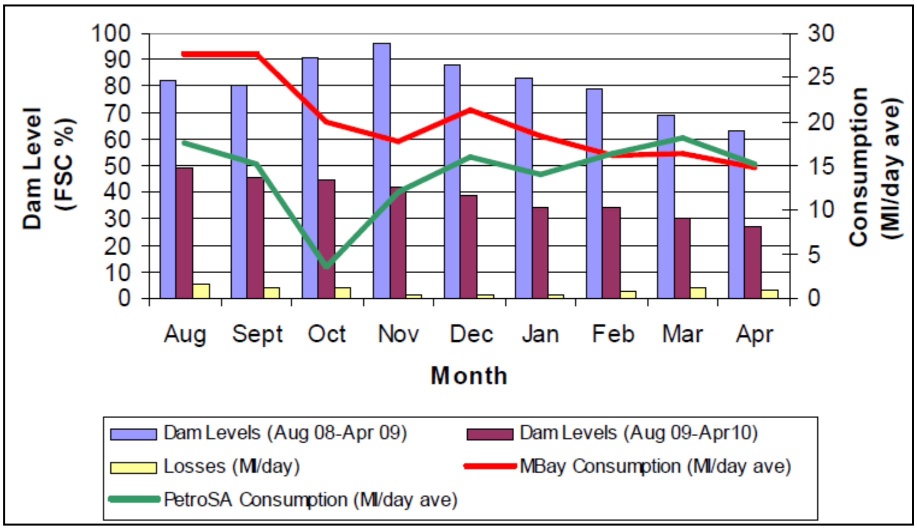


Figure 5.5: Wolwedans Dam levels, average daily municipal and PetroSA water consumption August 2009 – April 2010: Mossel Bay Muncipality (du Preez, May 2010)

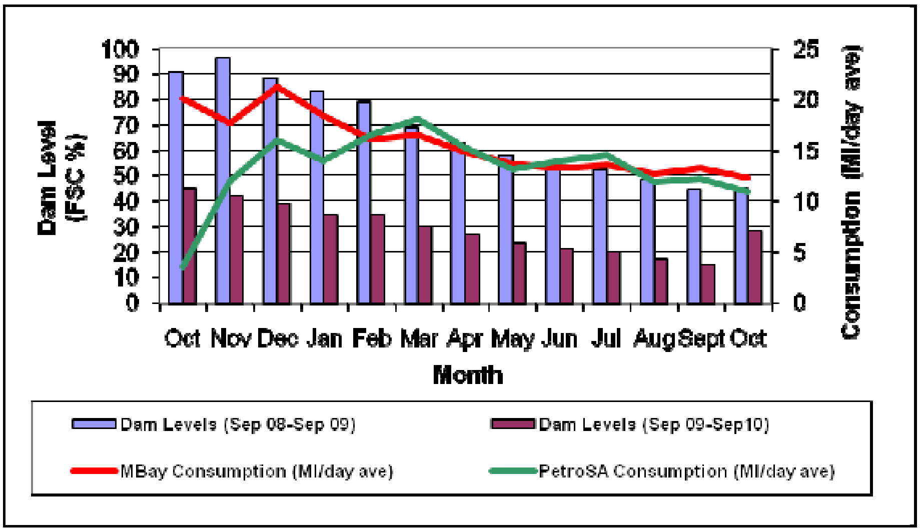


Figure 5.6: Wolwedans Dam levels, average daily municipal and PetroSA water consumption October 2009 – October 2010: Mossel Bay Muncipality (du Preez, October 2010)

5.3 Under-recognition and investment in Integrated Water Resource Management, including diversification of water supply options

A recurrent risk factor that increased exposure to hydrological and agricultural drought conditions was the limited value placed on and under-investment in Integrated Water Resource Management (IWRM). This was reflected by high dependence on surface water sources, rather than a diversified mix that included groundwater supplies. It was also characterised by the limited availability of skilled technical personnel, uneven municipal capacity to manage water infrastructure/services, as well as constrained capacity both to upgrade water infrastructure, and provide access to alternative water conservation technologies.

5.3.1 Limited availability of skilled technical personnel

Effective IWRM is currently restricted by a lack of adequate capacity as well as a lack of technical skills - and applies to all spheres of government, from National State Departments to Municipal scale (DWA, 2011). The shortage of skilled personnel was flagged throughout the study area during field interviews and is clearly influencing effective water management.

Field research findings were corroborated by a recent report by the Department of Water Affairs that flagged the deficiency in qualified or skilled hydrologists and hydro-geologists in South Africa. According to the report 'there has been a decline in the number of "person years" of experience in hydrology in the state sector. Experienced professionals are leaving public institutions to work in the private sector and in foreign countries' (DWA, 2010:13). The report notes that as retired personnel are not easily replaced, the number of vacancies for hydrologists and geo-technicians is estimated at 47% and 53% respectively.

The policy of Occupation Specific Dispensation (OSD) has led to many critical water management posts remaining vacant due to candidates being deemed unsuitable (DWA, 2010). This is now undermining efficiency and sustained and effective management (ibid).

While many coastal towns within the study area have retained experienced municipal engineers, those inland reported uneven access to skilled personnel. This translated into poor management of scarce water resources, especially in areas with erratic rainfall. For instance, in Prince Albert, the recently appointed municipal engineer noted that the town's limited technical skills and capacity shortage had resulted in poor water resource management prior to his arrival. The Prince Albert case-study (Box 6) below illustrates many of the challenges faced by small towns that were simultaneously affected by drought conditions as well as internal capacity constraints.

> With a population of twelve thousand inhabitants, Prince Albert has a small revenue base, with 85% of inhabitants reportedly indigent. Tourism is the main economic activity with seventy guest houses hosting 2,000–3,000 visitors annually while agriculture employs many residents, mainly in fruit and sheep farming. Annual water restrictions are necessary due to the town's low rainfall and high temperatures in December and January. The town depends mainly on borehole water with a 10% DWA allocation from the river. The *reticulation system is outmoded*, with *24% water lost due to leakages*, particularly in the disadvantaged areas.
>
> A recently appointed engineer carried out a *municipal water audit*. Concerned about unregulated water use, he began *monitoring flow and repairing identified leaks*. He also *installed over 20 bulk water meters* funded through a MIG grant and *introduced systems and rules* where none existed before. The engineer was of the view that the town did not experience a 'drought' but rather a 'water shortage', with demand out-stripping supply.

Box 6: Managing water shortage in Prince Albert

5.3.2 Constrained capacity to manage water infrastructure and services

Field research in drought-affected areas revealed *widespread evidence of poor or non-existent water monitoring,* with municipal water use remaining unaccounted for due to poor metering and leakages. This applied not only to small towns such as Calitzdorp but also to larger commercial centres such as Beaufort West where 52% of water used from the Gamka Dam could not be accounted for (DWA, 2011). Beaufort West is also the oldest municipality in South Africa and as such has an ageing and crumbling infrastructure that is prone to frequent water bursts and electricity disruptions. Although respondents noted that it was possible to monitor illegal water pumping through monitoring of electricity usage, even this recourse may not be feasible in small municipalities such as Calitzdorp due to limited technical and local management capacity.

In Calitzdorp, as observed in other towns visited, *inadequate record-keeping* and water monitoring also undermined effective water resource management. Calitzdorp experienced a shortage of water in the town during the drought which was attributed to multiple factors, all related to poor water management. For instance, local small holders use flood irrigation methods provided by '*lei water'.* While this system relies on gravity and levelled lands to direct water through furrows (i.e. does not require electricity), *it is highly inefficient*. Respondents stressed that *drip irrigation was not affordable* due to escalating electricity tariffs.

Lack of local technical capacity in this instance also resulted in *'over-estimation' of Calitzdorp's available stored water.* A 2010 report (Salga, 2010) cited the siltation of the Calitzdorp dam, then equivalent to 17% of the dam's FSC, as a problem that confounded efforts to establish its dead storage volume. This effectively resulted in *under-estimating* the town's water supply risk rating during the drought. Once discovered, the rating was revised upwards from a 'low' to a 'medium' risk category.

Throughout the drought study area, local municipalities remarked on the *financial constraints* that prevented pro-active management of water supply, particularly monitoring and distribution. Since 2005, numerous municipalities reported commissioning technical studies and generating plans to upgrade ageing and out-dated infrastructure, as well as to strengthen monitoring of leaks. Unfortunately, funding for most of these developments was not forthcoming – despite marked population growth, housing development and identified increases in urban water demand in many areas.

5.3.3 Limited access to alternative technologies

Farmers described pro-active efforts to identify strategies to improve water use, especially new technologies that improved irrigation efficiency. Many reported drilling additional boreholes for groundwater. However, while this strategy often secured an alternative water source, it was unaffordable, due to the high electricity costs associated with pump operation. Sustained increases in electricity tariffs over recent years also reportedly undermined efforts by both commercial and emerging farmers to adopt less water-intensive irrigation methods, such as drip irrigation and micro-sprays – in favour of continued reliance on older and inefficient irrigation methods**.**

Despite these constraints, there was evidence of innovative efforts to reduce multiple risks –not only those associated with weather extremes. For instance, in the Langkloof, farmers are reportedly working closely with *Working for Water*, an alien vegetation clearing programme to achieve multiple benefits, described in Box 7 below.

In the Langkloof, farmers are working with *Working for Water*, a vegetation-clearing programme that removes alien trees. However, as this programme does not dispose of the cut tree trunks, branches and stumps, the residual debris increases wild-fire and flood risks. Farmers reported mulching the cut trees, and using the resulting product to insulate the ground in their orchards. This strategy reduces evaporation rates. It also reportedly lowers both water consumption and electricity pumping costs (for irrigation) by as much as 45%.

Box 7: Alternative technologies to reduce multiple risks – mulching trees removed by Working for Water in the Langkloof.

5.4 Constrained and uneven understanding of drought and water scarcity

An important risk that delayed early signal detection of escalating water shortage risk was the inadequate understanding of what drought is and its interface with water scarcity. This was more evident in urban centres, than in rural areas, which are accustomed to periodic droughts. An elderly sheep farmer explained that the drought has different consequences for farmers and 'townsfolk', so that while the town is concerned with water for people and the maintenance of municipal reticulation systems, the farmer is really only concerned with the provision of grazing for his stock - sheep in this example.

5.4.1 Understanding drought and the drought process

Consistent with prevailing drought management policy, a multi-generation Karoo farmer distinguished between several types of drought:

- Seasonal drought

- *'Skyn droogte'* - human-induced drought
- *Rampdroogte* - disaster drought

He interpreted a *seasonal drought* to be a lack of rainfall during a regular rainfall season. This does not always signal a drought but could be an early warning signal. *'Skyn droogte'* on the other hand is a *human-induced drought* caused directly by poor farming practices such as over-stocking and over-grazing. A *disaster drought* or *rampdroogte* refers to an extended period without rainfall and increased aridity that seriously affects normal farming activities.

5.4.2 Absence of drought definitions, indicators and criteria for urban settlements

While such definitions are well-established in agricultural risk management practice, they are not automatically transferrable to urban settings. The research team noted the *consistent absence of clear definitions and criteria for meteorological and hydrological drought* as these applied to urban centres. This was substantiated at the August 2009 Provincial Drought Management Meeting which requested SAWS to provide a definition of 'drought'. It was also indicated in 2011 by a range of varied and non-uniform definitions provided to the study team from municipal engineers, disaster managers and other sector specialists. The lack of clear, unambigous drought definitions and criteria that apply to urban areas limited early drought detection and response. However, from mid-2009 when the drought was identified and uniformly understood, government was able to implement a well-coordinated response.

Reports and field research indicated a wide-spread perception that 'urban drought' was synonymous with falling dam levels. There was limited appreciation that declining dam storage levels did not constitute an 'early warning' of impending drought, and could actually represent 'trailing' indicators of meteorological drought conditions a year earlier. Clearly, falling dam levels may also be attributed to water supply-demand imbalances due to rising consumption levels - independent of rainfall conditions.

5.4.3 Differentiating between *surface water* and *groundwater* hydrological droughts

A further insight generated by the 2009-2011 drought relates to the increasing need to differentiate between *surface water* and *groundwater* hydrological droughts. In Box 8, an experienced geo-hydrologist comments on the drought risk reduction opportunities and monitoring challenges associated with the increasing use of groundwater for municipal water supplies.

When *surface water* is the sole water source, *dam levels* and *river flows* will be the primary indicators of a hydrological drought. However, empty dams and little / no flow in rivers do not necessarily indicate groundwater depletion. In some cases (especially when groundwater is unused), groundwater levels may remain high, with full storage available, despite a surface water hydrological drought. This does not automatically constitute a groundwater hydrological drought. A *groundwater hydrological drought* would most commonly occur when aquifer storage becomes depleted in a production / wellfield situation.

However, the growing development of groundwater for municipal supplies in the southern Cape does increase the risk of *groundwater hydrological droughts*. This calls for close monitoring of wellfields to track the availability of groundwater, along with early signs of groundwater hydrological drought. The omission of such monitoring / management measures will weaken the system, making the supply vulnerable to drought conditions. Some key considerations for reducing the risk of future groundwater hydrological droughts are given below:

- All wellfields are unique. Specific management recommendations (e.g optimum pumping rates) need to be made by a *hydrogeologist* for each wellfield / borehole. *Early warning groundwater levels* also need to be determined. A *monitoring programme* needs to be put in place, and data analysed regularly to enable adaptive management as circumstances change (e.g onset of drought). This will ensure sustainability of groundwater resources - and provide timely early warning to activate contingency plans.

- A groundwater monitoring programme should incorporate the wellfield itself, as well as the surrounding aquifer, which signals aquifer health in the general area. This is important for indicating the availability of additional groundwater for contingency planning.

One possible strategy may involve developing a drought plan for the southern Cape where the "art" of using available groundwater storage (including in agriculture) is applied systematically to "tide the economy across droughts" (rather than enforcing equal restrictions on all users as a drought takes hold).

Box 8: Differentiating between surface water and groundwater hydrological droughts - a geo-hydrologist's perspective

5.4.4 See-saw variability in annual and seasonal rainfall

5.4.4.1 Western Cape rainfall and climate change projections

The Western Cape has been described as being highly vulnerable to climate change in the future (Midgley, Chapman, Hewitson, Johnston, de Wit, Ziervogel, Mukheibir, van Niekerk, Tadross, van Wilgen, Kgope, Morant, Theron, Scholes and Forsyth, 2005) Most climate studies show little evidence for the development of trends in changes in rainfall for South Africa (Midgley *et al.*, 2010). Kruger (2006), however, describes the Southern Coast of the Western Cape to have shown a significant decline in annual precipitation for the period of 1910-2004. This corresponds with observations made by Midgley *et al.* (2005), which suggest that low-lying areas such as the Southern Coast, display a negative trend over time – a decrease in annual precipitation. There is strong evidence that, in general, there is an increase in the rainfall intensity across the Western Cape (Midgley *et. al.*, 2010), although preliminary findings by de Waal (M.Sc unpublished) suggest that the trend for areas within the Langkloof may be one of decreasing intensity over the historical record, while in George and Knysna, the rainfall intensity signal remains unclear.

Findings from Kruger and Shongwe (2004) indicate a significant increasing temperature trend from 1960 and 2003 for the Southern Cape (particularly in spring), as well as general warming trends for the summer and winter months *(Midgley et al., 2005).*

Regional projections under the A2 (see IPCC, 2000) emissions scenario for the Southern Cape/Karoo region suggest that there will be a median temperature increase of between 1.5°C and 2.5°C for the period 2046-2065 when compared to the 1961-2000 period. Downscaled rainfall projections for the same time period project little change in rainfall for the Southern Cape for December-May and an increase in average precipitation from June-November. However, the precipitation anomaly for the Central and Klein Karoo shows little change throughout the year. Figure 5.7 below shows the mean annual rainfall for the Western Cape region.

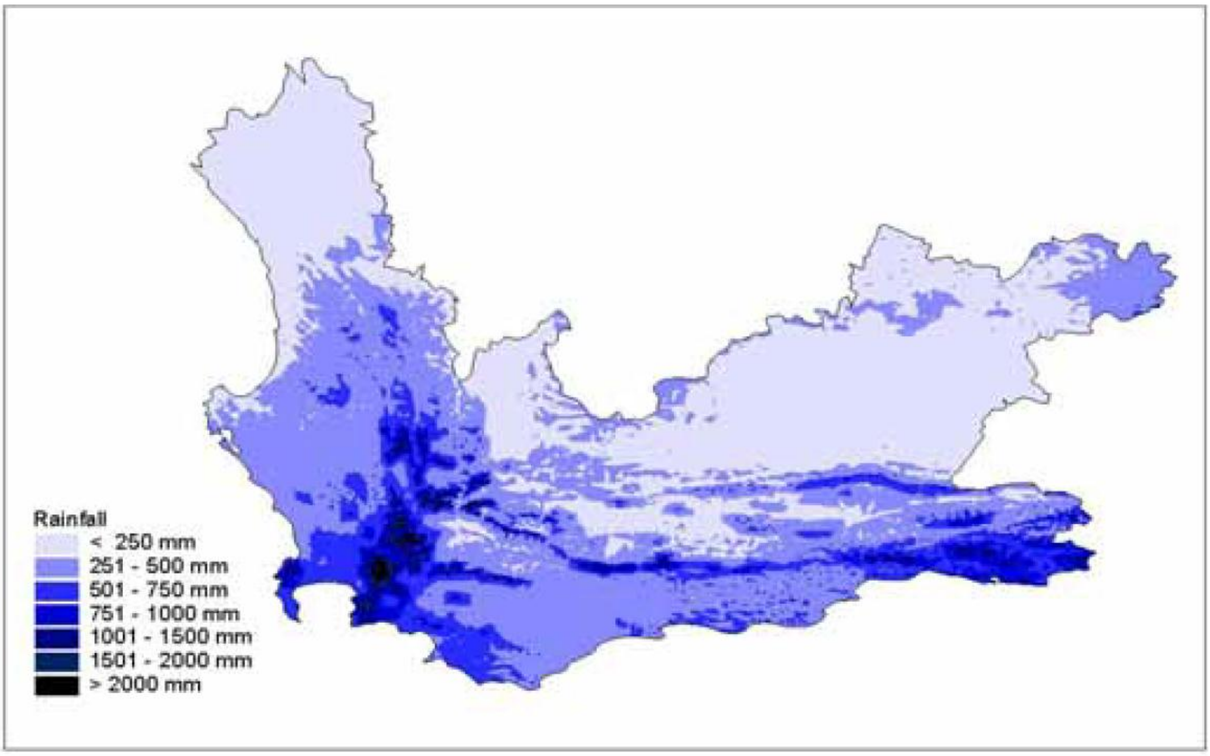


Figure 5.7: Mean annual precipitation for the Western Cape (Midgley *et al.*, 2005:8)

5.4.4.2 Local opinion on changing rainfall patterns

Climate variability and changing weather conditions were widely noted by those interviewed in the course of this study. Farmers and others interviewed repeatedly referred to observed changes in weather and rainfall patterns. Many of these are consistent with scientific projections associated with climate change, as illustrated in Table 5.4.

Table 5.4: Linking scientific understanding of climate conditions with local knowledge and perceptions – findings from field research

Linking scientific understanding with local knowledge and perceptions	
Climate change projections	**Local observations and perceptions**
There is strong evidence to suggest that there has been an increase in rainfall intensity across the Western Cape. Future projections suggest that this trend will continue with higher magnitude rainfall events occurring in the region (Midgley *et al.*, 2005)	In Laingsburg, the Municipal Manager noted that rainfall intensity has increased since his childhood, which has led to more flash floods A George dairy farmer suggested that cut-off low weather events should be accepted as commonplace and used as opportunities for additional water storage
An increase in the number of dry days and "dry spells" is projected in the future (Midgley *et al.*, 2005)	An elderly Laingsburg farmer suggested that droughts were now occurring more frequently, with an absence of "soft rains". His planting season has shifted to October due to longer winter "cold spells"

Linking scientific understanding with local knowledge and perceptions	
Climate change projections	**Local observations and perceptions**
Future projections indicate that mean annual temperatures are very likely to increase in the Central and Klein Karoo as well as the Southern Cape (Midgley et al., 2010). There is also evidence of an observed increase in the number of "very warm" days through the historical record (Midgley *et al.*, 2005)	A farmer in Amaliensteyn in the Klein Karoo commented that temperatures have become hotter while seasonal changes are unpredictable. The longer winters have affected planting cycles, with pumpkin (which used to be planted at the end of August) now being planted a month later
Rainfall projections suggest a slight weakening in winter rainfall and slightly more late summer rainfall occurring (particularly in the east of the province) (Midgley *et al.*, 2005)	Farmers in Calitzdorp observed that the seasons are changing, which influences planting periods

Other interviewees suggested that heavy rain patterns had shifted spatially in recent years. For instance, in Beaufort West, the Municipal Engineer, who has monitored rainfall changes since the 1980s, noted that rain is now falling predominantly over the town itself and not over the Gamka Dam mountain catchment, as before. This had implications both for surface water supply, as well as access to groundwater, due to slower rates of aquifer recharge. The Laingsburg Mayor also reported that the spatial extent of intense rainfall events was much narrower than he could recall in earlier years. (It should be noted that as the rain-gauge network density is sparse in much of the study area, such observations could not be tested by rainfall analysis).

5.4.4.3 Navigating rainfall extremes

A recurrent observation made by farmers, municipal engineers and disaster managers referred to the see-saw nature of rainfall patterns in recent years. Almost all respondents stressed that effective **drought risk** management *could not be separated* from **maximising the benefits of intense storms** (often endangering), while simultaneously minimising their destructive attributes.

Figures 5.8 and 5.9 illustrate the challenges of managing highly variable rainfall in Uniondale. Figure 5.9 indicates that in 2005, 2008, 2009 and 2010 annual rainfall of approximately 400mm was recorded These years were punctuated by heavy rainfall years in 2006, 2007 and 2010, all associated with cut-off low events, including an especially damaging cut-off low in November 2007 (with rainfall that year greater than 900mm, exceeded only in 1981 – the Laingsburg flood disaster). It was the flood damage to farm irrigation water storage from this event that escalated subsequent farm exposure to reduced rainfall in 2008, 2009 and 2010.

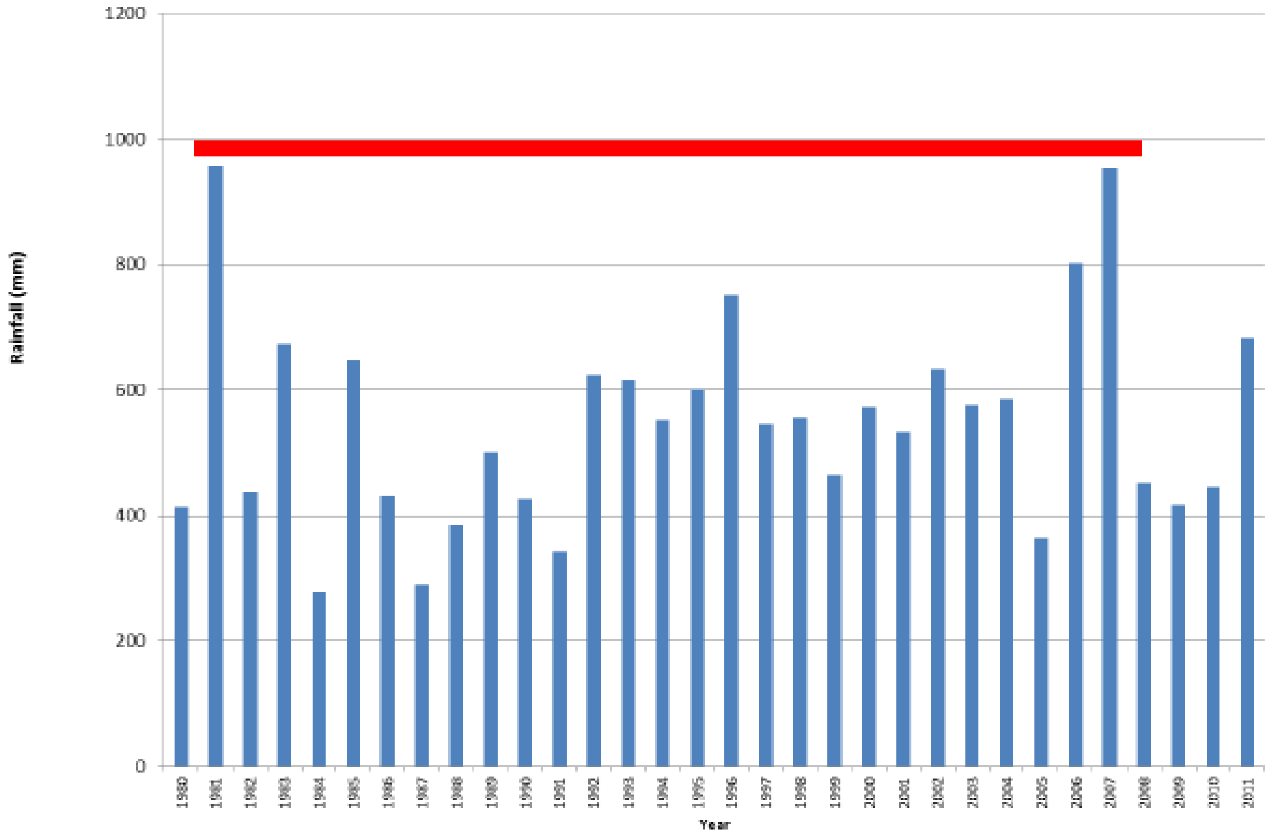


Figure 5.8: Annual rainfall for Uniondale Station 1990-2011

Figure 5.9 relates monthly rainfall data from Uniondale to Haarlem Dam levels from 2000 – 2011. It illustrates the relationship between intense cut-off low systems and monthly rainfall – shown in March 2003 (the 'Montagu Floods'), August 2006 (the 'Southern Cape Compound Disaster' attributed to two cut-off lows spaced three weeks apart) and the November 2007 cut-off low.

The challenge of providing reliable municipal water supplies to Uniondale, despite weather extremes, had been long acknowledged, and was measurably reflected in 2000/1 with the construction of a pipeline that linked the town to the Haarlem Dam (explained in Box 9 below).

In 2000/01, a pipeline was constructed, linking Uniondale to the Haarlem Dam. This was prompted by seasonal changes following heavy flooding in 1996. It was also motivated by dwindling river flow from the Kamanassie River due to increased upstream agricultural abstraction.

The new pipeline not only provided water to the town residents but also provided a lifeline to farmers along its course. This was especially the case after water shortages became an annual occurrence from December to February.

This meant that Uniondale, which had previously depended on the Kamanassie River for its water supply, withstood the 2009-2010 drought. A disaster manager noted, however, that water restrictions 'were not taken very seriously' in Uniondale as residents were confident in the supply of water from the Haarlem Dam.

Box 9: Construction of a pipeline that linked the town to the Haarlem Dam

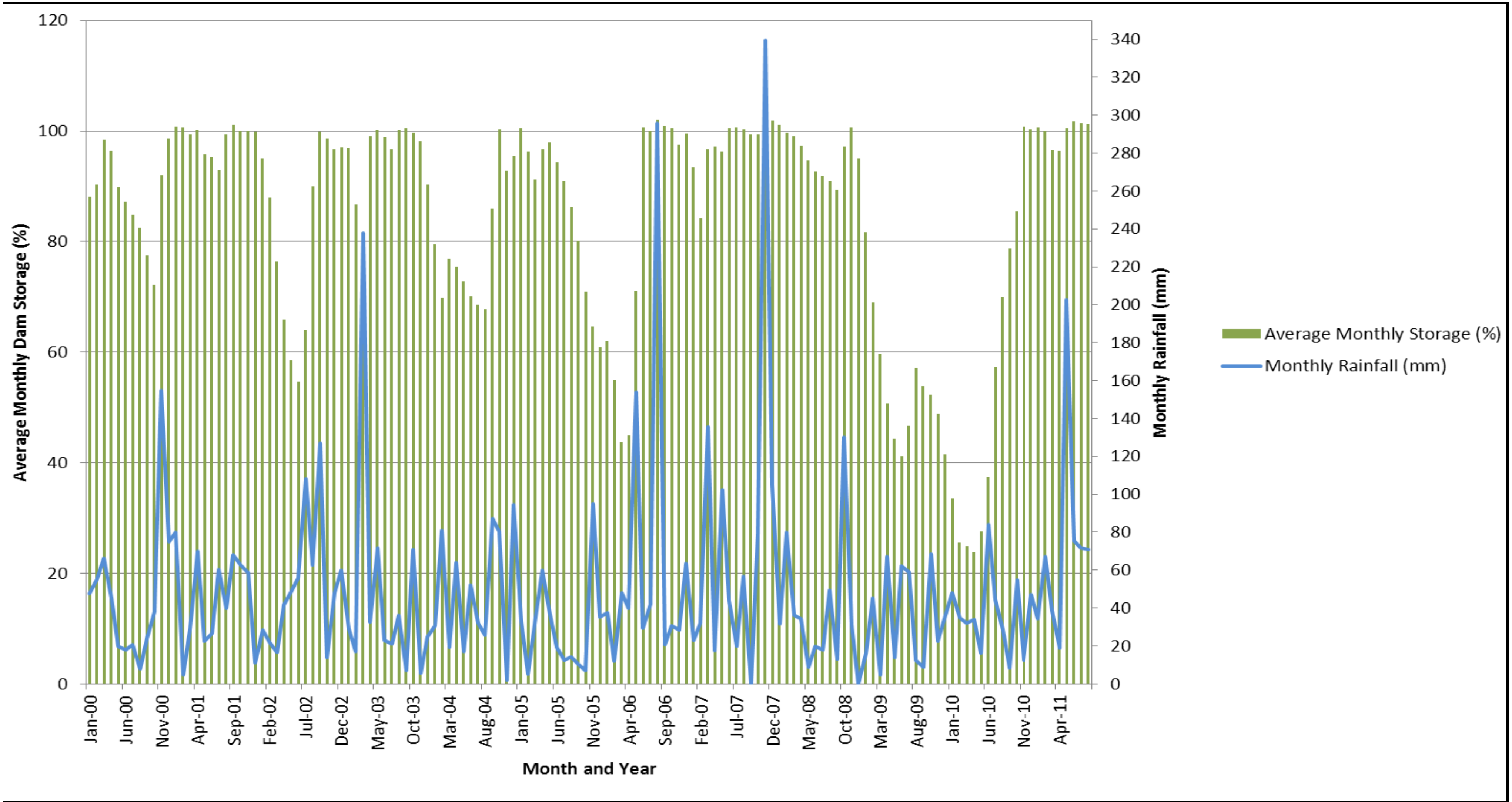


Figure 5.9: Average monthly dam storage (%) for Haarlem Dam and monthly rainfall at Uniondale rainfall station (mm) from January 2000 – August 2011

These difficulties in managing climate risks were not only noted in the Langkloof. Farmers in the Overberg *outside* the areas officially classified as drought-affected, but with farms straddling the Overberg/Eden boundary, commented that local rainfall patterns also appear to be changing. One Swellendam farmer, whose family has been farming the area for many generations, reported that heavy rains between 2004 and 2007 damaged four of his farm dams, two of which he rebuilt but lost again during subsequent floods.

A repeatedly noted constraint to anticipatory risk management for agricultural drought was the acknowledged inadequacy of *current on-farm water storage*. This was attributed to capacity constraints to retain no more than three months' water in storage (which was inadequate during prolonged dry spells). It is also associated with design features that are inadequate for intense rainfall events, such as emergency spillways not competent to pass the peak flows, with the inevitable result of damage and dam failure – consequently increasing farm exposure to the outcome of later low rainfalls.

5.4.5 The masking effect of heavy rainfall events on increasing water scarcity

The occurrence of intense cut-off lows, and associated heavy rainfalls across the southern Cape not only generated physical impacts on dam storage (both beneficial replenishment in some instances, while damaging structural losses and sedimentation in others). They also acted to 'mask' accumulating urban drought vulnerability, associated with poorly monitored and regulated urban water consumption. Figure 5.10 below from George, for instance, shows that urban water demand increased by 50% from 2000-2008 (red line). This consumption substantially increased the city's exposure to meteorological drought shocks – and continued even after there was clear evidence of declining rainfall (blue line).

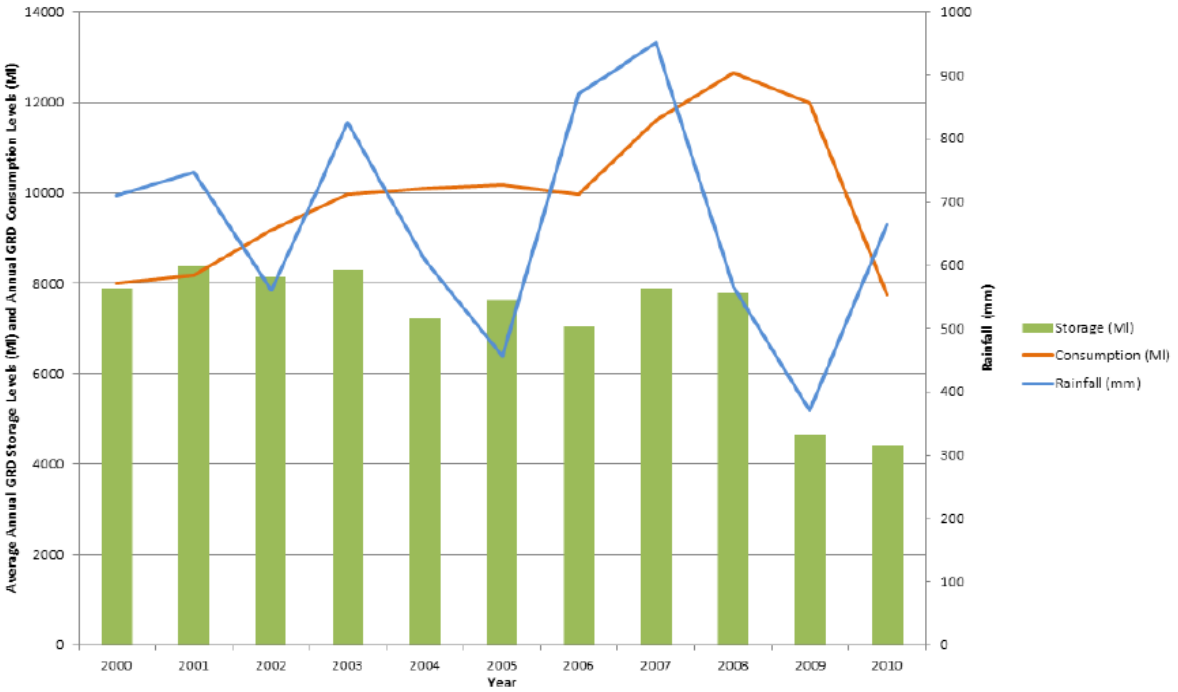


Figure 5.10: Average annual GRD storage levels (Ml), annual GRD consumption levels (Ml), George PW Botha rainfall (mm) from 2000 – 2010 (Barrett, 2012)

In part, this accumulating exposure to drought shocks was 'masked' by the almost annual occurrence of severe weather prior to the summer months. Figure 5.11 shows monthly Garden Route Dam (GRD) storage levels from 2000 – 2010. The heavy blue shading signals cut-off low storms that were classified as disasters due to their damaging flood impacts. However, in 2004, 2006, 2007 and 2008, these intense weather systems also conferred protective benefits to local water supply by resetting reservoir storage back to full capacity. As no comparable weather event occurred in 2009, the municipality became highly exposed to meteorological drought conditions due to its sustained high water consumption levels.

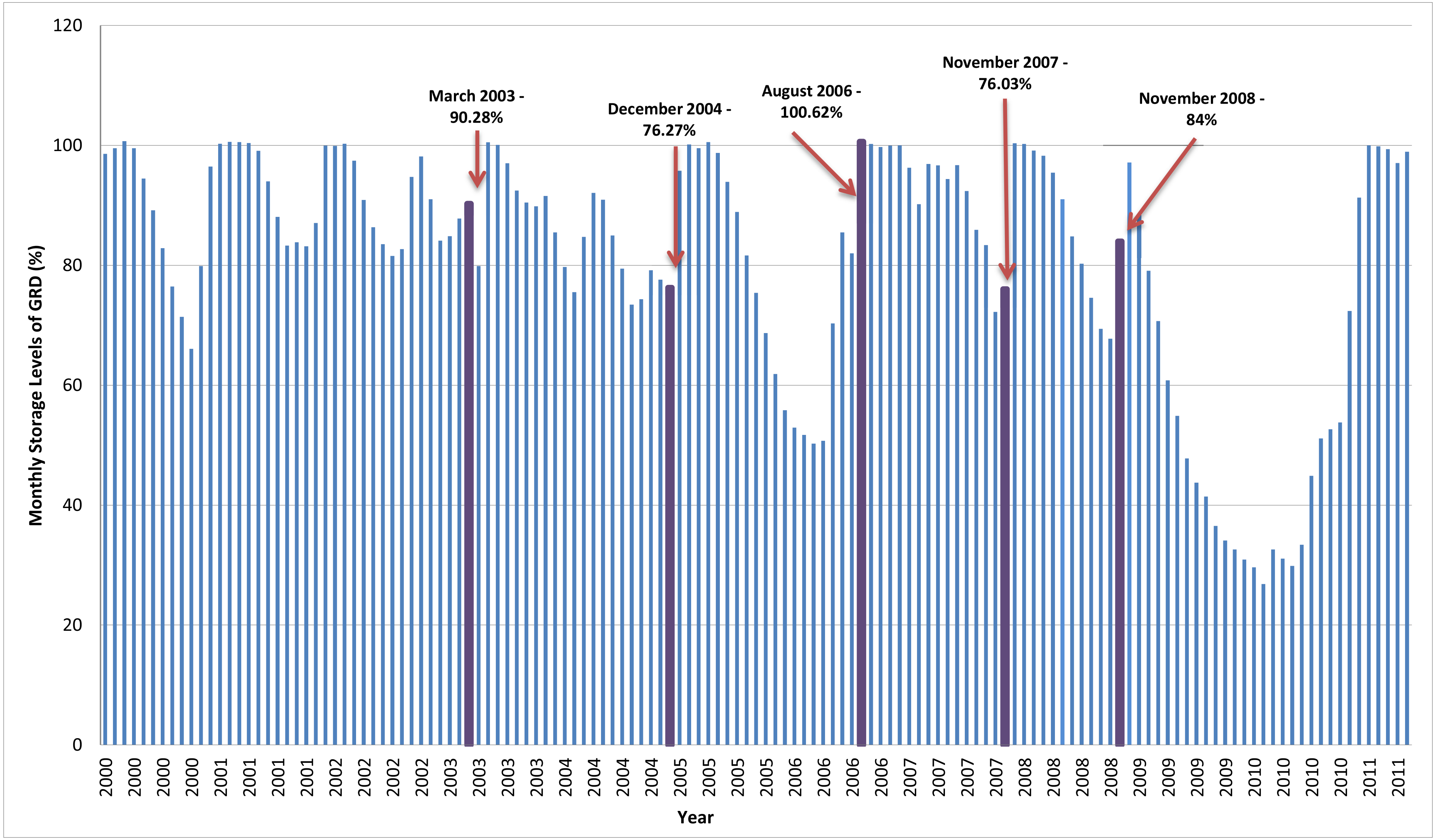


Figure 5.11: Monthly GRD storage levels from January 2000 - May 2011 with severe weather events (Barrett, 2012)

5.6 Accumulating drought risk conditions – the case of Barrydale, Swellendam

Within the Overberg District, the Swellendam Municipality town of *Barrydale* was also drought-affected. A focus group discussion with local businessmen, residents and farmers concluded that water was being poorly managed in the area. Focus group members noted that the municipality *seldom instituted water restrictions* and that there had been *no capital investment* to ensure adequate water provision, such as the *repair of numerous leakages*. They also stressed that the small municipal dam was *inadequate to cater for new development* in the area, with water consumption reportedly 'skyrocketing' over the last five to ten years.

This rapid growth was attributed to several factors: the *marketing of the R62 as a tourist destination* (increasing the number of accommodation facilities), the town's emerging status as a *popular retirement destination*, along with the construction of *several hundred RDP houses,* with running water and flush toilets.

Local farmers explained that the supply of water was the most limiting factor to their continued viability. They reported *storage capacity of 2-3 months' rainfall* in farm dams, while the town's residents depended mainly on river supply to the municipal dam. The groundwater level is highly variable, ranging from 2 to 15 m. It is also brackish, and *unsuitable for irrigation*. Although historically the town boasted a *'lei' water system*, usage is now drastically reduced to alternate weeks in summer, and once weekly in alternate months during winter.

During the recent drought, local farmers adapted their farming practices in several ways. Some *reduced stock numbers*, while others explored *alternative irrigation systems* which, due to steep increases in electricity tariffs, *proved expensive* to run. Lower yields *reduced labour needs*, resulting in the *laying–off* of even permanent farm workers.

Box 10: Case study from Barrydale, Swellendam

5.7 Conclusion

Consistent with prevailing studies and published literature on drought and water scarcity, the severity of the 2009-2011 Eden and Central Karoo drought emergency was amplified by key risk drivers that – over the past decade - had progressively escalated the risk of a wide-spread water shortage. These included greatly increased water demand - both in agriculture and in rapidly growing coastal towns – that was neither matched with rigorous water demand management, nor systematic investment in water infrastructure, including the essential technical capacity to manage it.

The risks were further exacerbated by lack of systematic drought risk management planning – especially as this applies in urban settings. Specifically, there was no uniform definition of 'drought', nor accompanying indicators that would have allowed for early signal detection. Nor were indicator-linked contingency plans in place that would have enabled an earlier, 'less resource-intense' response. Such plans are essential in both of the drought-affected districts, given their recent history of damaging weather extremes, along with their risk-escalating consequences. This is evident from widespread reports of flood-damaged dam infrastructure, that then increases farm exposure to periods of reduced rainfall.

Encouragingly, the insights and experience gained from this large, protracted and costly operation have been actively incorporated into many municipal policies and plans – hopefully, reducing local exposure to future drought events.

PART VI: FOCUS ON SOCIO-ECONOMIC EFFECTS

6.1 Introduction

6.1.1 Challenges in attribution of cause

Meteorological drought impacts were reported widely across the affected districts, reflected mainly in the diminished availability of ground and surface water. These effects, along with diminished vegetation conditions have been described in Parts I – IV, along with risk drivers that increased the severity of the resulting water shortages.

Although field research, findings from extensive interviews and document review indicated a broad suite of noted drought impacts, it was seldom possible to attribute reported losses exclusively to drought conditions. This was due to the convergence of the drought's timing with the global economic recession and associated local economic downturn. In addition, all farmers interviewed noted the destructive influences of pest animals and livestock diseases. Specifically, they underlined that jackals and lynx posed a more significant and consistent cause of livestock loss than drought. They also stressed the seriousness of livestock diseases such as Rift Valley Fever, which usually occurs after the heavy rains following a drought.

Unfortunately, a pervasive lack of documentation on stocking levels during the drought's course made it impossible to differentiate the severity of crop or livestock losses by location, type of farming, exposure to reduced ground and surface water supplies, or relative coverage through fodder relief. Similarly, despite the research team's extensive efforts to establish the scale of the social impacts, none of the various relief NGOs and organisations interviewed was able to corroborate its observations with quantitative data.

6.1.2 Complexity of causal chains: weather extremes and rural-urban connections

Two other factors have informed the presentation of this chapter. First, unlike many previous drought studies, this research underlines the inter-relationships between 'drought and floods', in two districts that, for much of the past decade, have been repeatedly shocked by severe weather. The disaster risk literature speaks of *simultaneous* and *sequential crises* as well as *synchronous failures* and their relative contributions to intensifying risk conditions (UNISDR, 2011:7)[5]. In this case, it is clear that conditions which escalated drought exposure and vulnerability were associated with previous severe weather and flood events.

Second, although considerable attention in previous studies has focused on 'agricultural drought impacts', the widespread reduction in water availability simultaneously and seriously affected urban areas as well as farming communities. This resulted in tightly interlinked effects that, themselves, generated further 'knock-on' impacts across a diversity of at-risk groups as well as urban and rural settlements.

This chapter describes effects described through more than a hundred interviews and field research. It focuses first on effects reported by farmers (including commercial and emerging farmers as well as farm workers). It continues with attention to private sector and municipal impacts, followed by noting the ecological effects identified. The chapter concludes by illustrating the complexity and tight 'interconnectedness' of local risk profiles that emerged during the drought

[5] 'Simultaneous crisis' refers to conditions in which different hazards occur at the same time. 'Sequential crisis' refers to conditions where hazards trigger cascading disasters in a range of interlocked systems. 'Synchronous failures' occur when different risks converge and interact (Kent, 2011; UNISDR, 2011:7)

with a specific focus on the Langkloof. The considerable risk management difficulties encountered in this location illustrate the on-going challenges faced more widely in the two drought-affected districts.

6.2 Reported agricultural impacts

6.2.1 Introduction

Meteorological drought impacts were widely reported in the agricultural sector, including effects noted by farmers, labourers who lost employment, and representatives of associated processing industries, that were also affected. These included small-scale subsistence and emerging farmers, large-scale commercial farmers, as well as those with irrigated crops such as vegetables.

In all areas, drought was acknowledged as an integral feature of farming – especially in the Karoo – and that water needed to be reserved to buffer dry spells. However, although drought was an anticipated risk occurring in natural cycles, farmers noted that the current economic climate delayed recovery and that impacts lasted longer.

Unfortunately, it was not possible to determine changes in stocking levels during the course of the drought. However, data provided by the Provincial Department of Agriculture and shown in Table 6.1 below indicated the following stock numbers for March 2010 for the affected municipalities. Table 6.1 shows that approximately 130,000 large livestock units were drought-exposed in the affected areas, with more than 175, 000 small stock units (excluding poultry) similarly exposed.

Table 6.1: Total Stock Units for Affected Municipalities – March 2010 (Provincial Department of Agriculture)

Town	Large stock units (LSU)						Small stock units (SSU)				Stock Total
	Beef	**Breeding animals**	**Dairy**	**Donkeys**	**Horses**	Total	**Goats**	**Poultry**	**Wool**	Total	
Calitzdorp	2 095	60	426	30	180	**2 791**	2 700	500	381	**3 581**	**6 372**
George	11 752	6 087	16 388	46	550	**34 823**	13 866	200 000	9 231	**223 097**	**257 920**
Heidelberg	5 504	929	19 423	18	264	**26 138**	3 018	4 000	3 180	**10 198**	**36 336**
Knysna	4 261	849	7 037	66	1 024	**13 237**	766	75 000	3 517	**79 283**	**92 520**
Mossel Bay	13 676	596	8 483	63	461	**23 279**	462	8 500	60 631	**69 593**	**92 872**
Oudtshoorn	4 126	240	2 025	20	278	**6 689**	5 200	12 000	2 045	**19 245**	**25 934**
Riversdale	6 460	1 943	10 082	16	230	**18 731**	3 028	20 000	9 271	**32 299**	**51 030**
Uniondale	2 269	821	520	118	182	**3 910**	44 996	3 000	15 133	**63 129**	**67 039**
Total	**50 143**	**11 525**	**64 384**	**377**	**3 169**	**129 598**	**74 036**	**323 000**	**103 389**	**500 425**	**630 023**

6.2.2 Farmers' reported drought impacts and their sequence

Table 6.2 traces the sequence of impacts reported by sheep, dairy, fruit and hops farmers interviewed through field work. It describes direct effects noted by those interviewed, and their strategies to manage these. It continues by illustrating wider 'knock-on' social and economic consequences to the farmer and local community. Invariably, these included reduced requirements for farm labour and associated livelihood consequences for those dependent on seasonal work.

Table 6.2: Illustrative Table Tracing the Drought's Direct Effects on Farmers and their Associated Consequences

Type of farming	Direct Drought Effects Reported by Farmers	Indirect Consequences Reported by Farmers	Wider Economic Impacts and Consequences for Community
Karoo sheep farmers	Natural stock reproduction cycles disrupted.	Unable to increase stock and struggled to meet regular financial obligations. Farmer's reduced labour for economic reasons.	Increased unemployment, and associated livelihood impacts for households dependent on agricultural incomes, particularly farm labourers and seasonal workers. Reduced local buying power in town, affecting local economy.
Fruit farmer (Ladismith)	During first 'drought' summer (2008-09), dams only 45% full compared to normal 95% capacity. The following winter was warmer than usual. This led to fruit trees flowering weakly in spring.	Unable to irrigate orchards, resulting in lower fruit yield and poorer quality. Swarms of bees were greatly reduced compared to previous years while the veld did not flower sufficiently.	Bee hives were still abandoned in 2011 despite there being 'amazing wild flowers' that year.
Dairy farmer (George)	Failed late 2008 rains, leaving irrigation dams un-replenished. (Dairy cows require large amounts of drinking water to produce milk). Human needs met from a natural spring on farm.	Farmers conserved water in irrigation dams for their cattle and ceased irrigating pasture. Water quality was later affected as dam levels fell. Attempted additional bore holes, but unsuccessful or produced poor quality water. Other farmers paid to 'truck in' additional water.	Farmers procured maize (priced low at the beginning of drought) and lucerne from the Orange River (high transport costs). Stock fed with maize and lucerne produced denser milk and higher yields than from usual grazing. This led to increased production and an associated oversupply of cheese.
George hops farmers	Lower rainfall and reduced irrigation.	Reduced *quality* of hops grown, but consistent yield. New boreholes drilled at +/- R 40,000 per borehole.	Drought experience indicated hops require 15-20% less irrigation than previously thought. As the yields were not significantly reduced, farm labour needs not significantly affected.

6.2.3 Small-scale farmers

Small subsistence farmers were particularly badly 'hit' by the drought, not having the capital resources to cope with the dry conditions. This is unlike many of the commercial farms that could resort to drip irrigation and/or microlines, both of which require a huge initial capital outlay but constitute an effective longer-term investment.

For instance, in Zoar, located in the Kannaland Municipality, a well-established community of small-scale farmers were reportedly severely drought-affected. The information was obtained from several interviews conducted at Amaliensteyn. According to a local farmer, orchards perished during the drought while crops died due to the heat and animals were lost due to the farmers' inability to provide fodder. Although the state provided fodder, farmers were required to pay 10% of the cost themselves, and many were unable to do so. However, a *'help-mekaar'* system prevailed with farmers trying to help one another.

Water supply was an on-going concern for the Amaleinsteyn community. Although potable water is supplied from the Tierkloof Dam, the narrow pipeline could not support the needs of the community, particularly in the hot summer months. The farmer commented that "*ons het genoeg water maar dit is nie reg beheer nie, of bestuur nie",* implying that water management is the real problem rather than actual supply. This observation is consistent with technical reports which noted **water supply losses of up to 40%** in the Kannaland Municipality, with large water losses and water theft specifically associated with the Tierkloof Dam (du Preez, July, 2010).

Small-scale farmers in both *Beaufort West* and *Oudtshoorn* also reported numerous impacts. In Beaufort West, these included livestock deaths associated with lack of vegetation and fodder assistance. Farmers stressed the impact of animal diseases such as Rift Valley Fever and Blue Tongue Disease, noting that vaccination costs were unaffordable – as was the co-funding requirement for accessing fodder relief. Constraints to accessing fodder relief were also underlined in focus group discussions with emerging farmers in Oudtshoorn, where the scale of this constraint was illustrated by fodder relief distribution records. These indicate that during the first phase of agricultural relief, 116 (92.5%) of farmers who qualified for fodder relief in Oudtshoorn did not take it.

6.2.4 Farm workers

At a Provincial Drought meeting on 25 May 2010, a Provincial Department of Agriculture representative reported on the drought's mounting agricultural impacts, specifically noting the '*dramatic loss of jobs'.* This was reiterated a year later by UNIEP (Uniondale Integrated Empowerment Project), a social assistance NGO based in Uniondale that profiled loss of jobs for seasonal workers on fruit farms in the Langkloof (*Kaaprapport 28 August, 2011*). Job losses were attributed to cost-cutting measures by farmers who, due to reduced production, had little option but to lay off farm workers.

Although the primary focus of this report is on drought and livelihood impacts sustained in the Western Cape, interview findings suggested that reduced seasonal labour requirements had much wider implications. For example, Barrydale farmers reported that as fruit farming requires skilled labour, seasonal workers usually arrive from as far afield as Zeerust. As these skilled seasonal workers were not employed during the drought, it is possible that the drought's livelihood impacts may have affected households as distant as the North West Province.

In response to rising concerns about drought-related job losses, the Department of Social Development convened a Drought Workshop in Kannaland from 11-12 November 2010. This sought to assess the broader socio-economic impact of the drought, particularly on farm dwellers and workers involved in the farming industry within the Eden District. The multi-stakeholder forum planned to develop longer-term developmental goals to counter the anticipated socio-economic impact of the drought.

Although reportedly some 320 farm workers lost their jobs in the Eden District, mostly in the George and Oudtshoorn areas, no verifiable quantitative information could be found to substantiate this. Following social work assessments, this original estimate of potential relief recipients was reduced to only 45 affected families located in and around George, while a report received from the Department of Social Development (undated), also provides evidence of the Department's support to at least fourteen drought-affected farm labourers in the Uniondale area.

Similarly, while a further 66 families were subsequently identified in Oudtshoorn and surrounding areas, assessments conducted by social workers established that few qualified for relief according to the eligibility criteria. A further group identified from the Mossel Bay area also failed to qualify for relief funding.

The Eden District Department of Social Development reportedly supported food aid to Early Childhood Development Centres throughout the Langkoof, Oudtshoorn, George, Hessequa, Mossel Bay and Knysna areas. However, despite numerous requests by the research team, this information could not be verified.

6.3 Private sector losses

6.3.1 Economic downturn attributed to recession, not to drought

Although concerns that significant business losses were sustained across both districts, this was not corroborated by interviews and field research in the major towns. For instance, a representative of the *George Business Chamber* indicated that none of its 305 registered members ceased operating during the drought period. However, the Chamber did stress that, due to its limited membership from previously disadvantaged groups, it could not accurately reflect on the business consequences for these communities.

Similarly, a member of the *Mossel Bay Business Chamber* could not associate drought with declining commercial activity, although he noted that businesses in the area had been under pressure due to the economic recession. This view was shared by the Branch Manager of the *George SEDA* who suggested that the drought, while not primarily responsible for the economic downturn in the region, did exacerbate the effects of the on-going recession, leading to job losses.

Such findings were consistent with a telephone survey of Garden Route accommodation establishments by the research team that also failed to indicate a downturn in business that could be attributed to drought. Similarly, field research results from *Beaufort West* (where the hospitality industry is sustained by transit accommodation along the N1 and not on tourism) indicated that Bed and Breakfast enterprises continued to trade as usual – evidenced by perusing a booking log of one of the busiest bed and breakfast establishments ('B & Bs') in the town.

6.3.2 Adverse impacts in smaller towns

Adverse impacts were reported, however. For example, B & Bs outside of *Beaufort West's* town centre did suffer and schools were also affected by the lack of water. A local car wash was forced to close while the abattoirs suffered a down-turn in production as, being a water-intense industry, it was forced to reduce the number of slaughtering days.

Local businesses in *Barrydale* on the R62 were affected. For example, a local general dealer explained that due to higher rates of unemployment during the drought period, he stocked his store with low-cost items that were more affordable for those with reduced buying power. He also extended his terms of repayment for those buying on credit. The drought reportedly also reduced real estate sales, as potential buyers became aware that Barrydale was a water-short town. Subsequently, a five-year moratorium was placed on property sub-divisions in the town, acknowledging that the inadequate water supply could not support further development.

In *Ashton*, canning factories were required to lay off workers due to reduced production.

6.3.3 Innovations to ensure business continuity

There was clear evidence of business innovation to ensure continuity of service. Some of these are illustrated in Table 6.3 indicating adjustments across a wide range of industries - from small-scale car washes to larger dairy processing plants.

Table 6.3: Examples of innovations made to ensure business continuity during the drought

Affected business (Municipality)	Drought Impact	Strategy adopted
Golf estate and hotel George	Drier conditions at the beginning of 2009 due to high temperatures and low rainfall. The estate uses municipal water in its accommodation establishments.	Implemented a grey water recycling system to irrigate its three golf courses.
Car washes Mossel Bay	Water restrictions were applied to residential areas but not to the commercial centre, to minimise impacts to the local economy.	Car wash businesses reportedly thrived as people could not wash their own cars at home and relied on the local car washes for this service.
24 hour family restaurant and petrol station Beaufort West	Severe water restrictions and water shedding impeded the normal flow of business.	Installation of two 10, 000 litre water tanks to keep business running during scheduled water shedding. This ensured toilets flushed and dishes were washed on the busy N1 route between Cape Town and Johannesburg.
Bed and Breakfast Beaufort West	Gamka Dam empty. Water shedding.	Spent R 60,000 to sink a borehole anticipating that the meagre water supply to the central town might dry up.
Cheese factory Ladismith	Reduced production during the drought which increased prices (the cheese production process requires three litres of water to produce one kilogram of cheese). Hygienic standards also require high water usage. Milk tankers need to be sanitised before collection of milk.	Instituted a water recycling programme. Tankers were rinsed with water that was then recycled and used for irrigation. As the used water has a high enzyme content it cannot be employed in the cheese production process.

6.4 Municipal Impacts

6.4.1 Opportunity costs due to diverted resources / reduced income from water restrictions

In addition to the considerable diversion of time, effort and expertise to manage the water emergency, combined with obvious physical reductions in supply, municipalities sustained opportunity costs during the drought. These included reduced municipal revenues due to diminished water consumption, along with the need to defray planned developments to accommodate immediate needs for water infrastructure financing. These consequences are clearly illustrated below by Mossel Bay's experience, detailed in the Municipality's 2010 annual report (Mossel Bay Municipality, 2010).

"The water shortage also compelled the Municipality to embark on expensive and unforeseen capital projects to augment the Municipality's water sources and to reduce its dependence on surface water. These necessitated the reprioritization of the budget as well as the cancellation or postponement of some projects in order to make the funds available for these projects.

One of the projects that was cancelled was the planned expansion of the municipal main building to create additional office space as well as an enlarged Council Chamber to accommodate the increase in the number of Councillors following the 2011 national municipal elections." (Mossel Bay Municipality, 2010)

Box 11: Planning implications for Mossel Bay Municipality due to unforeseen and urgent needs for new water infrastructure.

Examples of physical impacts in municipalities

Despite efforts to minimise the adverse impacts of scarce water supplies, numerous effects were noted. For instance, both *Beaufort West* and *Mossel Bay* municipalities reported the adverse effects of reduced grey water on the functioning of their sewerage systems.

Mossel Bay Municipality also noted problems in the application of water restrictions to blocks of flats supplied with only one centralised water meter and where 'granny flats' shared meters with the main house. These conditions led to disrupted water supply when the metred 'household' allocation was exceeded.

In B*eaufort West*, sporting activities ceased due to the lack of available water to irrigate the school fields. In addition, an olive grove – originally planted to augment the income of one of the schools - died.

In G*eorge*, investment implications emerged due to anxieties about the sustainability of water supplies. For example, during the drought, the George department of local economic development noted that the first question investors asked when considering business in George was "Is there water?" This indicated that the water shortage had emerged as a consideration in investment decision-making.

6.4.2 Positive outcomes

The successful management of the drought emergency, however, was also viewed as developmentally enabling. For example, the George Business Chamber representative explained that as a result of both the drought and the economic downturn, mutual support mechanisms had developed among local businesses. Furthermore, this had become a growing trend with local mentorship programmes being driven particularly by the George branch of SEDA. The Department of Local Economic Development representative also emphasised that drought relief funding had enabled George to advance its water agenda which, by implication, would allay investor concerns and benefit local economic growth. This was in part attributed to the diversification of water supply sources, beyond dependence on surface water to include groundwater, as well as additional supplies from water re-use and reclamation plants.

6.5 Social Consequences for Poor Households

Social impacts were also traced through interviews with various relief NGOs and organisations, although none was able to corroborate its information with quantitative data. Local social support organisations played an important role in easing the hardship experienced by poor families – as illustrated in the case study below from Life Community Services, located in George.

In George, Life Community Services was forced to *discontinue its food garden* due to the shortage of water for irrigation. This garden had previously provided food to many indigent families living in the George area while also augmenting the supply of vegetables to the organisation's soup kitchen which caters to some 2,000 local children.

The Life Community Services noticed a gradual increase in the *number of children requiring food during the drought,* although they did not keep a record of actual numbers. Child and Family Welfare in George also reported that it was called upon to provide increasing *numbers of food parcels* during the drought.

The organisation's staff was concerned to understand the reasons for increasing numbers of children attending their soup kitchen and began to visit children in their homes to assess the underlying household situation. They were alarmed to find *whole families 'starving' due to loss of employment on farms*, particularly fruit farms which had substantially reduced yields and therefore less need for seasonal labour. Family members reportedly usually worked on farms, not only in the George area, but as far afield as the Langkloof.

Box 12: Case study from Life Community Services located in George.

A recurrent finding noted in Beaufort West and Oudtshoorn which is consistent with observations by the Life Community Services staff, concerns the sensitivity of home gardens to reduced rainfall, combined with punitive water restrictions. Poor households noted that their 'gardens died', although many attempted to maintain these with grey water. For instance, an elderly woman in *Beaufort West* reported that her carrots, spinach, tomatoes and cauliflower died, which she would have used for household consumption to augment her R 800 monthly income. Field research indicated that home gardens augmented livelihoods directly as a source of food or indirectly as an income source (from vegetable sales). The loss of home gardening as a key drought amelioration strategy constituted an additional hardship for poorer households.

6.6 Ecological impacts

Although not the principal focus of this study, the research team explored increased risk of wild-fires. For instance, the dry and hot conditions increased the *occurrence of wild-fires*, particularly in the mountain catchments. Fires were reported by farmers in Amaliensteyn in the Klein Karoo, the Swellendam area and also in the Langkloof, where in March 2010 a fire raged across an extensive area, from Joubertina to Avontuur. Fire-related losses not only affected vegetation. For instance, an apiarist ('bee keeper') noted that intense wildfires had destroyed up to 300 of his bee hives.

Conservationists reported that large fires even spread into indigenous forests, despite the presence of protective *ecotones*, 30-40 metre areas of retardant vegetation located between plantations and the fringes of indigenous forest. However, during the drought the ecotones failed to halt the advance of fires into the indigenous forest.

The *indigenous forests in Knysna* were reportedly drought-affected, in the loss of several giant stinkwood trees. Regeneration of natural vegetation is lower in indigenous forests under drought conditions. A timber industry representative also reported that the drought had retarded the growth of young saplings. The research team also recorded numerous reports of an increased incursion/movement of wildlife into urban peripheral areas (particularly baboons), including instances of hungry bushbuck leaving indigenous forests to graze on young saplings in the plantations.

6.7 Loss exacerbating factors – navigating vulnerability, volatility and variability

6.7.1 Introduction

While many rural areas sustained real hardship during the drought and beyond, the Langkloof provides invaluable insights on the convergence of multiple risk drivers – both for commercial farmers, as well as emerging farmers and farm workers. Specifically, it illustrates the risk-amplifying connections between 'disaster events', as well as the mechanisms that led to the consequences of poorly managed rural risk being transferred into urban areas. It is the research team's view that similar processes may have prevailed in other areas. However, it was beyond the scope of this study to investigate these sites in comparable depth.

This case-example is separated into two further parts. Section 6.7.2 describes the effects of extreme weather in the Langkloof and its consequences for the accumulating risk profile of commercial fruit farmers – along with concurrent economic recessionary forces. Sections 6.7.3 and 6.7.4 augment this with a specific focus on the knock-on consequences for small-scale farmers and farm workers, whose rural livelihoods came under extreme pressure, and, in the latter instance, -resulted in their relocating to George for relief and employment.

6.7.2 Navigating variability and volatility – the case of Langkloof fruit farmers

2007 – 2010: Four difficult years

The Langkloof region covers approximately 7,000 ha and straddles both the Eastern and Western Provinces. This deciduous fruit-growing region also has an estimated permanent agriculture labour force of 8,700 people (Agri-SA, ND). Although they were seriously affected by meteorological drought conditions in 2009-2010, the Langkloof fruit farmers had sustained repeated weather shocks prior to 2009. However, it was the November 2007 cut-off low and associated flood damage to farm dams that increased the fruit farmers' exposure to drought conditions in 2009, due to compromised on-site water storage capacity.

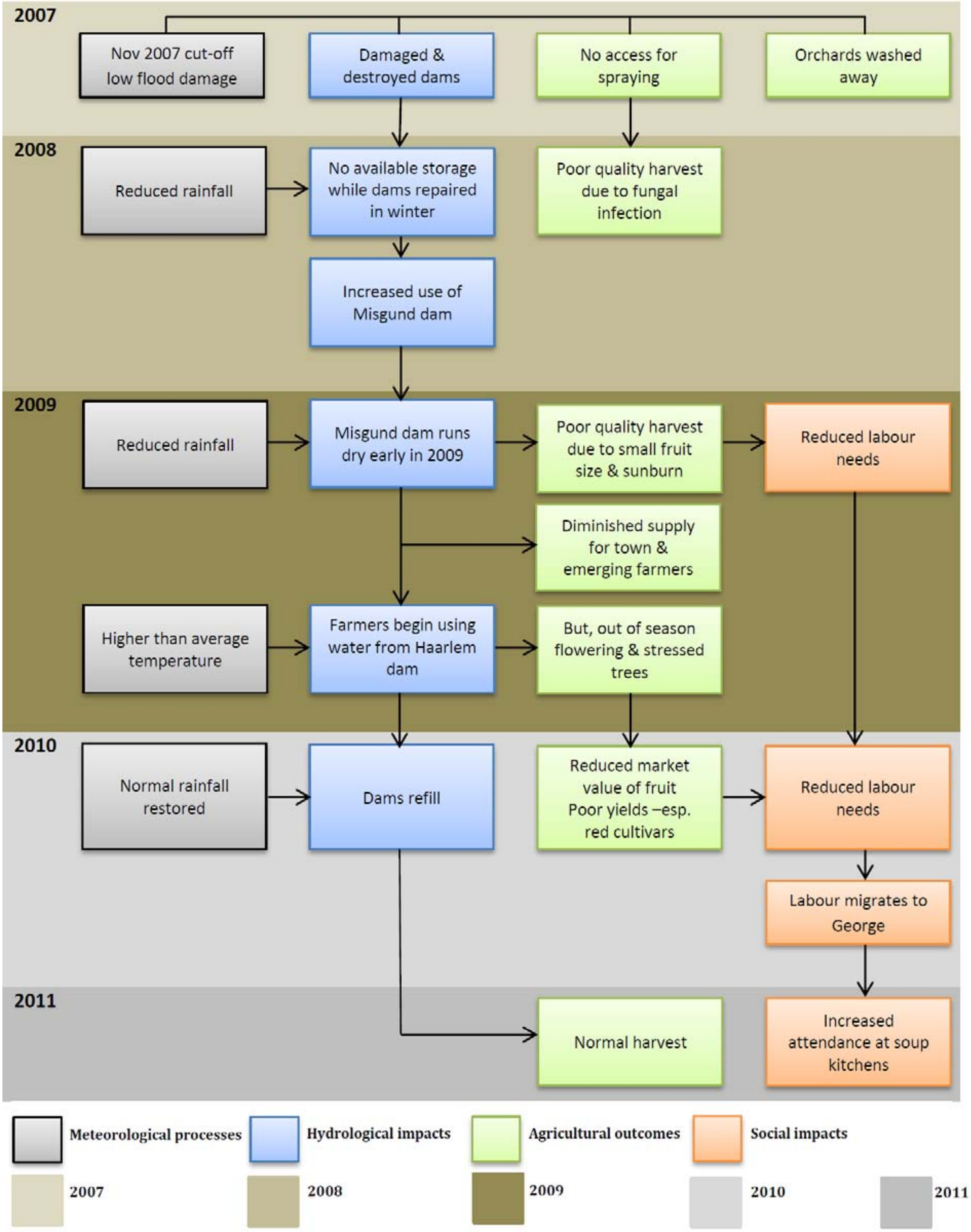


Figure 6.1: The staging of the drought and its hydrological, agricultural and socio-economic effects

Figure 6.1 indicates the prolonged nature of the drought 'recovery' process that continued until 2011 – four years after the 2007 cut-off low. The khaki-shaded boxes indicate the meteorological conditions that prevailed each year, while blue shading signals effects on ground and surface water. The green- and orange-shaded boxes respectively flag 'knock-on' agricultural and social consequences.

2007 – the November cut-off low

The November 2007 cut-off low brought intense and damaging rainfall. One farmer, whose family has farmed the Langkloof for generations, noted that 560mm of rain fell in 18 hours on his farm while, from 20-27 November, more 1,000mm rain was recorded. This meant that fruit trees stood in water for days, which damaged their roots. Access to the orchards for protective spraying was also impossible.

The original cut-off low flood damage estimates for the Western Langkloof were R 46.1m, subsequently adjusted down to R 17.5m. The reduced costs were, however, attributed to "the fact that most farmers repaired the damage and rehabilitation of orchards, fences, buildings access roads, fences, smaller irrigation systems, mainly from own funds or lending from commercial banks" (Agri-SA, ND)

2008 – Dams rebuilt with personal finance. No storage capacity

The dams were reconstructed in 2008, many with loans at interest rates as high as Prime +8% - +9% due to farmers' 'high risk' status. In addition, the 2008 rainfall was 83% of the annual average, and insufficient to replenish storage. Some farmers also incurred additional losses due to an intense hail storm in December that year (Agri-SA, ND).

With the onset of the drought, farmers were already vulnerable, with little additional water supply to irrigate their orchards, particularly at critical parts of the growing cycle.

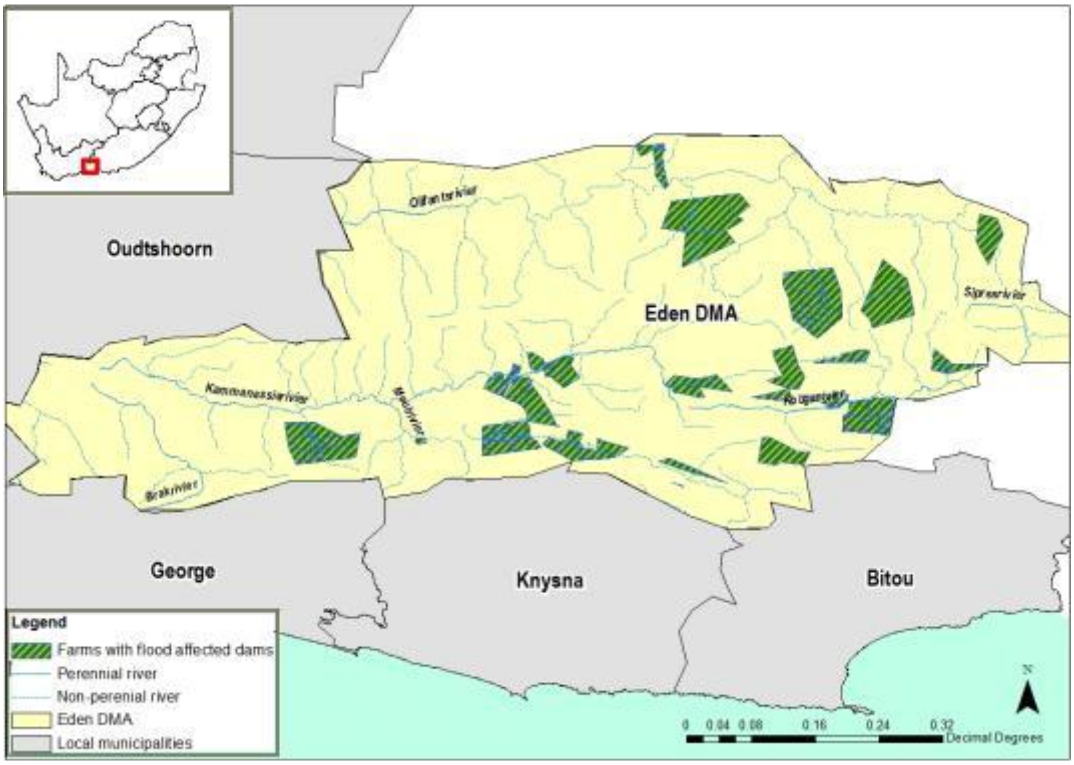
2009 – reduced harvest and poorer quality fruit

Due to compromised irrigation in 2008, the 2009 harvest was of poor quality. The low levels of carry-over water storage were also aggravated by a second year of below-average rainfall (416mm or 76.1% of the long-term mean). An Irrigation Board official from the Haarlem area, who had experienced three floods since 1991, noted that 2009 represented his first experience of insufficient water supply that resulted in many farmers turning to the Haarlem Dam for irrigation water. A second hailstorm was reported in April 2009 which, together with the December 2008 storm, reduced turnover by 20% (Agri-SA, ND).These factors were further compounded by the onset of the global economic recession that forced fruit farmer export earnings to drop by 30% (ibid). Reduced access to irrigation, along with higher temperatures in 2009 resulted in early, unseasonal flowering and stressed trees – reducing the 2010 harvest.

2010 – another poor harvest due to warmer winter in 2009

Measurable reductions in apple production for selected cultivars in both 2009 and 2010 from the Langkloof are shown below in Table 6.4. These indicate reductions in Golden Delicious, Granny Smith and Top Red/Starking varieties in 2009, respectively dropping to 55%, 80% and 33% of the 2008 harvest (Hortgro, 2012). Cripp's Red/Sundowner varieties production in 2009 also plummeted, constituting only 20.2% of the previous year's output. These indicate the particular sensitivity of the red cultivars to drought conditions (ibid).

Figures 6.2 and 6.3 show the farm location of some of the dams either destroyed or damaged by cut-off low-triggered flooding, as well as farms that subsequently were drought-affected.



Figures 6.2: Farm with dams either destroyed or damaged by cut-off low-triggered flooding

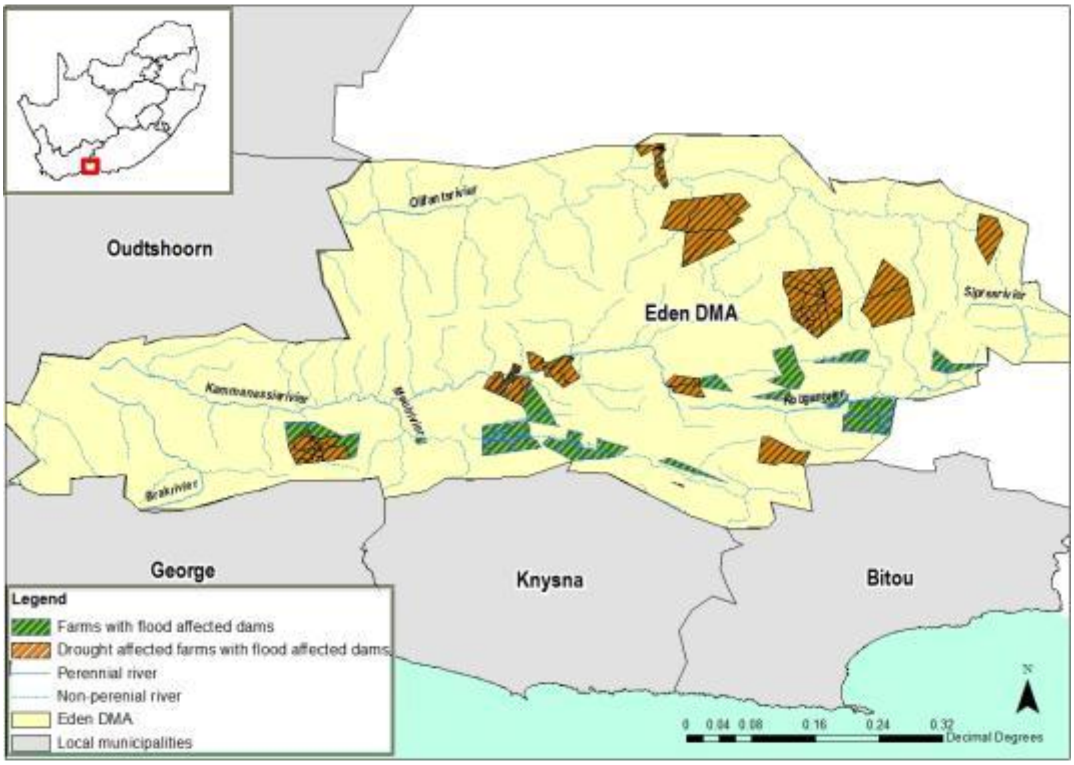


Figure 6.3: Farms that subsequently were drought-affected

Table 6.4: Apple Production (MT) Langkloof 2006 – 2011 (Selected Cultivars)

Apple Variety	2006	2007	2008	2009	2010	2011	Ave (2006-2011)	2009 as % of Ave.	2010 as % of Ave.
Golden Delicous	234 455	218 343	359 021	**198 963**	214 881	293 488	253 192	78.6	84.9
Granny Smith	852 828	679 914	746 799	**599 918**	727 201	674 865	713 588	84.1	101.9
Topred/Starking	52 762	26 047	125 609	**41 954**	**50 113**	70 060	61 090	**68.7**	**82.0**
Fuji	93 116	106 381	165 307	**122 198**	144 643	13,772	127 403	95.9	113.5
Braeburn	75 408	59 410	51 664	**96 347**	78 386	42 681	67 316	143.1	116.4
Cripp's Red/Sundowner	12 785	9 580	25 784	**5 198**	20 635	27 600	16 931	**30.7**	121.9

Data source: Hortgro, 2012

However, while monetary losses from the 2009/10 drought were estimated at R 30m (Agri-SA, ND), there were other significant social and economic impacts, that affected small-scale farmers and farm-workers. Several Langkloof fruit farmers interviewed reported reducing labour requirements during the drought.

6.7.3 Small-scale farmers – Haarlem

During a focus group discussion in Haarlem, small-scale farmers reported noticing drought warning signs. Despite experience in previous droughts, they reflected that this was the *first time they had seen their animals die* as a consequence.

Having *no water supply*, other than a limited dam quota provided by the Eden District Municipality, they were hard-hit by the drought, watching surrounding commercial farmers with individual quotas continue to irrigate their farms. However, while *local crops and livestock succumbed,* the dam continued to provide *household water supply*.

According to the local Irrigation Board, Haarlem farmers practise a labour-intense form of farming, using *outdated irrigation methods that are extremely inefficient*. This resulted in their being unable to irrigate their crops adequately, leading to *lost onion and potato crops* that had already been planted.

During the drought's peak, Haarlem farmers were provided with *fodder from the Free State* and received a *donation of maize* through the intervention of Agri-Weskaap. The farmers interviewed reported that they *did not receive drought relief* from the Department of Agriculture (this is corroborated by fodder relief reports for Uniondale, indicating that *101 farmers* did not redeem fodder vouchers, 45.5% of whom were classified as 'small-scale farmers').

A Haarlem farmer explained that he was now perpetually 'broke' as a result of the drought, and unable to afford to *inoculate his livestock*, whose immunity was already compromised. This has potential consequences for future outbreaks of preventable animal diseases. The low immunity of animals after a drought was also flagged by a representative of Agri-Weskaap, who explained that this leaves animals particularly disease-prone.

Box 13: Case study of small-scale farmers from Haarlem

6.7.4 Farm workers

Reportedly, up to 45% of Haarlem's residents work on surrounding farms. However, during the drought there was little work on the farms, with adverse impacts on household livelihoods. Some support was provided by the Department of Community Services, which delivered food parcels to desperately 'needy' Haarlem households, while a school feeding scheme was established for the school children. This scheme has continued due to the community's inability to cope after successive disaster impacts in recent years.

Although staff at the Life Community Services in George reported that children attending their soup kitchen were from farm worker families located as far as the Langkloof, they did not identify particular towns. As a result, it was not possible for the research team to connect constrained labour opportunities specific to Haarlem with subsequent farm worker relocation to George.

6.7.5 The progression of vulnerability: livelihoods of farm workers in the Langkloof

Figure 6.4 complements the earlier graphic (Figure 6.1) that presents the staging of the drought and its hydrological, agricultural and socio-economic effects. It illustrates the impact of cumulative external forces on poor families, and the process of accumulating vulnerability that is transferred across time and space – a process that began in the Langkloof and transferred to George.

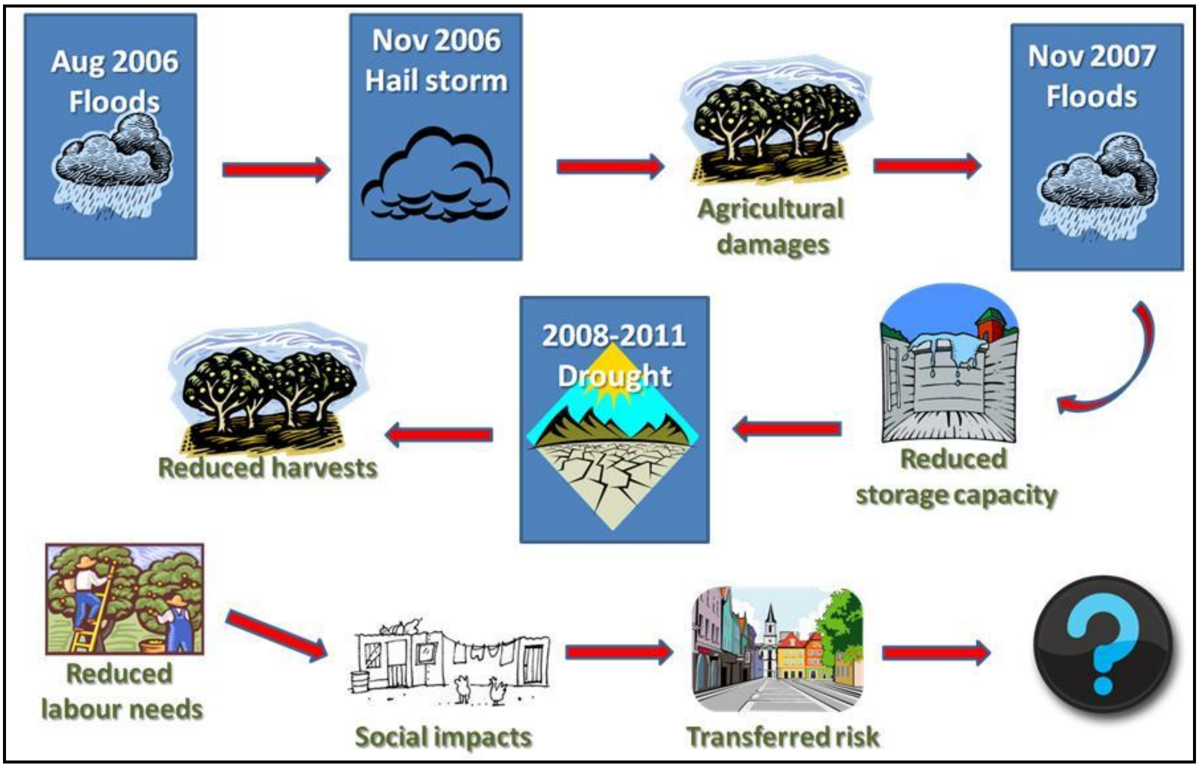


Figure 6.4: The Progression of Livelihood Risk: Focus on Langkloof fruit farm labourers

6.8 Conclusion

Despite the uneven documentation of drought impacts, numerous effects were sustained across both districts. There is clear evidence of enormous initiative taken by diverse stake-holder groups to minimise the drought's effects. These range from individual farmers and small businesses to the reprioritisation of budget lines by proactive municipalities. Access to capital to finance drought-minimising interventions constituted a crucial enabler, with evidence of many private enterprises self-funding strategies to reduce losses (often at great personal cost, and, in the case of bore-hole drilling, with no guarantees of successful return on investment).

Poor, rural households whose livelihoods depended (directly or indirectly) on agriculture came under particular pressure. There were clear instances (e.g. in Haarlem) where socioeconomic vulnerability was compounded by constrained access to water (for irrigation and livestock) and were amplified by poor access to fodder and livestock inoculation. Similarly, farm worker livelihoods became increasingly precarious, first, due to contraction in agricultural labour requirements and second, because of constrained access to formal social protection and social relief.

PART VII: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction – A period of extreme dryness, with sustained low rainfall for +/- two years

The period 2008-2011 was reflected in exacting meteorological, hydrological and agricultural drought conditions across the Eden and Central Karoo District Municipalities. These were evidenced by measurable reductions in rainfall, stream flow, groundwater levels and vegetation cover. These reductions were also not limited to a single annual cycle, and spanned at least two to three years. Unfortunately, the drought coincided with the global economic recession, whose impacts were most intense in 2008 and 2009, and which constrained the range of options available to manage the drought and its consequences.

Despite the duress sustained in the course of 2009-2011, the research team identified remarkable accomplishments achieved in the course of the drought response operation. However, the drought also revealed numerous deficiencies in water resource management, highlighting gaps to be addressed.

7.2 An impressive response by stakeholders - despite late detection of declining water availability

The 2009-2011 drought emergency generated a huge, complex operation by civil society, national, provincial and local governments that spanned two district municipalities and secured R 572m for wide-ranging relief activities. It was also supported by five separate local disaster declarations.

The effectiveness of the response to the drought was enabled through the establishment of two multi-stakeholder mechanisms as well as the availability of experienced disaster management expertise at district and provincial centres. Similarly, the involvement of competent personnel in technical departments at provincial and municipal levels was essential, along with access to updated monthly climate, agricultural and water risk management information for timely decision-making. The development and application of a water crisis risk-rating mechanism in 2009 was central to the effectiveness of the drought emergency response over time and across multiple municipalities.

The Provincial Department of Agriculture supported drought-stressed farmers, in cooperation with Agri-SA, and secured R 76.9m for relief. Unfortunately, due to the late finalization of DAFF's Framework for Drought Aid on 23 December 2010, the first phase of fodder relief did not commence until February 2011.

At the time this drought study was concluding (May 2012), R 26.9m had been expended, primarily for fodder relief, although not all recipients approved for relief assistance had redeemed their allocated vouchers.

7.3 A costly response, exceeding R 500 million

The 2009-2011 operation resulted in R 572.04m being allocated for drought response. Of this, R 495.0m (86.5%) was directed to improving urban water supply infrastructure, while R 76.9m (13.44%) was allocated for agricultural relief. Altogether, the National Treasury provided R 287.2m, or 58.0% of all funding for municipal water supply infrastructure. This was complemented by municipal co-funding, estimated cumulatively to be R 89.3m (18% of total costs). PetroSA's contribution added a further R 92.5m (18.7% of total expenditure), specifically for Mossel Bay. Smaller amounts from the Regional Bulk Infrastructure and Municipal Infrastructure Grants totalled R 24.2m, while the Eden District Municipality contributed R 1.8 m, primarily for awareness raising.

Although Mossel Bay received the largest National Treasury allocation for all municipalities (R 108.5m), Hessequa farmers were allocated the highest amount of agricultural assistance (R 14.3m).

While the allocation of substantial funding (R 495.0m) to expand urban water infrastructure addressed urgent water supply imperatives, this contrasted sharply with the very modest financial support released for agricultural risk management (R 76.9m). In Box 13 below, an experienced water engineer questions the disparity in the funding allocation, and contrasts the availability of skilled expertise available for agricultural risk management, with that in well-resourced municipalities.

Disparity in Capital Funding

"The drought converted to official disaster status, resulted in substantial capital being released for capital works for municipalities. This was essentially a capital contribution to the Industrial Water and Domestic Water use sectors. Contrary to this, no capital investment was released for agricultural use, e.g. for the construction of infrastructure to aid and augment the assured yield of irrigation water for, say, storage of water from periods of abundance in dams.

Disparity in resources

The drought disaster situation also highlighted the lack of resources in the agricultural sector and the abundance of resources on the other hand located in municipalities. The seven municipalities involved were all supported by a dedicated salaried team of technical people able to understand and work with the intricacies of financing, and could also depend on professional financial support within the municipalities. This was not the situation with agriculture, where under-staffed, under-resourced efforts tried to source desperately needed funds. The result was a disparity in investment in capital projects for Domestic/Industrial Water Use compared to the Agricultural Water Use. The limited funding of operational required fodder will not alleviate future drought imposed hardships – this contrary to the urban sector which can now rest assured that sufficient sustainable sources have been developed.

Disparity in Benefits attained

The drought disaster resulted in capital works being done in haste and under pressure to relieve especially water shortages in towns. This resulted in a number of projects which, in retrospect, could have been more beneficial if more thinking time was allowed. A typical example is the clearing of invasive alien vegetation in the Karatara area where a smaller investment would have resulted in sustainable jobs, immediate guaranteed water supply and environmental benefits compared to a substantial investment in a desalination plant with limited water, capital being exported and severe maintenance cost".

Source: Gorra Water and WCDoA

Box 14: Balancing municipal and agricultural allocation of resources for drought response – an experienced engineer's perspective

7.4 Active engagement by municipalities, the Department of Water Affairs and Department of Agriculture was central for effective response

7.4.1 The crucial role of engaged municipalities

Focused municipal response to the drought emergency resulted in numerous achievements. Impressive reductions in municipal water demand in particular were achieved between April 2008 and October 2010, with daily water consumption reportedly declining by a staggering 41% for Bitou, George, Mossel Bay, Knysna, Oudtshoorn and Hessequa Municipalities over this period. Such reductions were achieved through a focused suite of interventions, including increased tariffs, water restrictions, repairs to leaking infrastructure and intensive public awareness campaigns.

In addition, energetic efforts by district and municipal engineers ensured a remarkably rapid temporary expansion of local water supplies. These were measurably reflected by the expansion of groundwater supplies, as well as the establishment of reclamation, waste-water treatment and desalination plants, supplemented by increased river abstraction (in George, specifically).

It was however, the extraordinary achievements in water conservation demand management that ‘saved the day’, (guided by a monthly urban water supply monitoring and monthly risk rating report), as the majority of additional water supply projects did not come on-line until late 2010-2011, after the drought had broken.

7.4.2 Essential engagement by the Department of Water Affairs

The Department of Water Affairs played a crucial role in co-facilitating and coordinating emergency meetings, liaising with Provincial and National Treasury, as well as the Development Bank of Southern Africa (DBSA). It was also instrumental in facilitating the disaster declarations and for providing ‘hands-on’ support to municipalities and other governmental departments. DWA’s involvement in the operation ensured that regular status updates were provided to the MEC for Local Government, as well as the Premier and Provincial Cabinet.

The DWA also took the lead in the process of increasing abstraction from groundwater resources. This support from the Groundwater Section of DWA was wide-ranging, and included technical guidance, engagement in multi-stakeholder processes, and facilitation of legal/administrative/regulatory processes.

7.4.3 The protective role of agricultural relief

2,434 farms were approved for fodder relief by the Provincial Department of Agriculture, located primarily in the Eden District, with more than 900 farms in Hessequa alone allocated fodder relief vouchers. Unexpectedly, in the first phase of the agricultural relief programme, fodder relief vouchers were not redeemed for 409 farms, notably in Kannaland, Oudtshoorn and the Eden DMA. Furthermore, 40% of these were small-scale livestock farmers with undiversified livelihoods, many of whom were located in areas with limited access to water and unable to cross-fund their proportion of the fodder allocation from other income sources or cash reserves.

7.5 Drought severity amplified by risk drivers

Consistent with prevailing studies on drought and water scarcity elsewhere in the world, the severity of the 2009-2011 Eden and Central Karoo drought was amplified by interacting risk drivers that had progressively escalated the risk of a wide-spread water shortage. These included greatly increased water consumption prior to the onset of meteorological drought conditions, both in agriculture and in rapidly growing coastal towns. Prior to the drought emergency, such conditions had been accompanied neither by rigorous water demand management, nor systematic investment in water infrastructure and (in some municipalities) the requisite technical capacity to manage water supplies sustainably. Water resource development had not kept pace with demand. These risks were further exacerbated by a lack of systematic drought risk management planning – especially where this applies to urban settings. Specifically, there was no uniform definition of ‘drought’, nor were there accompanying indicators that would have allowed for early signal detection and possible early action. Prior to the drought emergency, no indicator-linked contingency plans existed that would have enabled an earlier, ‘less resource-intense’ response.

Climate variability and changing weather conditions were also widely noted as a key risk drivers by those interviewed. Farmers and others stressed the difficulties in managing the impacts of the ‘see-saw’ weather and variable rainfall patterns, with the impacts experienced during severe storms in the region exacerbating the effects of exposure to later periods of reduced rainfall. For instance, farm dams destroyed by earlier floods remained unrepaired and could not provide the necessary buffer to help tide farmers through the later drought.

7.6 Wide-ranging impacts reported, but poor documentation and records

Although field research and findings from extensive interviews and document review indicated a broad suite of drought impacts, it was seldom possible to attribute reported agricultural losses exclusively to drought conditions. This was due to the convergence of the drought's timing with the global economic recession, the associated local economic downturn and other environmental factors.

All livestock farmers interviewed noted the destructive influences of pest animals and livestock diseases. Specifically, they underlined that jackals and lynx posed more significant and consistent causes of small livestock loss than drought. Farmers also stressed the seriousness of livestock diseases such as Rift Valley Fever, which they noted after the heavy rains following a drought. It was beyond the study's scope to investigate the relationship between drought and pest animals, although jackal-associated livestock losses were also reported in the severe 1930s droughts (Vogel; pers comm.).

The lack of documentation on stocking levels during the drought's course made it impossible to differentiate the severity of livestock losses by location, type of farming, exposure to reduced ground and surface water supplies, or relative coverage through fodder relief. Similarly, although the research team pursued multiple avenues to establish the scale of the social impacts, none of the various relief NGOs and organisations interviewed was able to corroborate its observations with quantitative data.

There was evidence of enormous initiative taken by diverse stake-holder groups to minimise the drought's effects. These ranged from individual farmers exploring groundwater sources and small businesses installing on-site water storage tanks to the reprioritisation of budget lines by proactive municipalities. Access to capital to finance drought-minimising interventions constituted a crucial enabler, with evidence of many private enterprises self-funding strategies to reduce losses (often at great personal cost, and, in the case of bore-hole drilling, with no guarantees of successful return on investment).

Poor, rural households whose livelihoods depended (directly or indirectly) on agriculture came under particular pressure. There were clear instances (e.g. in Haarlem) where socioeconomic vulnerability was compounded by insufficient access to water (for irrigation and livestock) and were amplified by poor access to fodder and livestock inoculation. Similarly, farm worker livelihoods became increasingly precarious due, first, to a contraction in agricultural labour requirements), and second, by lack of access to formal social protection and social relief.

7.7 Summing-up of key gaps identified

7.7.1 Operational gaps related to Provincial and District Disaster Management Centres

- Limited discernment of **drought onset and impending water scarcity** (across multiple stake-holder groups), along with definitional difficulties with accurate 'disaster classification and declaration'. Specifically, there was no **uniform definition of 'drought'**

- **Limited application of the Standardised Precipitation Index (SPI) values to specific municipal jurisdictions** that may have delayed/excluded assistance for areas that were meteorologically drought-affected – for instance localities in 'transitional zones'/grey areas (i.e. Swellendam, Overberg District Municipality) that shared borders with drought-declared municipalities

- Lack of functioning **meteorological drought 'warning system'** in which SAWS could have advised the NDMC / PDMC / DDMCs of advancing/accumulating rainfall deficits (i.e. quarterly SPI maps overlaid with municipal boundaries), combined with forecast conditions and interpretations by experienced personnel

- Lack of **water risk rating/monitoring system** and inclusion of these assessments in quarterly reports to PDMC/DDMCs that would have identified escalating water supply risks before these reached critical levels

- **No contingency plans existed for managing advancing urban water shortages** in areas exposed to erratic rainfall (although George, Bitou and Mossel Bay have now generated drought management strategies after their experiences with this drought)

- Lack of **monthly/quarterly PDMC progress monitoring templates** that would have enabled wide-area monitoring over time – nor **project monitoring/summative reporting** processes for reconciling funds secured from National Treasury against actual deliverables (despite excellent meeting reports and administrative reports on activating funding)

- Serious **shortcomings in the water sector** that **exacerbated the drought's effects**, including: ageing municipal water distribution infrastructure, unaccounted-for water losses, and limited water management capability.

7.7.2 Sector-specific difficulties in agriculture and social development

7.2.2.1 Agriculture

The Western Cape Province's complex agricultural risk profile (i.e. annual back-to-back weather disasters, veterinary diseases and wild-fires) calls for urgent expansion of the Provincial Department of Agriculture's risk management capacity. Since 2003, agriculture has sustained the highest losses in every major weather-related disaster within the Province. This has generated heavy technical and support requirements for the Provincial Department, whose staffing has not kept pace with rising demand.

7.2.2.2 Social Development

Inadequate mechanisms for assessing social relief needs, especially of farm workers, resulted in unexpectedly low numbers of households receiving assistance for only three months. However, field research indicated clear evidence of considerable hardship in this instance that far exceeded the scale of social relief provided. This was in part due to deficits in agricultural support for commercial farmers and small-scale farmers, and amplified by the economic downturn. The scale of contraction in agriculture and its knock-on consequences to farm labour between the first quarters of 2010 an 2011 was measurably reflected in the loss of 51,000 agricultural jobs (Statistics SA, 2011). Although it is not possible to attribute agricultural job losses specifically to drought or conditions of economic duress, or other factors, it is noteworthy that the Western Cape's agricultural labour force shrank by 29.7%, from 172,000 to 121,000 jobs between January-March 2010 and January-March 2011 (Statistics SA, 2011).

7.8 Recommendations

The following recommendations are grouped into two action areas:

Those applicable to:

- The Provincial Disaster Management Centre

- The Provincial Department of Agriculture

7.8.1 Recommendations applicable to the Provincial Disaster Management Centre

- In consultation with relevant stake-holders, **develop uniform drought definitions** linked to:

  - unambiguous meteorological drought monitoring indicators (including SPI values)
  - quarterly water supply risk monitoring indicators as a minimum
  - municipal drought and/or escalating water scarcity contingency plans.

- **Incorporate spatially-represented meteorological drought indicators** in identifying drought-affected municipalities to avoid excluding towns that may be affected but fall outside the disaster-declared areas (this especially applies to small towns in transboundary drought 'transition zones' that may not have the resources to respond).

- Strengthen **drought early warning and response capabilities** by:

  - consulting with the Department of Agriculture and Agri-SA on improving the effectiveness and accessibility of timely meteorological drought warning information for farmers
  - consulting both the DWA and Eden District Municipality to restore the urban water supply risk-rating and monitoring system that was crucial to the management of the drought emergency, but has since been discontinued
  - requesting the National Disaster Management Centre consult the South African Weather Service to:
    - regularise the quarterly dissemination of **national SPI maps** (3-month, 6-month, 12-month and 24-month) overlaid with municipal boundaries
    - locate SAWS rainfall stations strategically for adequate rainfall monitoring (e.g. the Beaufort West Municipality has installed its own rainfall station near the Gamka Dam as there is no SAWS gauge within this crucial catchment).

- **Support efforts by DWA to strengthen urban water security by:**

  - encouraging municipalities to invest in reducing unaccounted-for water losses and bringing into operation water conservation and demand management practices
  - ensuring that all municipal water supply schemes have functioning reservoir operating rules in place, as well as flow gauging and other resource monitoring installations
  - ensuring that municipal disaster risk assessments incorporate considerations of urban water scarcity/shortage and drought, given patterns in population growth and provision of free basic water services
  - encouraging municipalities to implement strong water conservation and demand management programmes in instances where there is little scope to increase supply.

- **Develop uniform drought monitoring templates for monitoring relief activities,** including monthly/quarterly PDMC *progress* monitoring templates that enable wide-area monitoring over time and *summative* reporting processes for reconciling funds secured from National Treasury against actual programme outputs or payouts.

- **Support efforts by the Department of Local Government to locate skilled engineering** personnel within high-risk municipalities (not only for infrastructure development, but also to ensure robust on-going management of water resources).

7.8.2 Recommendations for the Provincial Department of Agriculture

- **Urge review of current agricultural relief assessment** processes to establish methods that:

    - are more effective in identifying and supporting farms that repeatedly sustain weather and other shocks (and that cannot recover)

    - incorporate economic risk factors that influence farm resilience and recovery under conditions of drought duress.

- **Improve the effectiveness of the current agricultural relief scheme, specifically:**

    - investigate the reasons for farmers *not taking up* their fodder relief allocations compared to those who redeemed their fodder vouchers

    - during drought episodes, compile livestock counts/registers at municipality/district municipality scale at least annually but preferably at six-monthly intervals in high-risk areas to track changes in asset profiles

    - investigate alternative relief strategies that include increased water allocations and/or livestock vaccination campaigns for small-scale farmers (combined with planned and managed de-stocking early into the drought – before the animals have lost too much condition), due to the increased likelihood of animal diseases during drought episodes

    - investigate the viability of 'fodder banks' to take advantage of abundant rainfall periods to produce/store animal feed to minimise livestock risks during dry spells

    - in cooperation with DWA and the WRC, **undertake research to determine reasons for failure of farm dams** under conditions of intense rainfall.

- Mobilise **Department of Labour training schemes for farm worker support** under conditions of drought duress, rather than support from Social Development's Relief of Distress scheme, due to the latter's narrow eligibility criteria.

- **Urge review of technical support requirements for agricultural risk management within the Provincial Department of Agriculture.**

This refers to consideration of needs for urgent expansion of current agricultural risk management technical capacity due to the disaster-related demands in the province and associated agricultural losses.

REFERENCES

Agricultural Research Council (ARC). 2009. Umlindi-the Watchman. 2009-01. 16 January 2009. Department of Agriculture. Pretoria. [Online]www.arc.agric.za.

Agricultural Research Council (ARC). 2010. Umlindi-the Watchman. 2010-01. 13 January 2010. Department of Agriculture. Pretoria. [Online] www.arc.agric.za.

Agricultural Research Council (ARC). 2011. Umlindi-the Watchman. 2011-01. 12 January 2011. Department of Agriculture. Pretoria. [Online] www.arc.agric.za.

Agri-SA. Undated. *Internal discussion document on Langkloof disaster losses.*

Barrett, LM. 2012. *An investigation of the rainfall-related and human-induced risk drivers that contributed to the acute urban water scarcity: A case study of the urban water scarcity in George Municipality from 2009-2010.* (Unpublished MPhil thesis). Department of Environmental and Geographical Science. University of Cape Town. Cape Town, South Africa.

Basson, H.L. and Mooiman, L.C. 2010. *Drought crisis management, challenges and solutions: Southern Cape, George.* Paper presented at the 74th IMESA Conference, 27-29 October, East London.

Beaufort West Municipality. 2010. Beaufort West Municipality Water Services Development Plan for 2010/2011. Ref. 244920KSO. Prepared by Kwezi V3 Engineers.

Belausteguigoitia, J.C. 2004 *Causal Chain Analysis and Root Causes: The GIWA Approach.* Ambio, Vol 33, No. 1-2. pp. 7-12.

de Waal, J., Extreme Rainfall Distributions: Analysing changing extreme rainfall patterns for the Western Cape. 2012. (unpublished M.Sc. thesis) Stellenbosch University. Stellenbosch, South Africa.

Department of Agriculture, RSA. 2005. *Drought Management Plan (DMP): A discussion document for public comment.*[Online] www.nda.agric.za/docs/Policy/2005DMP.pdf.

Department of Agriculture, RSA. 2008a*. Agricultural disaster risk management agricultural drought management plan (ADMP) February 2008: A discussion document*. Pretoria.

Department of Agriculture, RSA. 2008b*. National Agro-meteorological Committee (NAC) Advisory on the 2008/09 Summer Season Statement from the Agricultural Disaster Risk Management 04WCDoA2008 18 December 2008.* DoA, Pretoria. [Online] www.agis.agric.za/.

Department of Agriculture, Forestry and Fisheries (DAFF), RSA. 2010. *Annual report 2009/10*. Department of Agriculture, Forestry and Fisheries. South Africa.

Department of Environmental Affairs and Development Planning (DEADP), RSA. 2011. Western Cape Integrated Water Resource Management Action Plan: Status Quo Report Final Draft. Chapter 10: The Gouritz Water Management Area (WMA).

Department of Water Affairs, RSA. 2010. Groundwater Strategy 2010. Department of Water Affairs, South Africa.

Department of Water Affairs and Forestry, RSA. 2007. *Outeniqua Coast Water Situation Study: Report 1, Main Report.* Prepared by UWP Consulting (Pty) Ltd in association with BKS (Pty) Ltd.

Departement van Landbou-tekniese dienste, Verslag van departementele insake: Die bekamping van veldagteruitgang in die Karoo en aangrensende weigebiede. February 1980. Pretoria.

Disaster Mitigation for Sustainable Livelihoods Programme (DiMP). 2010. *RADAR (Risk and Development Annual Review) Western Cape*. Periperi Publications. Cape Town.

du Preez, J. 2010. *Eden District Water Crisis Management Report, 12 February 2010.* Eden District Municipality Technical Services Department, Eden.

du Preez, J. 2010. *Eden District Municipality, Water Crisis Management Progress Report*, *5 March 2010*. Eden District Municipality, Technical Services Department, Eden.

du Preez, J. 2010. *Eden District Municipality, Water Crisis Management Progress Report*, *7 May 2010*. Eden District Municipality, Technical Services Department, Eden.

du Preez, J. 2010. *Eden District Municipality, Water Crisis Management Progress Report*, *5 July, 2010*. Eden District Municipality, Technical Services Department, Eden.

du Preez, J. 2010. *Eden District Municipality, Water Crisis Management Progress Report*, *31 October 2010*. Eden District Municipality, Technical Services Department, Eden.

Eden District Municipality. 2010*. Urban domestic and industrial water status. Rural agricultural water status.* 5 March 2010.

Edwards, D. and McKee, T. 1997. *Characteristics of 20th Century Drought in the United States at Multiple Time-Scales.* Climatology Report No. 97-2. Fort Collins, USA. Colorado State University.

Gaffney. 2008. Gaffney's: Local Government in South Africa 2007-2008 – Official yearbook.

George Municipality, RSA. 2007. *George Bulk Water Supply Planning Study: Addendum Report.* Report No. 4317/401633. Prepared by Ninham Shand (Pty) Ltd, March 2007.

Gorra Water and WCDoA. 2012. Internal report (unpublished).

Government Gazette, RSA. 2010a. *No. 33325: Restrictions on the use of domestic water in the Municipalities of Beaufort West and Hessequa in the Western Cape Province.* Department of Water Affairs. 24 June, 2010.

Government Gazette, RSA. 2010b. *No. 33328: Restrictions on the use of domestic water in the Municipalities of Mossel Bay, George, Knysna and Bitou in the Western Cape Province.* Department of Water Affairs. 2 July, 2010.

Government Gazette, RSA. 2010c. *No. 33458: Restrictions on the use of agricultural water within Quarternary Drainage Areas K20A, K10E, K10F and K10B in the Western Cape Province.* 17 August 2010.

Government Gazette, RSA. 2010d. *No. 33859: Restrictions on the use of domestic water in the Municipalities of Mossel Bay, George, Knysna and Bitou in the Western Cape Province.* Department of Water Affairs. 17 December 2010.

Guttman, N. 1994. *On the Sensitivity of Sample L Moments to Sample Size.* Journal of Climatology. 7. pp. 1026-1029.

Hortgro. 2012. *Langkloof Inspections for Export (apples). Unpublished report.*

Intergovernmental Panel on Climate Change (IPCC). 2000. *The Special Report on Emissions Scenarios (SRES):* Special Report of Working Group III of the Intergovernmental Panel on Climate Change. University of Cambrige. Cambridge, United Kingdom. [Online] www.ipcc.ch/.

Intergovernmental Panel on Climate Change (IPCC). 2012. *Glossary of terms*. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555-564.

John, L & Karuri-Sebina, G. 2012. *Secondary cities in South Africa: The start of the conversation. The background report*, March 2012. South African Cities Network.

Kandji J.I., Verchot, L. & Mackenssen, J. 2006. *Climate change and climate variability in Southern Africa: Impacts and adaptation in the agricultural sector*. UNEP and the World Agroforestry Centre (ICRAF).

Kent, R. 2011. *Disaster Risk Reduction and Changing Dimensions and Dynamincs of Future Crisis Drivers.* Background Paper to the Global Assessment Report. 2011. Geneva Switzerland. UNISDR.

Kruger A.& Shongwe S. 2004. Temperature trends in South Africa: 1960–2003. International *Journal of Climatology*, Vol. 24, pp. 1929–1945.

Kruger A., 2006. Observed Trends in Daily Precipitation Indices in South Africa: 1910-2004. *International Journal of Climatology*, Vol. 26, pp. 2275-2285.

McKee, T., Doesken, N.J. and Kleist, J. 1993. *the Relationship of Drought Frequency and Duration to Time-Scales.* In: The 8th Conference on Applied Climatology. Anaheim, USA, 17-22 January, 1993. Boston, USA. American Meteorological Society.

Midgley G., Chapman R., Hewitson B., Johnston P., de Wit M., Ziervogel G., Mukheibir P., van Niekerk L., Tadross M., van Wilgen B., Kgope B., Morant P., Theron A., Scholes R. and Forsyth G. 2005. *A Status Quo, Vulnerability and Adaptation Assessment of the Physical and Socio-economic Effects of Climate Change in the Western Cape. Report to the Western Cape Government, Cape Town, South Africa*. CSIR Report No. ENV-S-C 2005-073, Stellenbosch.

Midgley G, van Wilgen B and Mantlana B (eds.). 2010. *South Africa's Second National Communication under the United Nations Framework Convention on Climate Change*. The Department of Environmental Affairs. Pretoria.

Mossel Bay Municipality, RSA. 2010. *2010 Annual Report.* pp. 11.

National Drought Mitigation Center. 2012. Vegetation Drought Response Index (VegDRI) 2012: *Percent Annual Seasonal Greenness*. [Online] http://vegdri.unl.edu/FAQ.aspx.

National Treasury, RSA. 2010a. *Budget Review 2010.* [Online] www.treasury.gov.za/documents/national%20budget/2010/review/Budget%20Review.pdf.

National Treasury, RSA. 2010b. *Adjusted Estimate of National Expenditure 2010.* pp. 361-362.

Nkhahle, S., Ngwenya, N. & Monson, T. (eds.). 2011. *Governing Migration & Urbanisation in South African Municipalities: Developing Approaches to Counter Poverty and Social Fragmentation.* South African Local Government Association (SALGA), Pretoria, South Africa.

Populstat. 2006. South Africa: Historical demographical data of the urban centres. [Online] http://www.populstat.info/Africa/safricat.htm.

Republic of South Africa (RSA). 2005. *Disaster Management Act (57/2002): A policy framework for disaster risk management in South Africa.* Government Gazette No. 27534, General

Notice 654. National Disaster Management Centre (NDMC), Pretoria, 2005. [Online] www.ndmc.gov.za.

Schmidt-Thomé, P. 2006. *Integration of Natural Hazards, Risk and Climate Change into Spatial Planning Practices*. Unpublished PhD Thesis, University of Helsinki, Finland. pp 31.

Schulze, R.E. 2003. *The Thukela Dialogue: Managing Water Related Issues on Climate Variability and Climate Change in South Africa*, University of Natal, Pietermaritzburg, South Africa, School of Bioresources Engineering and Environmental Hydrology, *ACRU*cons Report, 44. pp 152.

Schulze, R.E., Knoesen, D.M. and Kunz, R.P. 2011. Climate Change and Meteorological Drought: A 2011 Perspective. *In:* Schulze, R.E. 2011. *A 2011 Perspective on Climate Change and the South African Water Sector*. Water Research Commission, Pretoria, RSA, WRC Report 1843/2/11, Chapter 6.1, 179-185.

Seneviratne, S.I., N. Nicholls, D. Easterling, C.M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang, 2012: *Changes in climate extremes and their impacts on the natural physical environment.* In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 109-230.

South African Local Government Association (SALGA). 2011. *Development of a water conservation and water demand management strategy, business plan and implementation plan for the Kannaland Municipality*. Kannaland Report. October 2011.

South African River Health Programme (RHP). 2007. *State of the Rivers Report. Rivers of the Gouritz Water Management Area 2007*. River Health Programme. RHP. Department of Water Affairs and Forestry. Pretoria.

South African Weather Service. 2003a. *What is a Meteorological Drought?* [Online] http://old.weathersa.co.za.

South African Weather Service. 2003b. What is the Standardised Precipitation Index (SPI)? [Online] http://old.weathersa.co.za.

Statistics South Africa. 2010. *National Accounts: Environmental Economic Accounts: Water Management Areas in South Africa, Discussion Document* [Online] https://www.statssa.gov.za/publications/D04058/D04058.pdf.

Statistics South Africa. 2011. *Quarterly Labour Force Survey, Quarter 1, 2011.* PO211. p21

Umvoto Africa. 2010. Report commissioned by the Department of Water Affairs. Reconciliation strategy for Beaufort West, in: *Reconciliation strategy for all towns in the southern planning region*. Cape Town. South Africa. [Online] www6.dwa.gov.za/iwrp/DSS/Userfiles/iwrp/Documents/WC_DC5_WCO53_Beaufo_f.pdf

United Nations Development Programme. 2004. *Reducing Disaster Risk: A Challenge for Development.* United Nations Development Programme, Bureau for Crisis Prevention and Recovery, New York, USA. pp 146.

Urban-Econ: George. 2009. *George tourism impact assessment. Report prepared for Arcus Gibb.* Urban-Econ: Development Economics. George, South Africa.

United Nations International Strategy for Disaster Reduction Secretariat (UNISDR). 2011. 2011 *Global Assessment Report on Disaster Risk Reduction Revealing Risk, Redefining Development. Chapter 3: Drought risks*. UNISDR, Geneva. [Online] www.preventionweb.net.

United Nations International Strategy for Disaster Reduction Secretariat (UNISDR), 2009a. *Drought Risk Reduction Framework and Practices Contributing to the Implementation of the Hyogo Framework for* Action. UNISDR, Geneva. [Online] www.preventionweb.net/english.

United Nations International Strategy for Disaster Reduction Secretariat (UNISDR). 2009b. *2009 UNISDR terminology on disaster risk reduction.* UNISDR, Geneva. [Online] www.preventionweb.net.

United States Agency for International Development (USAID), 2007. *Adapting to climate variability and change a guidance manual for development planning*. USAID, Washington, DC. [Online] www.usaid.gov.

Vogel, C. 2012. Pers comm.

Weier, J. and Herring, D., undated. *Measuring vegetation (NDVI and EVI).* [Online] http://earthobservatory.nasa.gov.

Western Cape Department of Local Government (Directorate: District & Local Performance Monitoring). Undated. *Consolidated Annual Municipal Performance Report* 2008/09. [Online] www.westerncape.gov.za/.

Western Cape Department of Local Government & Housing. *Eden Water Crisis: Report to Cabinet, 4 November 2009*.

Western Cape Provincial Gazette, 2009a. Province of Western Cape: Provincial Gazette No. 6677. *Section 435. Declaration of a Local Disaster: George Municipality*.

Western Cape Provincial Gazette, 2009b. Province of Western Cape: Provincial Gazette No. 6676. *Section 438. Declaration of a Local Disaster: Mossel Bay Municipality.*

Western Cape Provincial Gazette, 2009c. Province of Western Cape: Provincial Gazette No. 6680. Section *447. Declaration of a Local Disaster: Knysna Municipality*.

Western Cape Provincial Gazette, 2010a. Province of Western Cape: Provincial Gazette No. 6751. *Declaration of a Local Disaster: Central Karoo District Municipality*.

Western Cape Provincial Gazette, 2010b. Province of Western Cape: Provincial Gazette No. 6757. Section *236. Declaration of a Local Disaster: Eden District Municipality*.

Western Cape Provincial Treasury (Directorate Budget Management: Local Government). 2010a. *Regional Development Profile: Eden District 2010 Working paper.* South Africa. [Online] www.capegateway.gov.za.

Western Cape Provincial Treasury (Directorate Budget Management: Local Government). 2010b. *Regional Development Profile: Central Karoo District 2010 Working paper.* South Africa. [Online] www.capegateway.gov.za.

Wilhite, D.A. and Buchanan-Smith, M. 2005. Drought as hazard: Understanding the natural and social context. In: *Drought and weather crises: Science, technology and management issues*. D.A. Wilhite, ed. Volume 86. Books in Soils, Plants and the Environment Series. Boca Raton, USA: Taylor & Francis.

World Meteorological Organisation (WMO). 2009. *Lincoln Declaration on Drought Indices* Inter-Regional Workshop on Indices and Early Warning Systems for Drought. University of Nebraska-Lincoln, U.S.A., 8-11 December, 2009. [Online] www.wmo.int/pages/mediacentre/press_releases/pr_872_en.html.

World Meteorological Organisation (WMO). 2009.

Xu, P. and Girgis, A.A. 2001. *Optimal Load-shedding Strategy in Power Systems with Distributed Generation.* In the Power Engineering SocietyWinter Meeting, 2001. IEEE. pp. 788-793

Presentations

Basson, H.L. 2010. *Drought crisis management, challenges and solutions: Southern Cape, George.* Presented at the 74th IMESA Conference, 27-29 October, East London.

Food and Agriculture Organization of the United Nations (FAO), 2006. Coping with Water Scarcity. A strategic issue and priority for system-wide action Alexander Müller (Assistant Director General – Sustainable Development). Presented at World Water Week, Stockholm, Sweden, 19-25 August, 2006. [Online] www.unwater.org

Smit, J.L. 2012. Western Cape Post 2010/11 Drought Analysis, Beaufort West Municipality. Presented at Post Drought Seminar, 19 March 2012, Cape Town.

South African Weather Services. 2009. *Drought Presentation.* Presented at Provincial Drought Management Meeting, George, 25 August, 2009.

Steytler, N. and Powel, D. 2010. Local Government Working Paper Series No. 1 2010, November. The Impact of the Global Financial Crisis on Decentralized Government in South Africa. Presented at the annual conference of the International Association of Centres for Federal Studies, 16-18 September 2010, Philadelphia.

Venter, C. 2010. *Economic impact of the global financial crisis on the South African tourism sector.* Presented at the Cape Town & Western Cape Destination Conference. Econex & Senior Economist Bureau for Economic Research (BER).

Western Cape Department of Agriculture. 2010. *Water situation in the rural and agricultural areas (Eden District Municipality)*. Presented at the Provincial Drought Management Meeting.

Explanation of Terms. [Online] www.wrcc.dri.edu

ANNEXES

ANNEX 1: LETTER OF INTRODUCTION FOR DIMP RESEARCH TEAM

LOCAL GOVERNMENT
Provincial Government of the Western Cape

CHIEF DIRECTORATE: DISASTER MANAGEMENT AND FIRE BRIGADE SERVICES
DIRECTORATE: DISASTER OPERATIONS

esteyn@pgwc.gov.za
tel: +27 21 937 0794: +27 21 931 9031
Private Bag X 3, Sanlamhof, 7532
www.capegateway.gov.za

REFERENCE: LG LG23/3
ENQUIRIES: E Steyn

To: Municipalities: **Central Karoo District and Local Municipalities**
Eden District and Local Municipalities

Provincial Departments: **Local Government (Municipal Infrastructure Grant)**
Agriculture
Environmental Affairs and Development Planning
Social Development
South African Social Security Agency (SASSA)
Provincial Treasury
National Departments: **Water Affairs**
Agriculture, Forestry and Fisheries
National Disaster Management Centre (NDMC)

Agri Western Cape / Klein Karoo
SANRAL
ACSA
MTN
Vodacom

Dear Colleague

COMPREHENSIVE POST EVENT ANALYSIS STUDY PERTAINING TO THE DROUGHT DISASTER IN THE WESTERN CAPE, JANUARY 2009 TO JANUARY 2011

The Department of Local Government, through its Provincial Disaster Management Centre (PDMC) in the Western Cape, deems it necessary to conduct a comprehensive post event analysis study pertaining to the drought disaster in the Western Cape, which occurred from January 2009 to January 2011 in both the Eden and Central Karoo Districts.

The PDMC is legally obligated to conduct debriefings and post event analysis studies subsequent to each and every significant major event. Therefore, the PDMC, as the monitoring and coordinating functionary as legislated by the National Disaster Management Act, 2002 (Act No 57 of 2002), is thus legally obligated to conduct an in-depth overview of major incidents in which lessons learned are catalogued from which to prepare and develop future response / readiness strategies.

During January 2009, the PDMC was alerted that the town of Sedgefield experienced a water crisis and subsequent to this, the entire Eden district Municipality was affected by drought conditions and or water shortages. According to the South African Weather Service (SAWS), the Eden District Municipality experienced the lowest rainfall in history and dam levels were at historically low levels. Opinions were that these conditions were drought related, an opinion also shared by the National

page 1

of 2

Department of Water Affairs indicated that the situation in Eden is indicative of a 1:100 to 1:150 year drought.

Because of the magnitude of the incident, a request was received for the classification of a disaster in the Eden and Central Karoo District municipal areas. The Eden District Municipality was classified as a local disaster area in terms of sections 23(1) of the DMA on 10 November 2009 and Beaufort West Municipality was also classified in terms of the above-mentioned section on 10 May 2010.

The emergency projects implemented include the re-use of effluent water, the exploration of boreholes and the implementation of desalination plants which contributed to the alleviation of the situation. The PDMC, together with all the relevant sector departments also valiantly assisted in mitigating the situation.

The **Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) at the Stellenbosch University (SU)** was appointed at the end of October 2011 as the service provider to conduct the study on behalf of the PDMC and will act as facilitator and researcher in this project.

The PDMC would like to request that the Central Karoo and Eden Municipal Disaster Management Centres to also inform the local municipalities within their area of jurisdiction, national and provincial departments, as well as state-owned enterprises to assist Dr Ailsa Holloway and her team from SU/DiMP in this mammoth task to compile the post event analysis report on drought for the Western Cape.

Should you require any further information, please do not hesitate to contact Dr Elmien Steyn at Tel (021) 937 0974 or via e-mail: esteyn@pgwc.gov.za and Ms Ronelle Pieters at Tel (021-937 0823 or via e-mail: rpieters@pgwc.gov.za.

Your assistance and co-operation is appreciated.

Kind regards

Pandaram

Mrs JV Pandaram
DIRECTOR: DISASTER OPERATIONS
PROVINCIAL DISASTER MANAGEMENT CENTRE
Date: 31 October 2011

ANNEX 2: INTERVIEW PARTICIPANTS

Field interviews

Attie Arnoldie	Owner of B & B Beaufort West
Jaffie Booysen	Municipal Manager Beaufort West
Ben Burger	Beaufort West Farmer
Michelle Buys	Fancourt Estate Community Liaison Officer
Danie Conradie	Laingsburg Farmer
Laurie Conway	SAB Hop Farms
Jan Crafford	Barrydale Farmer
Ingrid Cronje	George Chamber of Commerce
Charles Du Plessis	Agri Western Cape
Kobus Du Toit	Oudtshoorn Water Affairs
Frans Esterhuyse	Beaufort West Famer
Ernie Fourie	Chairman Gamka Irrigation Board/Farmer
Renaldo Groenewald	Ladismith Cheese
Deon Haasbroek	Oudtshoorn Water Affairs
Dave Hodgson	Uniondale Farmer
Paul Hoffman	George SEDA
Johann	(Local Pastor) Amaliensteyn Community
Jannie Le Roux	Beaufort West Famer
Gustav Lind	Beaufort West Farmer
Local farmer	Amaliensteyn (name not given)
Piet Lodder	Agri Klein Karoo
Pietie Lund	Beaufort West Farmer
Heinrich Mettler	Prince Albert Municipal Manager
Rodney Nay	Knysna Engineers Department
Wilhelm Nel	Farmers Association Ladismith
Gerhard Otto	Eden DM
Bob Reynecke	Ladismith Farmer
Hein Rust	Central Karoo DM
Sedgefield retired civil engineers	Engineers
Hennie Smit	Ratepayers Calitzdorp/Farmer
Louw Smit	Beaufort West Municipal Engineer
Rob Smith	Provincial Department of Human Settlements
Andries Stander	Haarlem Irrigation Board/Farmer
Thuys Swart	Ladismith Farmer
Jan Van Der Wywe	Laingsburg Farmer
Gerhard Van Zyl	Central Karoo Environmental Health
Ruan Veldman	Entomologist Stellenbosch University
Carlie Venter	George Municipality LED Department
Carel Venter	George Spatial Planning Department
Pierre Venter	Mossel Bay Chamber of Commerce
Fathima Watney	Eden DM Tourism
Pietie Williams	Municipal Manager Laingsburg
Christopher Wright	Beaufort West Municipal Engineering Department
Wendy Young	Eden DM

Telephonic interviews

Antoinette	SASPA
Rev. Stephan Anthony	Uniondale Integrated Empowerment Project (UNIEP) Uniondale
John Christie	Beaufort West Abattoir
Angela Conway	Southern Cape Land Committee
Mareyna De Vries	Life Community Services George
Andre De Wit	Langkloof Farmer
Sue Du Toit	Child & Family Welfare George
Esmarie Joubert	OK Bazaars Barrydale
Kenneth Kirsten	GIS Western Cape Provincial Directorate: Planning, Department of Human Settlements
Johan Kotze	Du Toit Group
Patrick Laws	George Social Development
John Moodie	Swellendam Honey Farmer
Florina Mouton	Department of Social Development (DSD)
Dr. Jaco Pienaar	State Veterinary Surgeon Beaufort West
Wiehan Steyn	FruitGro
Nelius Van Greunen	George Dairy Farmer
Koos Van Zyl	Agri-SA
Hettie Weyman	Ladismith Tourism

Focus group interviews

Amaliensteyn residents

Barrydale residents, business and farming representatives

Haarlem small farmers

Knysna: Multiple stakeholder meeting, Chamber of Commerce, SAN Parks, farmers, timber

Mossel Bay Technical Services Division

ANNEX 3: DISASTER DECLARATIONS

Western Cape Provincial Gazette, 2009a. Province of Western Cape: Provincial Gazette No. 6677. *Section 435. Declaration of a Local Disaster: George Municipality*.

Western Cape Provincial Gazette, 2009b. Province of Western Cape: Provincial Gazette No. 6676. *Section 438. Declaration of a Local Disaster: Mossel Bay Municipality.*

Western Cape Provincial Gazette, 2009c. Province of Western Cape: Provincial Gazette No. 6680. Section *447. Declaration of a Local Disaster: Knysna Municipality*.

Western Cape Provincial Gazette, 2010a. Province of Western Cape: Provincial Gazette No. 6751. *Declaration of a Local Disaster: Central Karoo District Municipality*.

Western Cape Provincial Gazette, 2010b. Province of Western Cape: Provincial Gazette No. 6757. Section *236. Declaration of a Local Disaster: Eden District Municipality*.

PROVINCE OF WESTERN CAPE | PROVINSIE WES-KAAP

ProvincialGazette | Provinsiale Koerant

6677 | *6677*

Friday, 20November 2009 | *Vrydag,20November2009*

TEXT EXTRACTED

P.N. 435/2009 — 20 November 2009

GEORGE MUNICIPALITY

DECLARATION OF A LOCAL DISASTER

Notice is hereby given in terms of section 55(1) of the Disaster Management Act, 2002 (Act 57 of 2002) that the George Municipality, in consultation with the National-, Provincial- and Municipal Disaster Management Centres, on 06 November 2009, resolved that due to the current drought conditions in the jurisdiction area of the George Municipality, the Municipal area be declared as a local state of disaster in terms of the said Act.

The National Disaster Management Centre endorsed the classification of the George Municipality by classifying the drought as a local disaster in terms of Section 23 (1) (b) of the said Act on 10 November 2009.

CM AFRICA, MUNICIPAL MANAGER

P.K. 435/2009 — 20 November 2009

GEORGE MUNISIPALITEIT

AFKONDIGING VAN 'N PLAASLIKE RAMP

Kennis geskied hiermee ingevolge artikel 55(1) van die Rampbestuurswet, 2002 (Wet 57 van 2002) dat die George Munisipaliteit, in oorleg met die Nasionale-, Provinsiale- en Plaaslike Rampbestuursentrums op 06 November 2009, besluit het dat, as gevolg van die huidige droogte in die Munisipaliteit se jurisdiksiegebied, die Munisipaliteit as 'n plaaslike rampgebied ingevolge die gemelde Wet verklaar word.

Die Nasionale Rampbestuursentrum het die klassifikasie van die George Munisipalitieit ondersteun deur die droogte as 'n plaaslike ramp ingevolge Artikel 23 (1) (b) van die gemelde Wet te verklaar op 10 November 2009.

CM AFRICA, MUNISIPALE BESTUURDER

PROVINCE OF WESTERN CAPE

PROVINSIE WES-KAAP

ProvincialGazette

Provinsiale Koerant

6677

6677

Friday, 20November 2009

Vrydag,20 November2009

TEXT EXTRACTED

P.N. 438/2009 20 November 2009

MOSSEL BAY MUNICIPALITY

DECLARATION OF A LOCAL DISASTER

Notice is hereby given in terms of section 55(1) of the Disaster Management Act, 2002 (Act 57 of 2002) that the Mossel Bay Municipality, in consultation with the National-, Provincial- and Municipal Disaster Management Centres, on 04 November 2009, resolved that due to the current drought conditions in the jurisdiction area of the Mossel Bay Municipality, the Municipal area be declared. as a local state of disaster in terms of the said Act.

The National Disaster Management Centre endorsed the classification of the Mossel Bay Municipality by classifying the drought as a local disaster in terms of Section 23 (1) (b) of the said Act on 10 November 2009.

Municipal Manager, PO Box 25, MOSSEL BAY 6500

P.K. 438/2009 20 November 2009

MOSSELBAAI MUNISIPALITEIT

AFKONDIGING VAN 'N PLAASLIKE RAMP

Kennis geskied hiennee ingevolge artikel 55(1) van die Ramp Bestuurswet, 2002 (Wet 57 van 2002) dat die Mosselbaai Munisipaliteit, in oorleg met die Nasionale-, Provinsiale- en Plaaslike Ramp Bestuur Sentrums op 04 November 2009, besluit het, dat as gevolg van huidige droogte in die Munisipalitiet se jurisdiksie gebied dat die Munisipaliteit as 'n plaaslike ramp gebied in terme van genoemde Wet verklaar word.

Die Nasionale Rampbestuursentrum het die klassifikasie van die Mosselbaai Munisipalitieit ondersteun deur die droogte as 'n plaaslike ramp in terme van Artikel 23 (1) (b) van die genoemde Wet te verklaar op 10 November 2009.

Munisipale Bestuurder, Posbus 25, MOSSELBAAI 6500

PROVINCE OF WESTERN CAPE

PROVINSIE WES-KAAP

ProvincialGazette

Provinsiale Koerant

6677

6677

Friday, 20November 2009

Vrydag, 20November 2009

TEXT EXTRACTED

P.N. 447/2009 27 November 2009

KNYSNA MUNICIPALITY

DECLARATION OF A LOCAL DISASTER

Notice is hereby given in terms of section 55 (1) of the Disaster Management Act, 2002 (Act 57 of 2002) that the Knysna Municipality, in consultation with the National-, Provincial- and Eden District Disaster Management Centres, on 4 November 2009, resolved that due to the current drought conditions in the jurisdiction area of the Knysna Municipality, the Municipal area be declared as a local state of disaster in terms of the said Act.

The National Disaster Management Centre endorsed the classification of the Knysna Municipality by classifying the drought as a local disaster in terms of Section 23 (1) (b) of the said Act on 10 November 2009.

J.B. Douglas, Municipal Manager, PO Box 21, KNYSNA, 6570

P.K. 447/2009 27 November 2009

KNYSNA MUNISIPALITEIT

AFKONDIGING VAN 'N PLAASLIKE RAMP

Kennis geskied hiermee ingevolge artikel 55 (1) van die Ramp Bestuurswet, 2002 (Wet 57 van 2002) dat die Knysna Munisipaliteit, in oorleg met die Nasionale-, Provinsiale- en Eden Distriksrampbestuursentrums op 4 November 2009, besluit het, dat as gevolg van die huidige droogte in die Munisipaliteit se jurisdiksie gebied dat die Munisipaliteit as 'n plaaslike rampgebied in terme van genoemde Wet verklaar word.

Die Nasionale Rampbestuursentrum het die klassifikasie van die Knysna Munisipaliteit ondersteun deur die droogte as 'n plaaslike ramp in terme van Artikel 23 (1) (b) van die genoemde Wet te verklaar op 10 November 2009.

J.B. Douglas, Munisipale Bestuurder, Posbus 21, KNYSNA, 6570

PROVINCE OF WESTERN CAPE

PROVINSIE WES-KAAP

ProvincialGazette

Provinsiale Koerant

6751

6751

Friday, 28 May 2010

Vrydag, 28 Mei 2010

TEXT EXTRACTED

CENTRAL KAROO DISTRICT MUNICIPALITY

DECLARATION OF A LOCAL DISASTER

Notice is hereby given in terms of section 55(1) of the Disaster Management Act, 2002 (Act 57 of 2002) that the Central Karoo District Municipality, in consultation with the Provincial and National Disaster Management Centres, on 28 April 2010, resolved, that due to the current drought conditions in the jurisdiction areas of the Central Karoo District Municipality (Beaufort West Municipality), the District (Beaufort West Municipality) be declared as a local disaster in terms of the said Act. The National Disaster Management Centre endorsed the classification of the Central Karoo District Municipality (Beaufort West Municipality) by classifying the drought as a local disaster in terms of section 23(1)(b) of the said Act on 11 May 2010.

S JOOSTE, Acting Executive Municipal Manager, Private Bag X560, BEAUFORT WEST, 6970

28 May 2010 21869

SENTRAAL KAROO DISTRIKSMUNISIPALITEIT

AFKONDIGING VAN 'N PLAASLIKE RAMP

Kennis geskied hiermee ingevolge artikel 55(1) van die Rampbestuur Wet, 2002 (Wet 57 van 2002) dat die Sentraal Karoo Distriksmunisipaliteit, in oorleg met die Provinsiale en Nasionale Ramp Bestuur Sentrums, op 28 April 2010, besluit het, dat as gevolg van huidige droogte in die Sentraal Karoo Distriksmunisipaliteit (Beaufort-Wes Munisipaliteit) se jurisdiksie gebied dat die Sentraal Karoo Distriksmunisipaliteit (Beaufort-Wes Munisipaliteit) as 'n plaaslike ramp gebied in terme van genoemde Wet verklaar word. Die Nasionale Rampbestuursentrum het die klassifikasie van die Sentraal Karoo Distriksmunisipaliteit (Beaufort-Wes Munisipaliteit) ondersteun deur die droogte as 'n plaaslike ramp in terme van Artikel 23(1)(b) van die genoemde Wet te verklaar op 11 Mei 2010.

S JOOSTE, Wnde Uitvoerende Munisipale Bestuurder, Privaatsak X560, BEAUFORT-WES, 6970

28 Mei 2010 21869

PROVINCE OF WESTERN CAPE

PROVINSIE WES-KAAP

ProvincialGazette

Provinsiale Koerant

6757

6757

Friday, 11 June 2010

Vrydag, 11 Junie 2010

TEXT EXTRACTED

P.N. 236/2010 11 June 2010

EDEN DISTRICT MUNICIPALITY

DECLARATION OF A LOCAL DISASTER

Notice is hereby given in terms of section 55 (1) of the Disaster Management Act, 2002 (Act 57 of 2002) that the Eden District Municipality, in consultation with the Provincial and National Disaster Management Centres, on 4 November 2009, resolved, that due to the current drought conditions in the jurisdiction areas of the Eden District Municipality, the District be declared as a local disaster in terms of the said Act.

The National Disaster Management Centre endorsed the classification of the Eden District Municipality by classifying the drought as a local disaster in terms of section 23 (1) (b) of the said Act on 10 November 2009. This declaration will be applicable until further notice.

M. HOOGBAARD, Act. Executive Municipal Manager, P.O. Box 12, GEORGE, 6530

P.K. 236/2010 11 Junie 2010

EDEN DISTRIKSMUNISIPALITEIT

AFKONDIGING VAN 'N PLAASLIKE RAMP

Kennis geskied hiermee ingevolge artikel 55(1) van die Ramp Bestuurswet, 2002 (Wet 57 van 2002) dat die Eden Distriksmunisipaliteit, in oorleg met die Provinsiale en Nasionale Ramp Bestuur Sentrums, op 4 November 2009, besluit het, dat as gevolg van die huidigedroogte in die Eden Distriksmunisipaliteit se jurisdiksie gebied dat die Eden Distrik as 'n plaaslike ramp gebied in terme van genoemde Wet verklaar word.

Die Nasionale Ramp Bestuur Sentrum het die klassifikasie van die Eden Distrikmunisipaliteit ondersteun deur die droogte as 'n plaaslike ramp in terme van Artikel 23 (1) (b) van die genoemde Wet to verklaar op 10 November 2009. Hierdie verklaring bly van krag tot verdure kennisgewing.

M. HOOGBAARD, Wnde, Uitvoerende Munisipale Bestuurder, Posbus 12, GEORGE, 6530

WATER RESTRICTIONS:

CONTENTS • INHOUD

GOVERNMENT NOTICE

DEPARTMENT OF WATER AFFAIRS

No. 565 **24 June 2010**

RESTRICTIONS ON THE USE OF DOMESTIC WATER IN THE MUNICIPALITIES OF BEAUFORT WEST AND HESSEQUA IN THE WESTERN CAPE PROVINCE.

I, Nobubele Ngele, in my capacity as the Acting Director General of the Department of Water Affairs, by virtue of the powers vested in me in Section 63, read together with Section 72 of the National Water Act, 1998 (Act No. 36 of 1998), and in terms of Section 6(1)(i) Schedule 3 of the same Act, hereby direct that, as from 01 January 2010 until any further Notice is published in this regard:

- The taking of raw water for domestic and industrial purposes from natural resources in the town of Beaufort West as well as in the area of jurisdiction of the Hessequa Municipality, be reduced by 40% to supply 60% of the unrestricted use. The reduction is based on water consumption in the year 2008 and will be adjusted to allow for population growth;
- The taking of groundwater from private boreholes for the irrigation of gardens must not be permitted between 07:00 and 17:00 hours in the town of Beaufort West as well as in the area of jurisdiction of the Hessequa Municipality.

This Notice overrides any other previous authorisation on water restrictions issued by the Department of Water affairs relating to this area.

ACTING DIRECTOR GENERAL: DEPARTMENT OF WATER AFFAIRS

DATE: 11/5/10

Printed by and obtainable from the Government Printer, Bosman Street, Private Bag X85, Pretoria, 0001
Publications: Tel: (012) 334-4508, 334-4509, 334-4510
Advertisements: Tel: (012) 334-4673, 334-4674, 334-4504
Subscriptions: Tel: (012) 334-4735, 334-4736, 334-4737
Cape Town Branch: Tel: (021) 465-7531

DEPARTMENT OF WATER AFFAIRS

No. 577 **2 July 2010**

RESTRICTIONS ON THE USE OF DOMESTIC WATER IN THE MUNICIPALITIES OF MOSSELBAY, GEORGE, KNYSNA AND BITOU IN THE WESTERN CAPE PROVINCE

I, Nobubele Ngele, in my capacity as Acting Director-General of the Department of Water Affairs, by virtue of the powers vested in me on section 63, read together with section 72, of the National Water Act, 1998 (Act No. 36 of 1998), hereby direct that, in terms of section 6(1)(i) of schedule 3 of the National Water Act, 1998, the following Notice should apply in the municipalities of Mossel Bay, George, Knysna, and Betou in the Western Cape, as from 1 January 2010 until further notice:

- The taking of raw water for domestic and industrial purposes from natural resources in the areas of jurisdiction of the following municipalities be reduced by 40%, to supply 60% of the unrestricted use. The reduction is based on water consumption in the periods as indicated, and will be adjusted to allow for population growth: Mossel Bay (2008), George (2008), Knysna (2004) and Bitou (2006).

- The taking of groundwater from private boreholes for the irrigation of gardens is not permitted between 7h00 and 19h00 hours.

This Notice overrides any other previous authorisation on water restrictions issued by the Department of WaterAffairs relating to this area.

Cungele

DIRECTOR GENERAL (Acting)
DATE: 9/3/10

GOVERNMENT NOTICE

DEPARTMENT OF WATER AFFAIRS

No. 711 **17 August 2010**

RESTRICTIONS ON THE USE OF AGRICULTURAL WATER WITHIN QUATERNARY DRAINAGE AREAS K20A, K10E, K10F AND K10B IN THE WESTERN CAPE PROVINCE.

By virtue of the powers vested in me in Section 63, read together with Section 72, of the National Water Act (Act No. 36 of 1998), I, Nobubele Ngele, in my capacity as Acting Director General of the Department of Water Affairs -

Direct, in terms of Section 6(1)(i) of Schedule 3 of the National Water Act, 1998, that as for the period from 16 July 2010 until any further Notice is published in this regard, that: -

The taking of raw water for agricultural purposes from natural resources within the following quaternary drainage areas in the Western Cape be reduced by 60%, to supply 40% of the unrestricted use of the existing lawful water use as registered under the Water Authorisation, Registration and Management System of the Department of Water Affairs:

K20A, including the full catchment of the Great Brak River, all tributaries thereto, the main stem river upstream of and riparian users to the Wolwedans Dam;

K10E and K10F, including the full catchment of the Moordkuil River (secondary tributary to the Small Brak River), all tributaries thereto, the main stem river upstream of the pump stations to the Klipheuvel Dam;

K10B, including the full catchment, all tributaries thereto, the main stem river upstream of the Hartebeeskuil Dam and downstream releases made from the said storage works situated within a tributary to the Hartenbos River.

This Notice overrides any other previous authorization on water restrictions issued by the Department relating to this area.

ACTING DIRECTOR GENERAL:, DEPARTMENT OF WATER AFFAIRS
DATE: - 15/7/10

DEPARTMENT OF WATER AFFAIRS

No. 1203 **17 December 2010**

RESTRICTIONS ON THE USE OF DOMESTIC WATER IN THE MUNICIPALITIES OF MOSSELBAY, GEORGE, KNYSNA AND BITOU IN THE WESTERN CAPE PROVINCE

I, Nobubele Ngele, in my capacity as Acting Director-General of the Department of Water Affairs, by virtue of the powers vested in me on section 63, read together with section 72, of the National Water Act, 1998 (Act No. 36 of 1998), hereby direct that, in terms of section 6(1)(i) of schedule 3 of the National Water Act, 1998, the following Notice should apply in the municipalities of Mossel Bay, George, Knysna, and Betou in the Western Cape, as from 1 January 2010 until further notice:

- The taking of raw water for domestic and industrial purposes from natural resources in the areas of jurisdiction of the following municipalities be reduced by 40%, to supply 60% of the unrestricted use. The reduction is based on water consumption in the periods as indicated, and will be adjusted to allow for population growth: Mossel Bay (2008), George (2008), Knysna (2004) and Bitou (2006).

- The taking of groundwater from private boreholes for the irrigation of gardens is not permitted between 7h00 and 19h00 hours.

This Notice overrides any other previous authorisation on water restrictions issued by the Department of WaterAffairs relating to this area.

Cungele

DIRECTOR GENERAL (Acting)
DATE: 9/3/10

ANNEX 4: DISTRIBUTION OF SMALL, MEDIUM AND LARGE LIVESTOCK FARMERS AUTHORIZED TO RECEIVE FODDER RELIEF

District	Municipality	Scale	Vouchers redeemed		Vouchers not redeemed		Total	
			Voucher (Rand)	No. farms	Voucher value	No. farms	Voucher value	No. farms
Central Karoo District	Beaufort West	Large	311 485.44	31	36 690.72	6	348 176.16	37
		Med.	11 520.00	1	0.00	0	11 520.00	1
		small	97 079.04	32	13 176.00	3	110 255.04	35
	Beaufort West Subtotal		**420 084.48**	**64**	**R 49 866.72**	**9**	**469 951.20**	**73**
	Laingsburg	Large	571 435.20	58	20 160.00	2	591 595.20	60
		Med.	67 449.60	6	0.00	0	67 449.60	6
		Small	39 543.36	17	2 592.00	2	42 135.36	19
	Laingsburg Subtotal		**678 428.16**	**81**	**R 22 752.00**	**4**	**701 180.16**	**85**
	Prince Albert	Large	50 400.00	5	0.00	0	50 400.00	5
		Small	R 0.00	0	2 457.60	2	2 457.60	2
	Prince Albert Subtotal		**50 400.00**	**5**	**R 2 457.60**	**2**	52 857.60	7
	Central Karoo		**1 148 912.64**	**150**	**R 75 076.32**	**15**	**2 447 977.92**	**165**
Eden District	Bitou	Large	394 800.00	22	7 085.88	4	401 885.88	26
		Med.	96 802.56	6	0.00	0	96 802.56	6
		Small	304 790.04	50	56 540.16	6	361 330.20	56
	Bitou Subtotal		**796 392.60**	**78**	**R 63 626.04**	**10**	**860 018.64**	**88**
	George	Large	2 303 474.40	121	0.00	0	2 303 474.40	121
		Med.	415 845.12	26	81 687.84	5	497 532.96	31
		Small	465 867.72	53	197 472.84	17	663 340.56	70
	George Subtotal		**3 185 87.24**	**200**	**R 279 160.68**	**22**	**3 464 347.92**	**222**
	Hessequa	Large	11 508 220.08	620	701 362.68	55	12 209 582.76	675
		Med.	1 346 370.67	80	0.00	0	1 346 370.67	80
		Small	1 489 021.32	212	54 002.88	5	1 543 024.20	217
	Hessequa Subtotal		**14 343 612.07**	**912**	**R 755 365.56**	**60**	**15 098 977.63**	**972**
	Knysna	Large	852 600.00	45	24 027.84	3	876 627.84	48
		Med.	78 558.72	5	0.00	0	78 558.72	5
		Small	92 456.64	12	0.00	0	92 456.64	12
	Knysna Subtotal		**1 023 615.36**	**62**	**R 24 027.84**	**3**	**1 047 643.20**	**65**
	Mossel Bay	Large	4 427 090.76	237	396 171.96	28	4 823 262.72	265
		Med.	541 674.24	33	0.00	0	541 674.24	33
		small	1 043 336.76	143	101 809.92	8	1 145 146.68	151
	Mossel Bay Subtotal		**6 012 101.76**	**413**	**R 497 981.88**	**36**	**6 510 083.64**	**449**
	Kannaland	Large	R 0.00	0	94 161.36	14	94 161.36	14
		Small	R 0.00	0	344 401.92	32	344 401.92	32
	Kannaland Subtotal		**R 0.00**	**0**	**R 438 563.28**	**46**	**438 563.28**	**46**
	Oudtshoorn	Large	125 256.96	7	783 254.28	69	908 511.24	76
		Med.	3 313.92	1	58 425.60	3	61 739.52	4
		Small	9 288.00	2	850 799.52	44	860 087.52	46
	Oudtshoorn Subtotal		**R 137 858.88**	**10**	**R 1 692 479.40**	**116**	**1 830 338.28**	**126**
	Uniondale	Large	916 552.44	56	681 049.68	55	1 597 602.12	111
		Med.	135 854.40	8	0.00	0	135 854.40	8
		Small	562 902.48	136	219 021.72	46	781 924.20	182
	Uniondale Subtotal		**1 615 309.32**	**200**	**R 900 071.40**	**101**	**2 515 380.72**	**301**
	Klein Karoo Subtotal		**1 753 168.2**	**210**	**3 031 114.1**	**263**	**4 784 282.28**	**473**
	Eden Subtotal		**27 114 077.23**	**1875**	**4 651 276.08**	**394**	**31 765 353.31**	**2269**
	Total		**28 262 989.87**	**2025**	**4 726 352.40**	409	32 989 342.27	2434

ANNEX 5: INFRASTRUCTURE DATA COLLECTION TEMPLATE

Desalination and reclamation/waste water treatment plants

Municipality	Launch Date	Size	Cost of construction	Running cost (monthly)	Water produced
Knysna (Desalination)					
Mossel Bay (Desalination)					
Bitou (Desalination)					
George (Desalination)					
Beaufort West (Reclamation)					

Boreholes

Municipality	Date	No of boreholes	Water produced	Cost
Knysna				
Mossel Bay				
Bitou				
George				
Beaufort West				

Pumping stations

Municipality	Date	Date	Capacity	Water	Cost
Knysna					
Mossel Bay					
Bitou					
George					
Beaufort West					

ANNEX 6: TOURISM DATA COLLECTION TEMPLATE

Name of guest house/BB/lodge	
Municipality	
Year guest house was established	

	Number of visitors hosted in peak season												
	’00	**’01**	**’02**	**’03**	**’04**	**’05**	**’06**	**’07**	**’08**	**’09**	**’10**	**’11**	**’12**
November													
December													
January													
February													

Comments

ANNEX 7: EXTRACT OF AGRICULTURAL RECORDS

Department of Agriculture / Departement van Landbou

Disaster Relief Grant Paid

Reference **B030** District Municipality: **Central Karoo** Local Municipality: **Beaufort West** Nearest Town: [redacted]

Assignee: [redacted] Farm Name: **Sarelsrivier**

Address:	Posbus 79	Contact :	[redacted]	ID-doc:	[redacted]	Lat:	-[redacted]	Long: [redacted]
Town:	Aberdeen	Contact :	[redacted]	SARS:	[redacted]	Category Farmer	**Large scale**	
Postal Code:	6270	e-Mail :	[redacted]					

Scheme	Assistance	Type Of Assistance	Detail Of Assistance	Final Subsidy	Subsidy paid to	Source Doc No	Source Doc date	Month
Drought Relief Scheme/Droogtehulpskema 2007/2009	Livestock assistance	Drought Relief	Fodder	R 12 598.87	BKB Beperk	05294085 + ..67	10 January 2010	Dec-2009
				R 12 597.66	BKB Beperk	0584675	29 January 2010	Jan-2010
				R 12 597.66	BKB Beperk	05295414	26 February 2010	Feb-2010
Drought Relief Scheme Eden 2010			Fodder/Voer - Transport/Vervoer	R 10 054.78	Karoo Vleisboere Koöperatief BPK	MBI106226	12 October 2010	Oct-2010
Drought Relief Scheme/Droogtehulpskema 2007/2009				R 8 144.60	BKB Beperk	05293826	07 December 2010	Dec-2010
				R 1 832.60	BKB Beperk	05293535	04 December 2010	Dec-2010

Summary for 'Reference' = B030 (6 detail records) **R 57 814.07**