A REVIEW AND ASSESSMENT FOR THABA CHWEU LOCAL MUNICIPALITY VELDFIRE MANAGEMENT IN MPUMALANGA PROVINCE

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2004061277

Submitted in partial fulfilment of the requirements for the degree Masters in Disaster Management

In the

Disaster Management Training and Education Center for Africa

At the

UNIVERSITY OF THE FREE STATE

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2011

ACKNOWLEDGEMENT

The writing of this mini dissertation has been one of the most significant academic challenges I have ever experienced in my academic career. I would like to express my sincere gratitude to the All Mighty for giving me the inspiration and strength for the completion of this Master Degree. My deepest gratitude is extended to the following persons who gave me support and guidance during the difficult times of the research study:

- My supervisor, Ms. Alice Ncube, for being supportive, patient and willing to give me guidance that assisted me to produce good work in completing my dissertation.
- My mother Mrs. Ethel Siwele and siblings (Rodney, Portia, Eddy and Edwin) for their emotional and financial support.
- My fiancé Mr. Nkosinathi Nkwinika and my son Ndzalama, for their moral support and enduring all the sleepless nights I spent without them.
- Mr. Thabang Thinda, for the inputs, advice and guidance provided throughout and towards the completion of the dissertation.
- Mr Sakkie Van Der Merwe, Thaba Chweu Local Municipality: Chief Fire Officer. I thank you for allowing me the opportunity to conduct the research study in the municipality.
- Mr. John Masina, Thaba Chweu Local Municipality: Fire and Rescue Officer, I would like to thank you and the fire crew for welcoming and for accommodating me during their fire season preparations and providing me with all the necessary information.

This dissertation is dedicated to my father, the late Mr. Mahlori Edward Siwele. I will always love and remember you dad.

EXECUTIVE SUMMARY

This research study aims at reviewing and assessing the current veldfire management plan that Thaba Chweu Local Municipality (TCLM) Fire Brigade Services utilises in managing the veld fires in its region. It also assists the Fire Brigade Services in compiling an integrated veldfire management plan which combines elements of fire prevention, fire protection, fire suppression and fire recovery. The review and assessment of the plan will, however, assist in identifying and knowing the strength of the veldfire management systems and also propose the necessary improvements that will enhance the effectiveness of the management of veldfires. Thus, a well-developed and appropriate plan should include strategies such as a well-planned firebreak system, a fire protection system, fire fighting safety policies and procedures and a resource management system (including equipment, communications and training of personnel). Adequate and appropriate fire management strategies are imperative to ensure that forest resource together with its ecological and other associated values is protected. The research study emanates from the recent devastating veldfires of 2007 that destroyed 10,000 ha of forest plantation in the Mpumalanga Province.

The purpose of the NVFF Act as amended by the National Fire Laws Amendment Act is to prevent and combat veld, forest and mountain fires throughout South Africa. The Act applies to the open countryside beyond the urban limit and puts in place a range of requirements. The NVFF Act also specifies the responsibilities of land owners. The Act further elaborates that the term *'owners'* includes lessees, people in control of land, the executive body of a community, the manager of State land, and the Chief Executive Officer of any local authority. Farmers continue to use fire in veld and forest land to manage grazing and habitats and as a measure to help prevent uncontrolled fires. One of the research objectives is to ensure that the integrated veldfire management plan complies with the legal requirement of the NVFF Act and explores the ecological condition that may cause veldfire in the region.

The Act further makes provision for the establishment of Fire Protection Association (FPA), which is designed to lay down minimum standards to be maintained by members in relation to all aspects of veldfire prevention and readiness for fire fighting and to regulate controlled burning to

conserve ecosystems and reduce fire danger. The Theoretical frameworks of different authors from local and international perspectives were consulted to gain more knowledge that will assist in improving and upgrading the current veldfire management plan.

The findings of the research show that TCLM Fire Brigade Services have the fire prevention, fire preparedness, fire protection and suppression measures in place and there has been a decline of veldfire incidents since the TCLM implemented the prevention programme which involved community participation. Hence, the Fire Brigade Services does have a veldfire management plan that is used in addressing veldfires which is not approved by the municipal council. Therefore there is a need, therefore, to have an integrated veldfire management plan that is composed of all the prevention measures and approved by the municipal council.

The importance of the research will contribute to organisational learning within all agencies involved in the management of veldfires in the district and the Mpumalanga province as a whole. The research will further focus on improved service delivery and enhanced capacity among agencies and members of local communities to understand, prepare for, prevent and respond to veldfires. In addition, the findings should, wherever appropriate, relate to the disaster management policy for South Africa, while taking account of current policies and institutions. A well developed plan cannot only directly save lives but also serve to reduce loss of property and disruption of social networks.

The results show that Thaba Chweu Local Municipality conducts most of its fire awareness campaigns at community, primary and high schools. FAO (2006) spells out that a well- informed public will be more likely to use fire carefully and adhere to policy and legal boundaries and thus assist in the prevention, detection and reporting of veldfires.

In conclusion, cooperation and coordination is the key to veldfire management and prevention strategies because of the authority given to local government by the Act. The research document will assist the municipality on upgrading the current existing veldfire management plan in order to proactively deal with the veld and forest fires within its vicinity. Compliance to the current veld and forest Act and other relative legislative frameworks on fire control and management

must be effectively enforced to promote the use of prescribed burning and minimise breakaway fires. The research document also explores the theoretical framework of the management of veldfires as well as the legislative requirements of the given discussions.

The research document will further demonstrate the author`s commitment to assist in reducing disaster risks posed by veldfires. Successful implementation of the plan will requires concerted efforts from all stakeholders within the district. The veldfire management plan recognises the importance of cross-border collaboration and provides framework collaboration with the municipal`s neighbours. If put to good use, the contingency plan will strengthen capacities at all levels to mount a timely and coordinated management and control to veldfire outbreaks in the district and the province.

LIST OF TABLES

LIST OF FIGURES

LIST OF GRAPHS

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

CBFiM	Community-based fire management
ICS	Incident Command System
FAO	Food and Agriculture Organisation
LEFPA	Lowveld Escarpment Fire Protection Association
WOF	Working on Fire
NAFU	National Agricultural Farmers Union
NVFFA	National Veld and Forest Fire Act
FPA	Fire Protection Association
DMA	Disaster Management Act
DAFF	Department of Agriculture, Forestry and Fisheries
FDI	Fire Danger Index
FDR	Fire Danger Rating
FEMA	Federal Emergency Management Agency
TCLM	Thaba Chweu Local Municipality
WUI	Wildland urban interface
JFM	Joint Forest Management programme
IFFM	Integrated Forest Fire Management

GLOSSARY OF TERMS

Community based fire management (CBFiM): CBFiM is a type of forest and land management in which a local resident community (with or without the collaboration of other stakeholders) has substantial involvement in deciding the objectives and practices involved in preventing, controlling or utilising fires (FAO, 2006).

Direct attack: A method of fire attack where wet or dry fire fighting techniques are used. It involves suppression action right on the fire edge which then becomes the fireline (Teie, 2005).

Disaster: Progressive or sudden, widespread or localised, natural or human-caused occurrence which causes or threatens to cause death, injury or disease, damage to property, infrastructure or the environment, or disruption of the life of a community, and is of a magnitude that exceeds the ability of those affected by the disaster to cope with its effects using only their own resources (DM Act, 2002).

Disaster Management: Continuous and integrated multi-sectoral, multi-disciplinary process of planning and implementation of measures aimed at preventing or reducing the risk of disasters, mitigating the severity or consequences of disasters, emergency preparedness, a rapid and effective response to disasters and post disaster recovery and rehabilitation (DM Act, 2002).

Fire: Rapid, persistent chemical change that releases heat and light and is accompanied by flame, especially the exothermic oxidation of a combustible substance (Trollope, 1985).

Fire behaviour: The manner in which a fire reacts to the variables of fuel, weather and topography (Trollope, 1985).

Firebreak: A natural or constructed barrier utilised to stop or check fires, or to provide a control line from which to work (Teie, 2005).

Fire danger: A general term used to express an assessment of fixed and variable factors such as fire risk, fuels, weather and topography, which influences whether fires will start, spread or cause damage and also the degree of difficulty of control to be expected (Teie, 2005).

Fire danger rating: A fire management system that integrates the effects of selected fire danger factors into one or more qualitative or numerical indices of current protection needs (Teie, 2005).

Fire-ecology type: A class of vegetation types that is relatively uniform in terms of the fire regimes within the constituent vegetation types (Teie, 2005).

Fire ecology: The study of the relationships between fire, the physical environment and living organisms (Teie, 2005).

Fire hazard: A fuel complex, defined by volume, type condition, arrangement, and location that determines the degree of ease of ignition and of resistance to control. (Teie, 2005).

Fire management: All activities required for the protection of burnable forest and other vegetation values from fire, and the use of fire to meet land management goals and objectives. It involves the strategic integration of such factors as knowledge of fire regime, probable fire effects, values at risk, level of forest protection required, cost of fire-related activities, and prescribed fire technology into multiple-use planning, decision-making and day-to-day activities to accomplish stated resource management objectives (Teie, 2005).

Fire management plan: The systematic, technological, and administrative management process of determining the organisation, facilities, resources, and procedures required to protect people, property, and forest areas from fire and to use fire to accomplish forest management and other land use objectives (Teie, 2005).

Fire preparedness: All activities undertaken in advance of wildfire occurrence to decrease its extent and severity and to ensure more effective fire suppression. (Teie, 2005).

Fire prevention: All activities concerned with minimising the incidence of wildfire particularly those of human origin. (Teie, 2005).

Fire Protection Associations: A local institution formed by landowners or their agents for the purpose of predicting, preventing, managing and extinguishing veldfires; established in terms of Section 3(1) of the National Veld and Forest Fire Act. (NVFFA).

Fire season: Period(s) of the year during which fires are likely to occur and affect resources sufficiently to warrant organised fire management activities. A legally enacted time during which burning activities are regulated by state or local authority (Teie, 2005).

Fire weather: Weather conditions which influence fire ignition, behaviour, and suppression (Trollope, 1985).

Flank fire: A fire set along a control line parallel to the wind allowed to spread at right angles to it (Teie, 2005).

Fuel: Any material such as grass, leaf litter and live vegetation which can be ignited and sustain a fire. Fuel is usually measured in tonnes per hectare. Related Terms: Available fuel, coarse fuel, Dead fuel, Ground fuel, Elevated dead fuel, Fine fuel Ladder fuels, Surface fuels, and Total fine fuel. (Teie, 2005).

Fuel load: The oven dry weight of fuel per unit area. Commonly expressed as tons per hectare; it is also known as fuel loading (De Ronde & Goldammer, 1990).

Fuel Management: The act or practice of controlling flammability and reducing resistance to control fuels through mechanical, chemical, biological or manual means, or by fire, in support of land management objectives (De Ronde & Goldammer, 1990).

Initial attack: The control efforts taken by resources which are the first to arrive at the incident (Teie, 2005).

Incident Command System (ICS): A standardised, on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries (Teie, 2005).

Local municipality: A municipality that shares municipal executive and legislative authority in its area with a district municipality within whose area it falls, and which is described in section 155 (1) of the Constitution as a category B municipality (NVFFA, 1998).

Mitigation: Any risk management measure that reduces risk, including fuel reduction burning, other prevention measures, preparedness and so on (DM Act, 2002).

Preparedness: All activities undertaken in advance of the occurrence of an incident to decrease the impact, extent and severity of the incident and to ensure more effective response activities. (DM Act, 2002).

Prescribed burning: The controlled application of fire under specified environmental conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives. It is undertaken in specified environmental conditions (Teie, 2005).

Prevention: All activities concerned with minimising the occurrence of incidents, particularly those of human origin (Teie, 2005).

Veldfire: Any unplanned and uncontrolled fire that, regardless of ignition source, may require suppression response or other action according to agency policy (Teie, 2005).

Wildfire: An unplanned vegetation fire. A generic term which includes grass fires, forest fires and scrub fires (De Ronde & Goldammer, 1990).

TABLE OF CONTENTS

CHAPTER ONE: OVERVIEW OF THE RESEARCH STUDY

CHAPTER TWO: THEORETICAL FRAMEWORK

CHAPTER: THREE: RESEARCH METHODOLOGY

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATIONS

CHAPTER FIVE: DISCUSSION OF THE RESULTS

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATION

CHAPTER ONE: OVERVIEW OF THE RESEARCH STUDY

1.1 Introduction

In 1998, South Africa promulgated the National Veld and Forest Fires Act (No. 101 of 1998); hereafter referred to as the Act, which is currently administered by the Department of Agriculture Forestry and Fisheries (DAFF, 2007). Trollope & Potgieter (1985) argued that the Act is not legislation for the emergency management of veldfires, but rather a statute that introduces certain legal instruments to enable and promote veldfire management. It seeks to link natural resource management by property owners collectively or individually to the integrated veldfire management system: ecological fire management, fire prevention, preparedness, and response, and as such, it is a piece of environmental management legislation (Acocks, 1988).

The Act places a duty on all land owners, private, state or communal, to implement integrated veldfire management plan on their own properties (NVFFA 101 of 1998). The Act specifically states that land owners have the first and primary responsibility not only for ecological fire management, but also for the prevention and control of veldfires on their properties, within reasonable bounds. According to DAFF (2007) report, veldfires (veld, forest and mountain fires in terms of the Act's definition) are a persistent problem in South Africa. They frequently cause emergencies, and often grow to disastrous proportions (NVFFA of 101 of 1998). At the same time, veldfires are natural – they occur as part of a normal process of events in grassland, woodlands and fynbos, and even sometimes in natural forests (NVFFA of 101 of 1998).

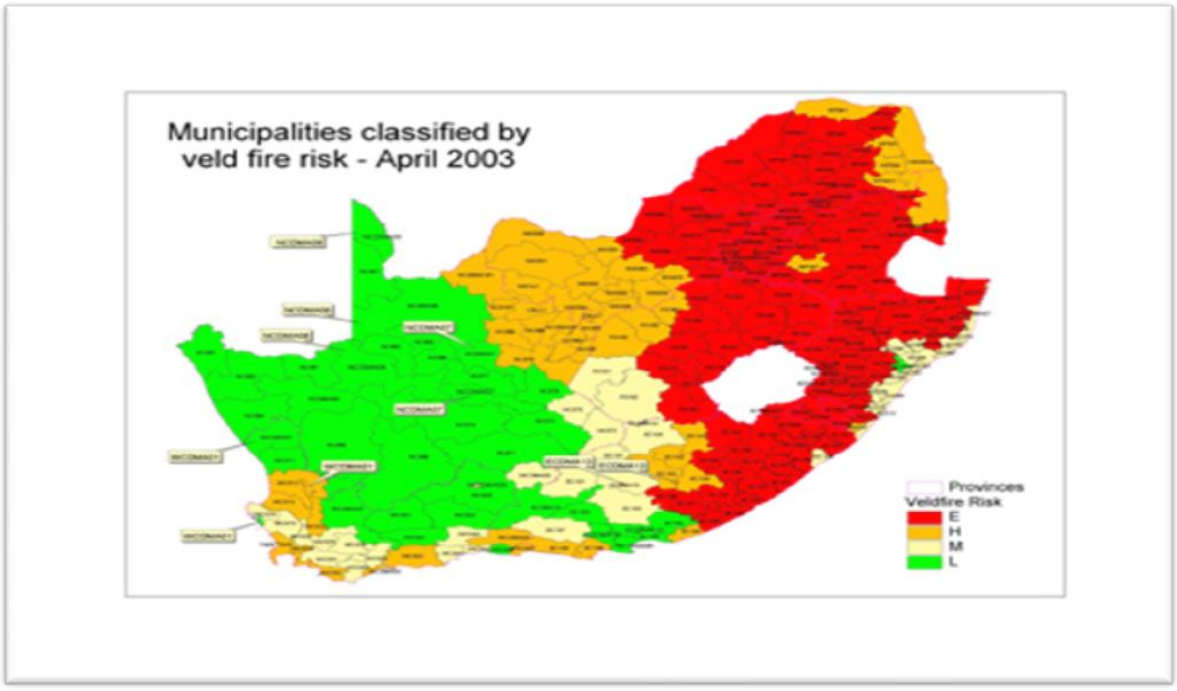
The earliest humans used fire a million years ago, and modern humans have been using veldfires for hunting and for managing their environment for hundreds of thousands of years (Acocks, 1988). People continue to use fire in veld and forest, to manage grazing and habitats, and as a measure to help prevent uncontrolled fires. In addition, it is important to manage veldfires properly so that the environmental values are protected (NVFFA, 1998). In the ecosystem, over 70% of South Africa has adapted to a greater or lesser extent to the presence of fire (Veldfire bulletin, 2009). In these ecosystems we need to manage fire in a way that imitates nature (Trollope & Potgieter, 1985). For this reason, the Municipal Fire Brigade services as stipulated

by the Act, must manage the control of veldfires both for the purposes of protection of people and their assets as well as for protecting our environmental values such as protecting biodiversity (NVFFA 101 of 1998). Without preventive measures, veldfires will continue to burn for as long as the weather is favourable and there is vegetation to burn. Anyone owning land has the first responsibility to control fires on his or her own land (Trollope & Potgieter, 1985). But when fires burn in severe conditions they quickly extend beyond property lines, and become a problem that cannot be handled by individuals, but can only be controlled by joint, co-ordinated efforts (NVFFA 101 of 1998).

1.2 The current situation of veldfires in South Africa

Disasters in South Africa have been dominated by localized incidents, such as veldfires, seasonal flooding and drought. Figure 1 shows that most municipalities are prone to veld or grass fires in South Africa (DAFF, 2007).

Figure 1: Map showing veldfires in South Africa



Source: DAFF, 2005

At national level, severe drought has affected macro-economic growth, as well as the livelihoods of the poorer sections of the population living in rural areas in particular (Trollope & Potgieter, 1985). It is difficult, however, to exactly measure the human, economic and environmental costs caused by disasters. According to the CSIR report in 2006, the annual cost of veldfires in South Africa, totalled at least R743 million at the time, whereas, the national cost of veldfire control was estimated at R70 million (Firewise communities, 2007). One company in Mpumalanga alone, for example, is estimated to have lost over R103 million and the most critical issue was the loss of 22 lives as the fires ranged uncontrolled through urban and agricultural areas (news24, 2007).

Disasters may result from environmental, technological and natural risk associated with unplanned or poorly planned urbanization (NVFFA 101 of 1998). The risk factors underlying a disaster occurrence have become increasingly inter-linked; for instance, declining livelihood opportunities in rural areas are associated with urban migration (Trollope & Potgieter, 1985). The result is a rapid growth of under-serviced settlements close to industrial or manufacturing areas which increase the potential for human death and injury in the event of an industrial accident. Trollope & Potgieter (1985) further elaborate that the disaster "*trigger*" may be the industrial accident, but the overcrowding and poor living conditions in the settlement nearby place many more at risk, and may result in a much bigger and more serious disaster (NVFFA 101 of 1998).

The purpose of the National Veld and Forest Fire Act (Act No. 101 of 1998) as amended by the National Fire Laws Amendment Act is to prevent and combat veld, forest and mountain fires throughout South Africa. The Act applies to the open countryside beyond the urban limit and puts in place a range of requirements. The NVFF Act also specifies the responsibilities of land owners. The Act further elaborates that the term *'owners'* includes lessees, people in control of land, the executive body of a community, the manager of State land, and the Chief Executive Officer of any local authority (DAFF, 2005). Farmers continue to use fire in veld and forest land to manage grazing and habitats and as a measure to help prevent uncontrolled fires.

1.3 Problem statement

According to Acocks (1988), veldfire is an extremely powerful and destructive phenomenon which occurs with significant frequency and intensity on many continents and in many countries. If left unchecked, these veldfires can cause widespread destruction and damage affecting economic sustainability and productivity for entire regions or peoples Acocks (1988). Arnold & De Wet (1993) further explain that Southern Africa is no exception in this regard and the responsibility for safety and management of this phenomenon rests with every individual living or working in and traversing areas prone to veldfires. Large forest fires have occurred more frequently in the southern African region since year 2004. Approximately 100,000ha of forests and farmlands were burnt by veldfires in the Southern African region in 2007 (News24, 2007). Mpumalanga Province lost more than 10,000 ha of forests due to veldfires in year 2007 (news24, 2007). Many lives, homesteads, livestock and wildlife were lost during the veldfires of 2007. Wind speed during the big fires of 31st August 2007 ranged from 90km to 150km per hour, rendering the fires impossible to control (Komatiland fires, 2007). As a result of devastating fires, the sustainability of both the forestry industry and all wood processing industries are at risk. The fires are causing a huge negative impact to the economy of the country. The forestry industry views the fire situation as a national disaster and therefore requests government's intervention.

Veldfires are a problem because they pose a risk to life, property and the environment (National Veld and Forest Fire Act, Act No. 101 of 1998). Over time people have become more and more vulnerable to this risk. This is because urban and peri-urban human settlements steadily expand, exposing lives and homes to fires in the neighbouring veld, and simultaneously increasing the chance of veldfires (Trollope & Potgieter, 1985). As our rural areas have been developed, especially through plantation forests and other plantations such as sugarcane, the risk of losses from fires has increased. People have become more urbanised; fewer of landowners understand veldfires, and so the chance of them starting fires or becoming victims to fires has increased (Trollope & Potgieter, 1985).

Veld and forest fire trends have shown that few serious veldfires occurred in industrial forests and in surrounding grassland in the Mpumalanga and KwaZulu-Natal Provinces in 2004.

Towards October 1994, three major plantation forest fires raged in the Sabie district (Thaba Chweu), destroying more than 10,000ha in each case (Global forest fire assessment, 2001). Ten fire-fighters lost their lives while extinguishing the fire in Pinus and Eucalyptus stands (Global forest fire assessment, 2001). Goodson & Adams (1998) reported that in 1994 thirty four fire-fighters died when combating fires in Kwazulu Natal. In 2007 another six fire-fighters lost their lives when responding to the veld and forest fire at Thaba Chweu municipality in Mpumalanga (DAFF, 2007). The Western Cape report (DAFF, 2000), mentioned that authorities in the USA developed a formal system of fire incident management in response to deficiencies found in fire-fighting systems after disastrous veldfires in the Los Angeles area of California in 1970. Grimwood, Hartin, McDonough & Raffel (2005) mentioned that many fire-fighters lives were lost due to poor training, unclear responsibility, lack of supervision and inefficient incident command. New tactical options must be explored to allow fire-fighters to increase their zones of safety during operation.

According to the findings from (DAFF, 2000) the rural Municipal Fire Services are unable to respond to veld and forest fires due to the fact that they have fewer resources, unlike the urban municipal fire services which are well equipped. In August 2003 Thaba Chweu lost the entire swatus of its crucial forestry sector around Wilgeboom near Graskop, Hendriksdal and Brondal near Sabie (Unpublished report, 2003). Two sawmills were destroyed in the blaze and large amounts of plantation equipment ranging from hand tools to vehicles were also destroyed (Unpublished Lowveld report, 2007). 1,000 fire fighters were deployed on the scene and the department of local government and housing was also organizing more helicopters to boost the operation (News24, 2007). Unfortunately one fire fighter lost his life during operation at Brondal, where he was run over by truck due to dense smoke (Unpublished Lowveld report, 2007).

The fire raging from forests and farms around Nelspruit, White river & Sabie made the province to request seven teams from Boksburg Fire Department in Gauteng to come and assist in combating the blaze (Unpublished Lowveld report, 2007). The 2007 devastating fires in Mpumalanga have exposed a big challenge that the province as a whole is faced with, when responding to veld and forest fires. According to the municipal fire brigade services officials and the community farmers, the challenge is the failure of a well coordinated management plan and

response to veld and forest fires. The lack of appropriate required equipments, resources and the unavailability of enough fire-fighters have contributed to the extent of the damage (DAFF, 2007).

Almost all municipalities lack the capacity to cope and manage fires that occur within their jurisdiction. Poor planning at local municipality level is another factor which affects the management of veldfires and response of municipalities as a whole to emergency situations (Goodson & Adam, 1998). Municipalities should be encouraged to design their veldfire management plans around the resources at their disposal in order to mitigate and prevent veldfires in their vicinity. The findings could be adopted by local municipalities within Ehlanzeni District Municipality for better and effective coordinated management of veld and forest fires.

1.4 Significance of the Study

The outcome of the veldfire management plan research will help veldfire managers and local land owners to make more informed decisions about the ecological and social consequences of fire. It will also help devise strategies for disaster risk reduction through corporative participation of the FPA's, farmers, agricultural initiatives such as the National Agricultural Farmers Union (NAFU) and other stakeholders.

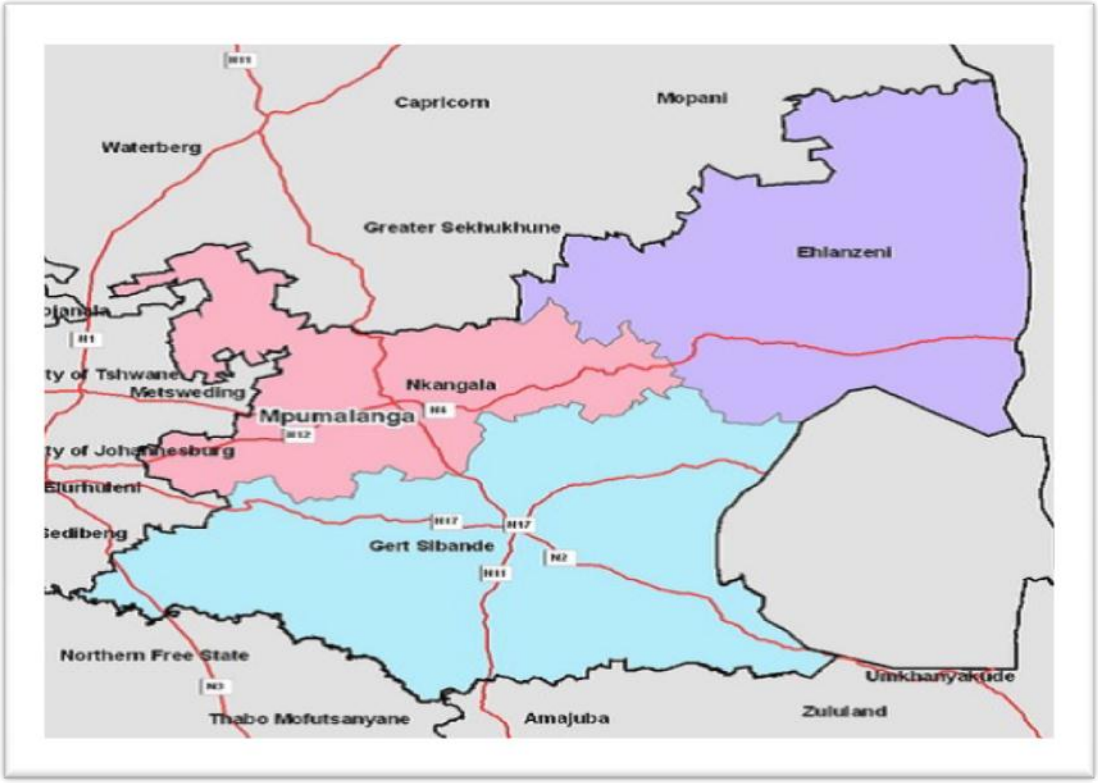
Similarly, the reviewed assessment of the current veldfire management plan may assist in identifying the strength of current veldfire management systems, and also propose necessary improvements that will enhance the effectiveness of the management of veldfires. It will further, provide the critical link in developing tools for predicting and mapping the degree of ecosystem change induced by the fire process and the post-fire residual ecosystem structures that dictate second-order fire effects. This information can lead to improved understanding of the role of fire in creating conditions that drive post-veldfire ecosystem processes, structures and functions. The importance of the research will contribute to organisational learning within all agencies involved in the management of veldfire in the district and the province as a whole. The research will further focus on improved service delivery and enhanced capacity among agencies and members of local communities to understand, prepare for, prevent and respond to veldfires. In addition, the findings should, wherever appropriate, relate to the disaster management policy for South Africa,

while taking into account current policies and institutions. A well developed plan cannot only directly save lives but also serve to reduce loss of property and disruption of social networks.

1.5 Limitation of the study

Mpumalanga Province is divided into three districts municipalities, which are further sub-divided into 18 local municipalities. The three districts are: Nkangala, Ehlanzeni and Gert Sibande. Figure 2 shows all three district municipalities of the province, hence, the province is predominantly forest.

Figure 2: Three districts in Mpumalanga

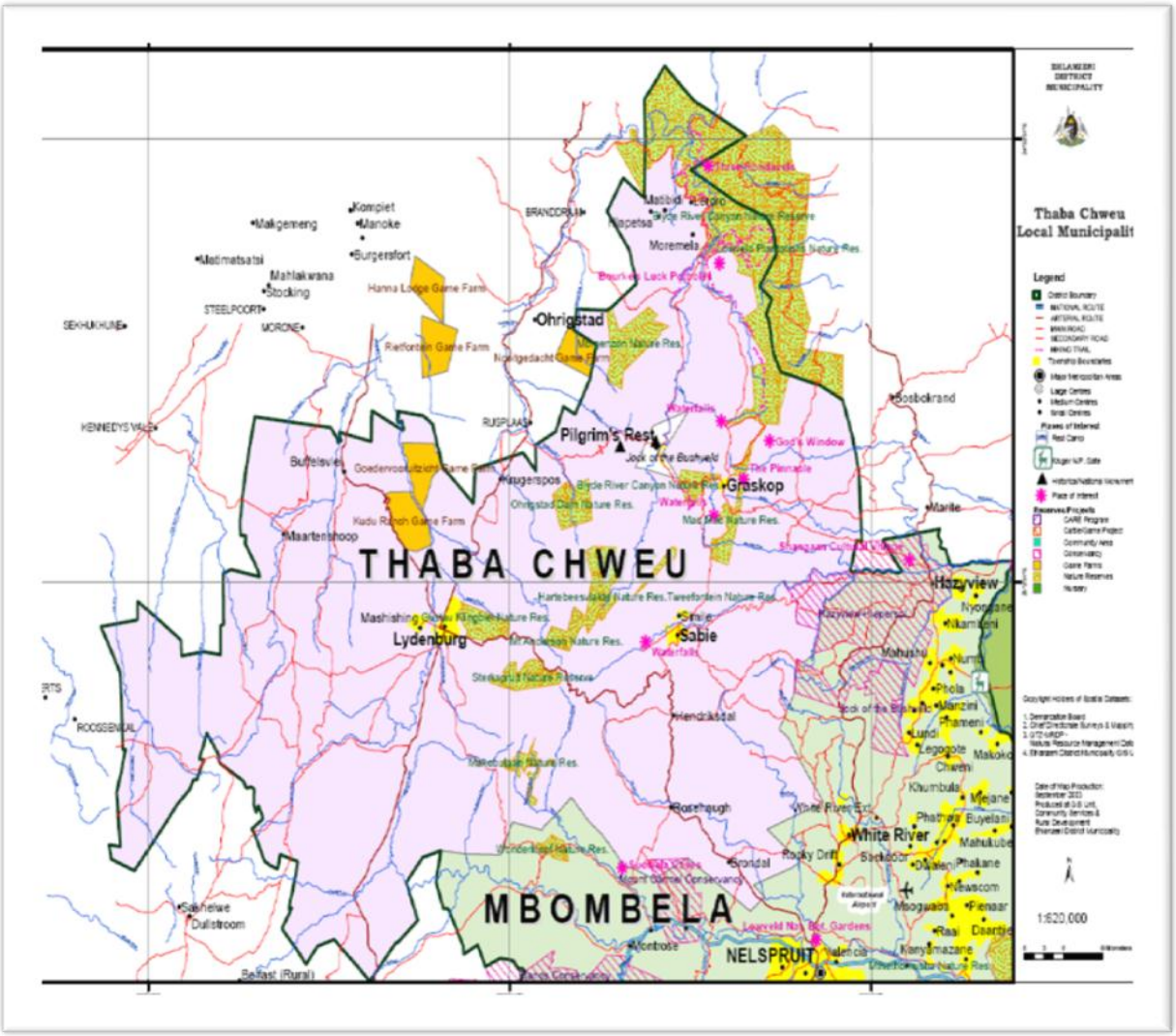


Source: Demarcation board:www.demarcation.org.za

The study will only be conducted in one local municipality known as Thaba Chweu Local Municipality within the Ehlanzeni District Municipality in the Province because this local municipality was the most affected by veldfires (27 July to 24 September 2007) that lasted for approximately eight weeks (unpublished report, 2007). Figure 3 depicts the boundary and towns

that fall within TCLM. The study will only focus on the review and assessment of veldfire management plan for the Thaba Chweu Local Municipality; it will further discuss and explore more on the preparedness and mitigation measures which will reduce the impact of veldfires.

Figure 3: Thaba Chweu Local Municipality



Source: TCLM IDP, 2009

1.6 Research questions

The research questions focus on whether:

- The existing plan is reviewed annually;
- What mitigation measures did the municipality use to minimize the impact of veldfire;
- How effective are the extended provision of the forest Act of 1984, the provision of the National veld and forest Act of 1998 are enforced an implemented in Veldfire management plan;
- What ecological conditions (e.g. weather, natural and alien vegetation) prompted the fires to occur and contribute to their intensity and spread;
- What institutional arrangements are in place for veldfire management?
- What strategies for veldfire management and veldfire fighting were adopted during the fires and how were resources (manpower and equipment) used;
- What proved effective, and what needs to be improved?

1.7 Research objectives

The following are the objectives that will assist in answering the research questions:

- To review and assess the existing veldfire management plan for the municipality;
- To ensure that the integrated veldfire management plan complies with the national veldfire policies, laws and regulations;
- To explore the ecological conditions (e.g. weather, natural and alien vegetation) that have prompted the fires to occur and contribute to their intensity and spread;
- To ensure and encourage that the plan provides sufficient resources (man power, facilities, infrastructure and enough funding) for a comprehensive fire management plan;
- To encourage the establishment of continuous community based fire control programme;
- To ensure and enhance that veldfire management plan includes provision to prepare annual forest fire management plans.

1.8 Research methodology

1.8.1 Research Design

According to Polit and Hungler (1999) research design is a blueprint or outline for conducting the study in such a way that maximum control will be exercised over factors that could interfere with the validity of the research results. The research design works as a systematic plan outlining the study, the researcher's methods of compilation, details on how the study will arrive at its conclusions and the limitations of the research (Kenneth & Wills, 2010). Research design can be used as the logical structure that ensures that all collected evidence helps eliminate bias when evaluating theories and arriving at a conclusion.

The study will use qualitative research method and descriptive research design. Descriptive research seeks to depict what already exists in an organisation and strive to answer the question "*what*" *is happening*? The purpose of descriptive research is to observe, describe and keep documents. Questionnaires and observations (personal engagement) will be used during data collection. In contrast, the researcher will be actively and directly involved when the fire crew from Thaba Chweu Municipality prepare their municipal fire season.

1.8.2 Qualitative research

Qualitative research is a type of scientific research that seeks to understand a given research problem or topic from the perspective of the local population it involves (Denzin & Lincoln, 2000). Struwig & Stead (2010) mentioned that qualitative research primarily involves fieldwork and interviews but can also include the analysis of photographs, motion pictures and documents. In contrast, the researcher is the primary instrument and that cannot be separated from the research process. Therefore, qualitative researchers believe that you cannot be unbiased and objective and that each researcher brings his or her biases, views, personal theories, opinions and attitudes to the research process.

1.8.3 Qualitative research focuses on investigation that:

- Seeks answers to a question
- Systematically uses a predefined set of procedures to answer the question
- Collects evidence
- Produces findings that were not determined in advance
- Produces findings that are applicable beyond the immediate boundaries of the study.

1.8.4 Qualitative research has the following characteristics (Chantel, 2002):

- Reality is subjective and multiple, as seen by participants in the study.
- The researcher interacts with what is being researched.
- Facts are value-laden and biased.
- The language of research is informal.
- Patterns and theories are developed for understanding.
- It provides accuracy and reliability through verification.

1.8.5 Sample

Sampling refers to the process of selecting participants for a research project while a sample is a portion of the elements in a population (Dane, 1990). It is not practical to include all members of the population in a research project, hence information is obtained only from a number of people (sample) that represent the population. The researcher will use purposeful sampling also known as judgment sampling technique. According to Struwing & Stead (2010), the participants show certain characteristics that the researcher is interested in. In this regard, this municipality is one of the municipalities that experienced the severe 2007 veldfire in Mpumalanga Province.

1.8.6 Characteristics of purposeful sampling are as follows:

- The total sample is not drawn in advance as is the case in quantitative research. The sample size is not finalized before the study commences but may change as the study progress.
- Each sampling unit is selected only after the information of the previous unit has been analyzed. An additional sampling unit is required if the previous unit provides insufficient information or if contrasting information is needed.

1.8.7 Non-probability Sampling

Non-probability sampling represents a valuable group of sampling techniques that can be used in research that follows a qualitative, mixed methods, and even quantitative research design (Strydom, Fouche & Delport, 2005). It requires researchers to use their subjective judgments, drawing on theory (i.e. the academic literature) and practice (i.e. the experience of the researcher and the evolutionary nature of the research process. Non-probability sampling will be used in the study, because it is much easier, quicker and cheaper when compared with probability sampling.

1.8.8 Characteristics of Non-probability sampling

- Every person who meets the criteria is asked to participate. For example, the fire personnel who participated were asked to participate in the study.
- It is a less complicated and a more economic procedure than random sampling.
- The researcher`s judgment is used to select individual subjects who meet the required criteria.

The sample size of 50 fire fighters will be obtained to participate in answering the questionnaires and the 50 participants include the operational fire crew and few middle management personnel.

1.8.9 Data collection

According to Struwig & Stead (2010) data is defined as information such as pictures, words, and numbers, which is gathered according to certain scientifically accepted procedures. Thus, in this study a set of questionnaires will be used to collect data and it includes both primary and secondary data collections. Primary data will be collected in the form of questionnaires which will be distributed to 50 fire fighters on duty. Secondary data refers to questions that require existing data for the veldfire that occurred from 2000 to 2011 and this kind of information will be obtained from the Komatiland Company since the company covers the greater of the municipal boundary.

1.8.10 Questionnaires

Close ended questions include all possible answer/prewritten response categories, and respondents are asked to choose among them (Struwig & Stead, 2010). The study will use the close ended questions such as multiple choice. The purpose of the study is to assess the veldfire management plan of Thaba Chweu municipality. The researcher will work together with the fire crew and observe how they create firebreaks and get prepared for the fire season.

1.8.11 Characteristics of a Questionnaire:

Brink and Wood (1998) identify the characteristics of questionnaires as follows:

- It is less expensive than conducting personal interviews
- Data on a broad range of topics may be collected within a limited period.
- The format is standard for all subjects and is independent of the interviewer's mood.
- Each participant enters her response on the questionnaire, saving the researcher`s time, compared to the time required to conduct personal interviews.
- Respondents feel that they remain anonymous and can express themselves in their own words without fear of identification.

1.8.12 Data Collection instrument

Apart from using questionnaires as the instrument to collect data, the researcher used a camera to capture pictures during the observation and to informally interview the Acting Chief Fire Officer.

1.8.13 Data analysis

The raw collected data during the interview and observation were interpreted and analyzed to give meaning to the raw data. For example, questionnaires, interviews and pictures captured were used when analyzing data. Data tabulation from spreadsheet was used to code the collected data and thereafter transform it to graphs for further analysis.

1.8.14 Ethical consideration

The researcher requested consent forms from the Chief Fire Officer and the fire fighters of Thaba Chweu Local Municipality. This was done in a formal manner by way of a letter to the selected municipality.

1.9 Conclusion

In conclusion, cooperation and coordination is the key to veldfire management and prevention strategies, because of the authority given to local government by the Act. This research document will assist the municipality on upgrading the current existing veldfire management plan in order to proactively deal with the veld and forest fires within its vicinity. The research document will also explore the theoretical framework of the management of veldfires as well as the legislative requirements of the given discussions. The research document will further demonstrate the author`s commitment to assisting in reducing disaster risks posed by veldfires. The successful implementation of the plan will require a concerted effort from all stakeholders within the district. The veldfire management plan recognises the importance of cross-border collaboration and provides framework collaboration with the municipal`s neighbours. If put to good use, the

contingency plan will strengthen capacity at all levels to mount a timely and coordinated management and control to veld fire outbreaks in the district and the province.

CHAPTER TWO: THEORETICAL FRAMEWORK AND LITERATURE STUDY

2.1. Introduction

This chapter aims to outline the views and discussions on veld and forest fire management of other authors. Different perspectives of other authors in terms of literature study for both local and international perspectives on the management of veldfires were explored. The theoretical framework will also assist in reviewing and assessing Veldfire Management Plan for Thaba-Chweu Local Municipality. It further illustrates the importance of legislative requirements as part of the theoretical framework for the study. The study also aims to explore the ecology and characteristics of veld and forest fires as well as the management of veldfires from other relevant authors.

2.2. Veldfire trends in South Africa

The following is the history of veldfires that occurred during the past 10 years in South Africa:

Table1: Major Veldfires experienced during 2000-2011

Year	**Major veldfires experienced during 2000-2011 & their impacts**
2000	• January, the Cape Peninsula was devastated by a serious fynbos veldfires which burned 8,000ha of fynbos vegetation. • Elsewhere in the Western Cape an additional 10,000ha of fynbos burned. In the Cape Metropolitan area 70 houses were damaged or destroyed by the fire and 200 shacks of an informal settlement were also destroyed. Total fire suppression costs exceeded R30 million, while insurance claims were expected to exceed R5 billion and no lives were lost.
2001/2002	• About 1,000ha of industrial plantations were lost in a fire at Sabie area in July 2002. The uncontrolled fire swept through 10 farms and 12,000ha of grazing land, killing livestock and destroying vehicles near Ottoshoop and injuring eight people among whom three were in a critical condition. • 1,200ha of Eucalyptus plantation were destroyed, as well as 7,000ha of maize in Piet Retief and Southern Highveld area.
2003/2004	• Veldfires hit Mpumalanga's Mbombela and Thaba Chweu Local Municipality, ravaging between 10,000 and 20,000ha of veld and forest, following severe drought and

Year	Major veldfires experienced during 2000-2011 & their impacts
	very strong wind.
2005/2006	• The Western Cape (Table Mountain) had numerous fires in 2005 that endangered homes and destroyed thousands of fynbos, putting several species at great risk of extinction. Approximately 20,000ha were destroyed by the Boland fires.
2007	• On the 2 August 2007 wildfires destroyed more than 37,400ha of plantation and 15,000ha of grazing and along two timber sawmills near Graskop and Sabie in Mpumalanga
2008/2009	• 0n the 3rd of September a total number of 47,000ha of land and 253ha of cash crops were destroyed in the Free State Province. • On 2nd September same year, forest fires in the Vaal Water area of the Waterberg District municipality destroyed about 30,000ha of land and one man was killed by the fire.
2010/2011	• Large fires were raging near Sasolburg, a long N1 between Kroonstad and Sasolburg, between Paul Roux and Bethlehem, north of Kestell, whereby an estimated 100,000ha of grazing were destroyed in the Free State.

Source: extracted from Aupiais & Stammers (2000) and Goldammer & De Ronde (2001).

2.3. The vegetation of South Africa

The vegetation of South Africa can be defined as an area with homogeneous natural flora type (Teie, 2005). Normally, these areas will have similar weather conditions, fire regimes and plant biomasses and also sensitive to interference with its natural cycles and disturbances of this natural vegetation will have a huge ecological impact in a region (Teie, 2005). According to Bond et al (2003), the vegetation of South Africa can be divided into two classes: namely, fire-dependent types (FD) and climate-dependent types (CD). FD vegetation requires fires to maintain its biodiversity and would become dominated. South Africa's fire-dependent biomes are at risk of some form of severe ecological and land degradation if veldfires are inappropriately managed (Trollope, 1999).

However, it is important for the fire manager to have knowledge of the available biomes in her region, because if these biomes or vegetation are not managed properly, it will contribute towards fire hazards in that particular area. In South Africa there are five main vegetation types (Teie, 2005) and the five present a seasonal veld and forest fire problem in the country (Teie, 2005), namely:

- Forestry Plantations
- Savannah Grassland
- Fynbos
- Afromontane and Lowland Forest
- Karoo.

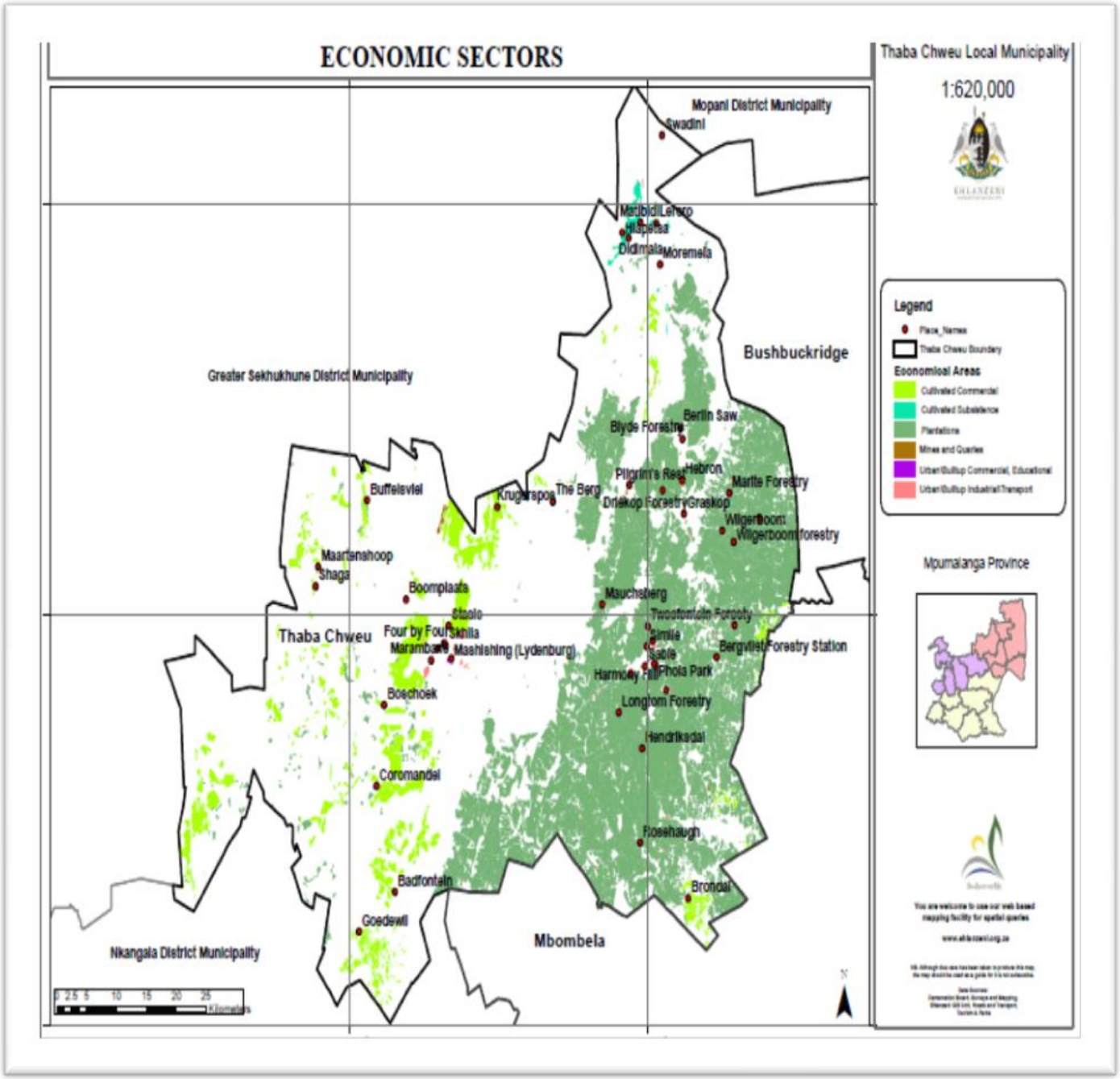
Only forest plantation and savanna grassland are available in the Thaba Chweu Local Municipality and will be discussed in detail below.

2.3.1 Forest Plantations

According to Teie, (2005), forest plantations were originally established to provide industrial timber, mainly in those countries, such as South Africa and the United Kingdom which had small natural forest estates, but since the mid 1980s, forest plantations have assumed greater importance as a source of wood in nearly every country, whatever their forest cover; thus often taking pressure off the natural forest and for the provision of protective functions (Teie, 2005). Below is Figure 4, a map showing the forest plantation that is within the TCLM boundary.

Practically, the forest plantations do not only form part of biomes, but also give strength to the element of the South African economy (Teie, 2005). This kind of biome is more vulnerable during the veldfire season. The forest plantations are either pine, grown for wood pulp and lumber, eucalyptus and wattle which are grown for wood pulp (Teie, 2005). Thus, the pulp and lumber plantations are a vital part of the economic growth and being destroyed by fire, it would be a greater loss to the economy of agriculture (Goldammer & De Ronde, 2004). Hence, fire is also used to remove the harvest litter and prepare the area for the next plantation.

Figure 4: Map showing forest plantation of TCLM



Source: TCLM IDP, (2011)

2.4. Characteristics of veldfires

2.4.1. Fire Ecology

Fire ecology is the study of the ecological and historical role of fire and fire effects on the environment, ecosystems, plants, and animals (Ecological Society of America, 2002). Fire ecology examines the role of fire in ecosystems (Goldammer & De Ronde, 2004) Thus, a fire ecologist studies the origins of fire, its influence on the spread, intensity and fire relationship within ecosystems. South Africa has several different biomes, each containing a variety of vegetation types. A biome is a large ecological unit with distinctive associations of plant and animal species and climatic conditions and it contributes to the fire ecology (Kruger, Forsyth, Slater, Maitre & Matshate, 2006).

Besides human activities related to urban living and agricultural production, fire is the most widespread ecological disturbance in the world (Komarek, 1971). Africa is also considered the fire continent because of the widespread occurrence of biomass burning, particularly in the savanna and grassland biomes (Komarek, 1971). Goldammer and De Ronde (2004) mention that in most areas of the summer rainfall south of the Sahara, particularly in the vast grassland savanna biomes, fires are mainly caused by lightning and humans and these fires are far more frequent than in fynbos.

2.4.2. Fire Behaviour

Fire behaviour is defined as the manner in which a fire reacts to the variables of fuel, weather and topography (Goldammer & De Ronde, 2004). It is further understood to be the general term used to refer to the release of heat energy during combustion as described by the rate of spread of the fire front, fire intensity, flame characteristics and other related phenomena such as crowning, spotting, fire whirlwinds and fire storms (Goldammer & De Ronde, 2004). To be successful as a veld or forest fire manager, one needs to understand and be able to predict what the fire is going to do under various conditions. It further assists in applying the appropriately prescribed burning to achieve the desired effect, and to ensure that fire suppression tactics are applied successfully.

Furthermore; the acquired knowledge will also play a vital role in all fire related management, control decision-making and make them more efficient in their role in veldfire management as a tool.

2.4.3. Chemistry of Fire

When enough heat (just over 160˚C) is applied to a fuel in the presence of air (oxygen), fire will be produced (Heikkila, Gronovist & Jurvelius, 1993). Fire is a chemical reaction called rapid oxidation (Teie, 2005). All three elements are thus, necessary for fire, and removing one of them will make it possible to extinguish a fire. The role of the three elements of fire can be further explained and illustrated by the fire triangle below (Heikkila, Gronovist & Jurvelius, 1993).

Oxygen

21% of the air is oxygen. A reduction in oxygen to 15% extinguishes a fire. This can be achieved by either smothering or covering the fire by using sand, fire swatters, sacks and branches (Heikkila et al., 1993).

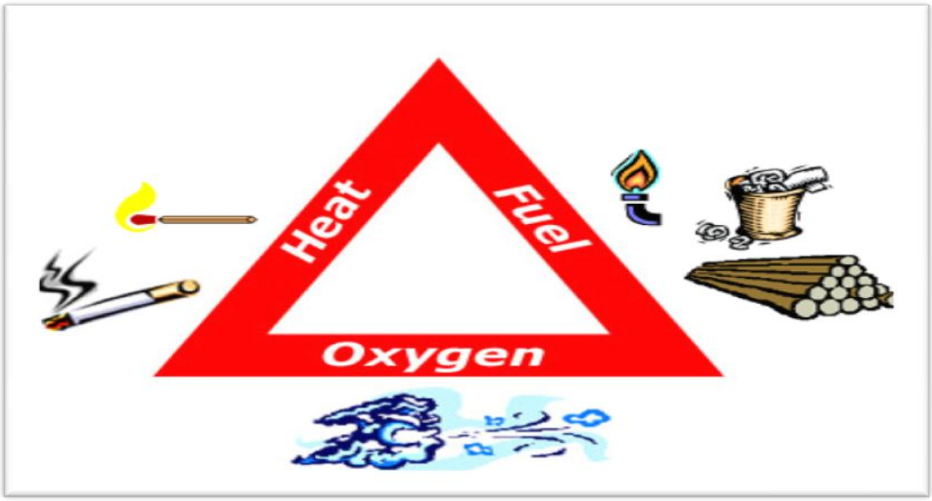
Fuel

Wildfire is primarily controlled by focussing on the fuel component of the triangle.

Heat

In order to ignite a fire, fuel must be brought to its ignition temperature (Heikkila et al, 1993). If the heat drops below the ignition temperature, the fire goes out. Water is the most effective agent for this reduction of heat. Smothering the fire with sand also helps to reduce the heat, thereby extinguishing the flame (Heikkila et al., 1993).

Figure 5: The Fire Triangle



Source: Goldammer & De Ronde (2004)

2.4.4. Veld and Forest Fire Environment

The veld and forest fire environment influences the behaviour of a fire. All of the factors interact with each other to set fire behaviour at a specific point in time. As factors change, the fire behaviour also changes. As time passes, for instance, the position of the sun also moves in relation to the terrain, and its influence on fuels, and air masses (Teie, 2005).

2.5. Weather related factor

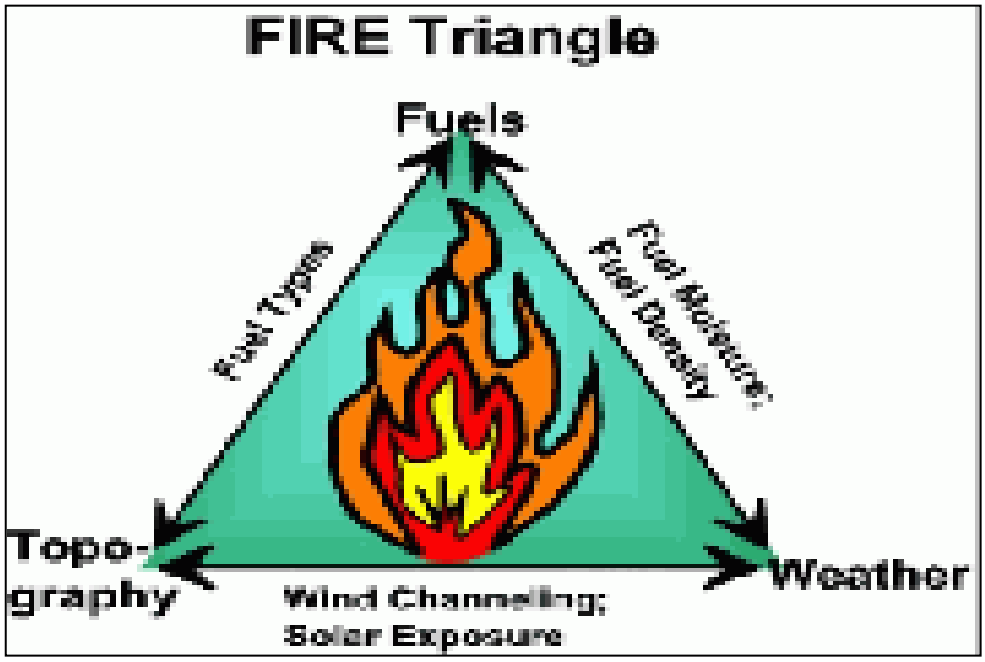
Weather is the state of the atmosphere and is often described in terms of temperature, humidity, stability, pressure, wind speed and direction, clouds and precipitation (Forest encyclopaedia network).

2.5.1. Wind speed and direction

Wind is the most dynamic variable influencing fire behaviour. It provides more oxygen to the fire front and affects the rate at which fuels dry ahead of the fire front (Goldammer & De Ronde, 2004). This causes pre-heating in front of the fire by means of radiation from the flames, thereby preparing it for ignition and promoting the spread of the fire front (Teie, 2005). An increase in

wind speed will increase the drying rate of fuel, while the wind direction will determine the direction towards which the back fires and head fires will spread. According to Teie (2005) the stronger the wind, the faster will be the rate of spread of a head fire burning with the wind. The veld and forest fires that are demonstrating extreme fire behaviour can be classified as wind-driven fire or plume-driven, depending on which force is stronger (Heikkila et al., 1993).

Figure 6: Weather triangle



Source: Goldammer & De Ronde (2004)

The greatest forest fire on record in the Southern Cape, South Africa, for instance, occurred during a Bergwind in February 1869, and burned along the Southern coastal areas from Swellendam to Uitenhage (Goldammer & De Ronde, 2004). Research done in the Eastern Cape Province and the Kruger National Park in South Africa shows that, under atmospheric conditions suitable for controlled burning, wind plays a significant but non-dominant role affecting fire intensity (Trollope & Potgieter, 1999).

2.5.2. Precipitation

According to Geldenhuys (1994), in Africa precipitation is mostly in the form of rain, but can also be in the form of dew, heavy fog, or even snow at high altitudes. Thus, the amount of precipitation and its seasonal distribution are important factors in controlling the beginning, ending and severity of local fire seasons (Geldenhuys, 1994). According to Goldammer & De Ronde (2004), like air humidity, the occurrence of precipitation will increase fuel moisture rapidly to levels at which fires will not burn, hence, in the summer rainfall areas of Africa, rain is normally associated with seasonal thunderstorms, which are important for the occurrence and behaviour of fires in three ways, namely rainfall, thunder-induced winds and lighting fires. The natural grasslands are dynamic and high summer rainfall can be followed by long dry winter periods, when curing will produce above-average available fuel and thus an increased fire hazard (Trollope, 1999).

2.5.3. Air Temperature

The main effect of air temperature is to reduce fuel moisture. As temperature is normally cool during the night, fuel moisture will then be higher and fires can be brought under control during this period (Heikkila et al, 1993). However, as the temperature rises after sunrise, reaching a peak during the 12:00-15:00 period (if there is no sudden weather change as a result of oncoming frontal systems), this time of the day will be the time when fires reach their highest intensities (Goldammer & De Ronde, 2004). During the midday period when the maximum day temperatures occur, it is the most difficult and uncomfortable period to fight fire and fire fighters will tire more easily as dehydration becomes a problem (Goldammer & De Ronde, 2004).

2.5.4. Relative Humidity

Relative humidity is defined as the ratio between the amount of water vapour a unit of air contains at a given temperature, and the amount of water vapour the unit of air can contain at the same temperature and pressure (Goldammer & De Ronde, 2004). Heikkila et al. (1993) mentioned that the amount of moisture in the air affects the amount of moisture in plant fuels.

This further, indicates that 30% of relative humidity is the danger point for wildfires (Goldammer &De Ronde, 2004). When the humidity is above 30%, wildfires are not too difficult to control, but below 30% wildfires are general more difficult to control.

2.6. Topographic components

2.6.1. Elevation

The elevation or altitude of a site also has a direct impact on how a fire will act and burn (Teie, 2005). This is because weather and elevation have such a great effect on the type and availability of fuel (Teie, 2005). Elevation affects the following factors:

- Amount of precipitation received: The elevation and aspect of a particular area has a direct impact on the amount of rain that will fall. The amount of rain has a direct impact on the type of vegetation that will grow in an area.
- Fuel types and loading: there is normally less fuel at higher elevations. This is mainly due to the fact that there is less soil, and the temperatures are cooler.

2.6.2. Position on a Slope

The position on a slope has an effect on fuel availability. There is usually more fuel at base and midslope sites than on the top of a ridge because of greater variations in temperature and relative humidity (Teie, 2005). This has a direct impact on the potential size of fires (Teie, 2005). More fires will burn over larger areas if they start at the base of a slope than if they started at midslope. One of the reasons is that there is normally more fuel available at the base of a slope.

2.6.3. Aspect

Aspect is the direction a slope is facing relative to north (Teie, 2005). The orientation of a slope to the sun has a direct bearing on the amount of solar radiation that reaches the surface. Although

aspect is fixed, the amount of solar radiation received varies with the position of the sun (Teie, 2005). The impact of aspect on fire behaviour, therefore, changes throughout the day.

2.6.4. Steepness of slope

It has a dramatic effect on fire behaviour. Not only do steep slopes allow a fire to move quickly uphill, they also allow burning material to roll downhill (Teie, 2005). Steep terrain is one of the common denominators in fatal fires (Geldenhuys, 1994).

2.7. Fuels

Available fuels are those that will ignite and support combustion under specific conditions. Normally, only a portion of the fuels in an area are available to burn. The extent to which the fuel will burn is therefore, primarily controlled by the size of the material and its moisture content (De Bano, 1998). The drier the material, the more of it will be consumed and the larger the material, the less of it will be consumed.

Fuel load is regarded as one of the most important factors influencing fire behaviour because the total amount of heat energy available for release during fire is related to the quantity of fuel (Luke & McArthur, 1998). Fuel loads also depend on the forest type, life stage of the forest and time since the last fire. For example older and over-mature forests may have an accumulation of large woody debris (Geldenhuys, 1994). Thus, forested areas and plantations can range from 200 to 1,200 tons per hectare, and timber logging slash can range from 60 to 400 tons per hectare (Teie, 2005). The fire manager needs, therefore, to focus on fuel loading that is subject to burning under the current and predicted weather conditions when developing strategy and tactics for veld fire management.

Size and shape of the fuel also play an important role on how fuel burns. The finer the fuel, the higher the ratio and the quicker it releases its moisture. Again the flat fuels (like leaves) have a greater surface area to volume ratio than larger fuels like logs (Teie, 2005).

2.7.1. Fuel Compactness

According to Goldammer & De Ronde (2004), Fuel compactness generally refers to the spacing between fuel particles. Combustion is most favoured when fuel is sufficiently loosely packed to enable adequate quantities of oxygen to reach the flame zone, but dense enough for efficient heat transfer to occur (Luke & McArthur, 1998).

2.7.2. Fuel Moisture content

Fuel moisture content is defined as the amount of water in a fuel, and is expressed as a percent of dry weight of what fuel (Teie, 2005). The fuel moisture content further, controls what fuel will actually burn and with what intensity. Thus, when fuels are hot and dry, they ignite and burn easy. When fuels are cool and wet, the possibility of ignition will be reduced, if ignited, the fuels will burn very poorly.

2.8. Legislative requirements for veld and forest fires

2.8.1. Constitution of South Africa (Act No. 108 of 1996)

Section 24 (a) (b) preludes that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislature and other measures that prevent pollution and ecological degradation, promotes conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

2.8.2. National Veld and Forest Fire Act of 1998 (Act No.101 of 1998)

The main purpose of this Act is to prevent and combat veld, forest and maintain fires throughout the Republic of South Africa. These provisions are in line with the National Disaster Management policy, and in many cases with international trends. This Act places the duty on

every owner on whose land a veld fire may start or burn, or from whose land it may spread, to prepare and maintain a fire break on his/her side of the boundary between his/her land and the adjoining land.

The Act further makes provision for the establishment of a Fire Protection Association, which is designed to lay down minimum standards to be maintained by members in relation to all aspects of veld fire prevention and readiness for fire fighting and to regulate controlled burning to conserve ecosystems and reduce fire danger. Chapter 3 of the Act provides for the prevention of veld fire through a fire danger rating system. The Act further outlines that when the fire danger is rated as high in any region, warning must be published at the earliest possible opportunity in all the main languages used in that particular region. Chapter 5 places a duty on all land owners to acquire equipment and avail personnel to fight fires. It provides for agreement to be reached between the minister and the Fire Protection Association, or between such associations to assist each other in the case of a fire.

The act also sets out relevant offences and penalties that may be applicable. Section 25(1) outlines that any person who lights, uses or maintains a fire in the open air is in contravention of the law, and is guilty of a first category offence. Such person may be liable of conviction for a fine of two years imprisonment or both.

Hence section 25(3) preludes that any person who commits any of the under mentioned acts is guilty of a second category offence. Such person is liable for a fine or two years imprisonment or both.

- Failure to prepare a firebreak when obliged to do so in terms of section 12(1) or 14
- Failure to give notice of intention to burn a firebreak in terms of section 12 (2) (b)
- Burning of a firebreak when a fire Protection Association has objected in terms of section 12 (4) (a)
- Failure o inform adjoining owners of the matter referred to in section 12 (5)
- Failure to meet the standards of readiness for fire fighting
- Failure to notify the persons

- Refusal to assist a Fire Protection officer or a forest officer
- Hindering or obstructing a Fire Protection officer
- Leaving unattended a fire which she lit , used or maintained before that fire is extinguished
- Lighting, using or maintaining a fire, which spread and causes injury or damage, with or without permission from the owner.
- Throwing, putting down or dropping a burning material, other burning material or any other material capable of spontaneous combustion or self-ignition and by doing so, making a fire which spread and causes injury or damage.
- Lighting, using or maintaining a fire in a road reserve

Any owner who occupies or person in control of land on which a fire occurs who fails to take reasonable steps to extinguish a fire or to confine it to that land or to prevent it from causing damage to property on adjoin land is guilty of a first category offence. Any person who prevents a Fire Protection Officer, Police Official, Forest Officer or an officer appointed in terms of section 5 or 6 of the Fire Brigade Services Act , 1987 (Act No.99 of 1987) from acting in terms of section 27, 28 or 29 is liable for a fine or 6 months imprisonment or both.

The Act provides the formation and constitution of fire protection association. The main purpose of the association is to predict, prevent, manage and extinguish veld fires. It also mentions that where there is a fire service or fire services in the area in respect of which a fire protection association may be formed, the Chief Fire Officer or officers of that or those services or persons authorised by them in writing, must attend the founding meeting.

2.8.3. Disaster Management Act 57 of 2002

The Act provides for an integrated and coordinated Disaster Management policy that focuses on preventing or reducing the risk of disasters, mitigating the security of disasters, emergency preparedness, rapid and effective response to disaster and post-disaster recovery. Section 53 (1) outline that each municipality must:

- Prepare a DM plan for its area according to the circumstances prevailing in the area.
- Co-ordinate and align the implementation of its plan with those of other organs of state and institutional role players.
- Regularly review and update its plan.
- Anticipate the types of disasters that are likely to occur in the municipal area and their possible affects.
- Place emphasis on measures that reduce the vulnerability of disasters prone areas, Communities and Households.
- Provides for appropriate prevention and mitigation strategies.
- Facilitate maximum emergency preparedness.
- Contain contingency plans and emergency procedures in the event of a disaster, providing for the allocation of responsibilities to the various role- players and coordination in the carrying out of those responsibilities.

2.8.4. Occupational Health and Safety Act (Act 85 Of 1993)

The Act provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety, and to provide for matters connected therewith.

2.8.5. Fire Brigade Service Act No. 99 Of 1987

The Fire Brigade Services Act provides for the establishment, coordination and standardization of fire brigade services. Local authorities are allowed to establish and maintain a fire brigade service for the following different purposes:

- Preventing the outbreak or spread of a fire.
- Fighting or extinguishing a fire.
- The protection of life or property against the fire or other threatening danger.
- The rescue of life or property from a fire or other dangers.

2.8.6. National Environmental Management Act of 2004

Land owners need to assure compliance with the principles outlined in Chapter 1 of the Act. It stipulates that people and their needs must be placed at the forefront of veldfire management, as a field of environmental management. Veldfire management, as part of sustainable development, should avoid, minimise or remedy the disturbance of ecosystems and loss of biological diversity and pollution or degradation of the environment.

2.8.7. The Municipal Systems Act No. 32 of 2000

This Act places several duties upon municipalities. Those immediately relevant to veldfire management are:

- To promote and undertake development in the community and
- To promote a safe and healthy environment in the municipality.

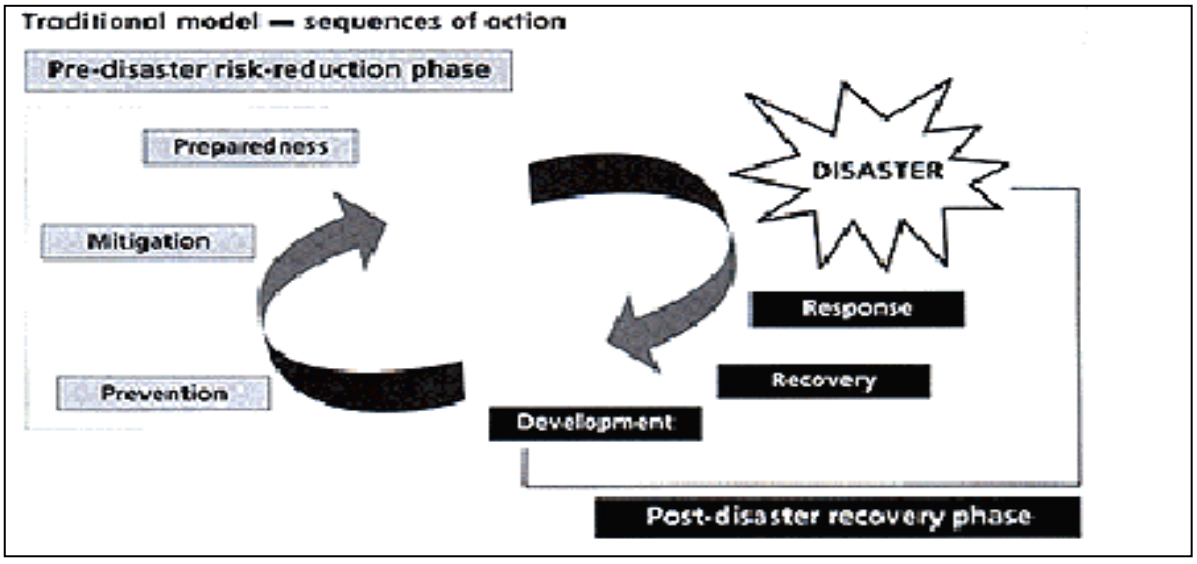
2.9. Veldfire prevention measures

The disaster management cycle (figure 7) illustrates the ongoing process by which governments, businesses, and civil society plan for and reduce the impact of disaster, react during and immediately following a disaster, and take steps to recover after a disaster has occurred (Warfield,1998). In contrast, appropriate actions at all points in the cycle lead to greater preparedness, better warnings, reduced vulnerability of veldfire or the prevention of disaster during the next iteration of the cycle (green paper on disaster management, 1998). Most of all the complete disaster management cycle includes the shaping of public policies and plans that either modify the causes of disasters or mitigate their effects on people, property and infrastructure (Carter, 1991). The disaster management cycle is divided into two phases: pre-disaster risk reduction and post disaster recovery phase whereby, the pre-disaster risk reduction phase focus on prevention, mitigation, preparedness and early warning aspects and post disaster recovery phase consists of disaster, response, recovery, rehabilitation and reconstruction (figure: 7). The disaster management cycle shows the vital role that disaster management plays in ensuring that

appropriate policies or plans that focuses on prevention, risk reduction and mitigation of the severity of disasters (veldfire) are in place. The first phase of the cycle shows that a well developed appropriate veldfire management plan should include prevention, protection and suppression measures in order to be able to manage the adverse impact of veldfires in South Africa.

Prevention is defined as actions designed to impede the occurrence of a disaster event and/or prevent such occurrences from having harmful effects on communities (Carter, 1991). However, prevention forms the first step in the pre-disaster risk reduction phase of disaster management cycle. Veldfire prevention is defined as all those activities concerned with minimising the incidence of forest fires, particularly those of human origin. According to FAO (2006), fire prevention may be considered the most cost-effective and efficient mitigation programme an agency or community can implement. Prevention activities include aspects such as training and community awareness programmes, law enforcement as well as research on improving risk reduction of the veldfire and controlling burning off in veldfire prone areas prior to high risk fire season. (Carter, 1991). There are three elements to a veld and forest fire prevention programme: education, fuel breaks and enforcement (Teie, 2005). The purpose of the forest and fire prevention program is to eliminate or reduce risk and hazards.

Figure 7: Disaster Management Cycle



Source: Green paper on Disaster Management, 1998

The exact causes of fires are of great importance since management actions must address them in order to reduce the risk and impact of veldfires (Bothma, 2000). According to Goldammer & De Ronde (2004) fire prevention efforts need to be strengthened in Africa and more effective signs, special warning messages in the media during dangerous periods, school programmes and community outreach programmes. To run an effective programme in South Africa it is crucial to consider the social context of the fire programme (Calvin & Wettlaufer, 2000).

Strategic actions for fire prevention:

- In areas in which objectives require minimizing the number of fires and the area burned, a comprehensive prevention plan should be developed.
- Prevention plans should take into account traditional uses of fire, be based on laws or regulations restricting fires and involve local community leaders and organisations.
- Data should be collected on a monthly and annual basis on frequency, specific causes and locations of human-caused fires, reasons for starting the fires, and area burned in order to establish an effective prevention programme.

Fire prevention programmes should include information on the need to use and mange fire in certain situations. The above information extracted from FAO (2006).

2.9.1. Public Education/ Awareness

According to Brown and Davis (1993), people are the primary problem in the prevention of fires. Most people are unaware of the impact of these veldfires (Brown & Davis, 1993). Thus, prevention of these fires requires the public understanding of the damaging aspects of fire and actions that lead to their elimination or reduction (Goldammer & De Ronde, 2004). Educating the public is the primary effort, which may include the following media:

- Books, News releases, magazine articles.
- Radio messages.
- Television programmes.
- Signs, posters and exhibits.
- Handouts.

Fire awareness and educational activities can be very effective in involving the community and other groups in a fire management programme and in engaging the community as a responsible partner (FAO, 2006). A well-informed public will, therefore, be more likely to use fire carefully and to adhere to policy and legal boundaries. This fire awareness can also assist in the prevention, detection and reporting of fires, work with fire personnel to control unwanted fires, and provide a source of local and traditional knowledge.

Strategic actions for awareness and education:

- Fire awareness and educational programmes should be developed and targeted to specific audiences and communities.
- Programmes should be sensitive to the culture and social norms of the community, including the application of fires to agriculture, forestry, biodiversity and traditional uses or to other basic needs.
- Fire awareness and educational materials should be gender sensitive and should reflect Local literacy levels should include oral presentation where printed material or local language barriers limit effective communication.
- Age appropriate information and educational materials should be developed cooperatively by technical experts and educational specialists and provided to all levels, introducing ecological and fire management concept into local schools.
- Primary and secondary schools, universities, non-governmental organisations and other institutions should be encouraged to develop locally and ecologically appropriate fire management programmes for teachers and other educators, based on local conditions and beliefs.

The above information is extracted from FAO (2006).

2.9.2. Delivery methods for fire prevention

A combination of visual, verbal and written methods can be used to deliver fire prevention messages. A selection of the correct method is important if the message is to reach the intended target group (Goldammer & De Ronde, 2004). In areas where literacy is low, for example, a message that involves visual elements and cues will be more effective. An awareness campaign is another method that can be used to deliver the fire message to the community. However, the campaign will allow the fire prevention message to be delivered in a variety of methods under a single banner or slogan (Goldammer & De Ronde, 2004). The campaign method is an excellent way to increase public awareness and to gain support (Goldammer & De Ronde, 2004). Fire prevention training in schools is very important, since establishing proper attitudes towards fire begins at a young age (Goldammer & De Ronde, 2004). Parents are also easily reached as children take the messages home.

2.9.3. Law Enforcement

Law enforcement is always a necessary tool in fire prevention. In South Africa, the National Veld and Forest Fire Act, No 101 of 1998, and the Forest Act of 1998, provide the essential background to law enforcement. However, legal deterrence only becomes effective through active enforcement. For instance, law enforcement measure is the publication of the "*prohibition on making of fires in the open air*", which is published annually in the Government Gazette for different South African regions.

2.9.4. Fire Breaks

A fire break is an artificial barrier constructed before a fire occurs, specifically as a line of defence along which fires may occur, stopped, checked or attacked (Teie, 2005). By preparing a fire belt, the fire manager is practically reducing the hazard present on the forest plantation. By so doing, the manager attempts to reduce the hazards for the following specific purpose:

- To stop or help stop a fire from reaching a particular area or property, especially to protected it. A fire belt cleared of inflammable material surrounding a plantation is a typical example.
- To prevent a fire from spreading away from a known or suspected ignition source. Preparing fire belts/ firebreaks along roads, railways lines, footpaths and other likely ignition sources are examples. The purpose here is basically containment, with the barrier located outside and near the source of the fire.
- To break up a forest area into units of 250 to 400 ha to aid in the general strategy of fire control. A grid of fire belts at more or less regular intervals in level areas and a planned system of fire belts in mountainous areas are designed to keep a fire within a particular area. The purpose here is to improve accessibility and create breaks in fuel continuity that will help to prevent extensive spread.
- To reduce fuel hazard in an area. For example, removal of forest litter, felling of dead or dying trees and preventative burning. The purpose is to reduce the rate of spread and difficulties of control over an area. The above information is extracted from (Teie, 2005).

These firebreaks need to be well positioned and regularly maintained in order to be effective (Forsyth & Bridgett, 2004). Furthermore, firebreaks have the advantage of preventing soil erosion, offering a safe place for fire fighters to work, low maintenance, and a pleasing appearance (Goldammer & De Ronde, 2004). In addition, the success of fire attack is often dependent on where the fire break is placed and how it is constructed (Teie, 2005).

The topographical features should be utilized fully when creating firebreak. The most effective position for a firebreak is on the crest of a ridge or spur. The reason is that breaks on the crest, or on both sides of the crest, are most effective as the air current approaching the crest diminishes danger of sparks being carried across tracers while the counter-current over the crest facilitates suppression (Teie, 2005).

2.9.5 Fire Preparedness

Preparedness is a continuous cycle of planning, managing, organizing, training, equipping, exercising, creating, monitoring, evaluation and improvement activities to ensure effective coordination and the enhancement of capabilities of concerned organizations to prevent, protect against, respond to, recover from, create resources and mitigate the effects of natural disasters, acts of terrorism, and other man-made disasters (FEMA, 2002). All additional activities undertaken prior to the beginning of the fire season are, however, considered to be part of preparedness actions. Preparedness includes training, equipping and staffing prior to the start of a fire. According to FAO (2006) an effective fire preparedness programme should be based on fire and resource management planning and should take into account year on year variations in funding, weather and human activities. Properly trained and equipped personnel at the proper locations will increase the effectiveness of any programme (Goldammer & De Ronde, 2004). The safety of fire fighters is thus, dependant on their understanding of fire characteristics and the local weather. Training in the effective use of equipment and fire suppression techniques is also important, while for supervisors and managers, training can help them better understand and effectively deploy a complex range of resources.

Strategic actions for fire preparedness:

- Preparedness plans should include all activities to be undertaken prior to the start of a fire.
- Safety considerations, both for fire fighters and the public, should be a key component off any preparedness plan.
- Plans and implementation should be based on an effective and cost-efficient mix of resources and organisations plans which should take ecological considerations into account, such as the impact of suppression actions on the environment and the role of fire in the ecosystem or in cultural areas.
- Plans should include processes and procedures to assess risk and hazards and to determine appropriate response and mitigation actions.

- Plans should assess the capabilities of remote communities and individuals living in outlying areas to protect their own assets and assist fire services in all phases of fire management. The above information is extracted from FAO (2006).

All training should be appropriate to local ecological, social and political conditions and should be delivered to the same standard for full-time, paid, rural workers or volunteers for the expected fire characteristics.

2.9.6. Fire Danger Rating

Chapter 3 of the Act provides for the prevention of veldfires through a fire danger rating system. A Fire Danger Rating (FDR) is a description of the range of elements of veldfire behaviour, the degree of difficulty in controlling a veldfire, and other relevant parameters of fire danger for each of several ranges or classes of fire danger rating for all regions (Teie, 2005). The sole purpose of fire danger rating system is to attempt to indicate with a rating on how things will burn or will burn in the future and key to success of the system is when the fire-fighter and fire manager accept the rating as real and reliable (Teie, 2005). Rating systems use basic daily weather data to calculate wildfire potential, by using forecasts, early warning which is provided many days in advance of a significant fire event (FAO, 2006). For example, forest and land management agencies, landowners and communities benefit from an early warning system that identifies critical periods of extreme fire danger in advance of their occurrence. In contrast, such early warning, particularly if delivered with high spatial and temporal resolution that incorporates measures of uncertainty and the likelihood of extreme conditions, allow fire managers to implement fire prevention, detection and preparedness plans before a fire problem begins (FAO, 2006).

When a fire danger is rated high in any region (Table 2) the Minister publishes a warning at the earliest opportunity in all the main languages used in the region (Goldammer & De Ronde, 2004). When a warning has been published, no person may light, use or maintain a fire in open air in the region where fire danger is high. For example, KwaZulu-Natal Midlands and Mpumalanga use the localised fire danger rating systems (Willis, Van Wilgen, Tolhurst, Everson,

D`Abreton, Pero & Fleming, 2001). Communication of fire danger rating indices to the public is essential if the national fire danger rating (NFDRS) is to be effective. Willis et al. (2001) present a colour-coded system for depicting fire danger that would be suitable for South Africa. Therefore, the system has five colour-coded fire danger rating categories, whereby each of these has the expected fire behaviour, recommended control measures, actions and restrictions for each category and table 2 on the following page indicate the colour-coded system (Willis et al. 2001).

Strategic actions for fire Danger Rating and early warning systems:

- Countries or organisations should establish a fire danger rating system or adapt an existing system to the local environment, based on land cover, vegetation and daily weather data.
- Countries or regions should install a national or regional early warning system, using existing, demonstrated science and technologies and based on a local fire danger rating system.
- An information network should be developed to provide reliable early warning of fire danger quickly to local authorities, landowners and communities and to take advantage of established community networks. The above information is extracted from FAO (2006).

Table 2: Fire Danger Rating

INDICATIVE COLOUR	**BLUE**	**GREEN**	**YELLOW**	**ORANGE**	**RED**
DANGER RATING	**Insignificant**	**Low**	**Moderate**	**High**	**High - extreme**
FIRE PREVENTION AND PREPAREDNESS MEASURES	No precaution is needed	Fires including prescribed burns may be lit, used or maintained in the open air on condition that persons making fires take reasonable precautions against the fires' spreading.	No fires may be allowed in the open air except those that are authorised by the Fire Protection Officer where a Fire Protection Association exists, or elsewhere, the Chief Fire Officer of the local fire service, or fires in designated fireplaces.	No fires may be allowed under any circumstances in the open air.	No fires may be allowed under any circumstances in the open air and Fire Protection Associations and municipal Disaster Management Centres must invoke contingency fire emergency and disaster management plans including extraordinary readiness and response plans. All operations likely to ignite fires halted. Householders placed on alert.
APPLICATION OF THE ACT			Above precautionary measure to be prescribed and made applicable nationally on days rated moderate.	Section 10(1) (b) applies: no person may light, use or maintain a fire in the open air.	Section 10(1) (b) applies: no person may light, use or maintain a fire in the open air.
RELATIONSHIP WITH DISASTER MANAGEMENT				The threat of disastrous wildfires exists at municipal level under these conditions. Municipal Disaster Management Centres must invoke contingency plans	The threat of disastrous wildfires at provincial level exists under these conditions. Municipal Disaster Management Centres must invoke contingency plans and inform

INDICATIVE COLOUR	BLUE	GREEN	YELLOW	ORANGE	RED
				and inform National and Provincial Disaster Management Centres. (Section 49 of the Disaster Management Act).	National and Provincial Disaster Management Centres. (Section 49 of the Disaster Management Act).
FIRE BEHAVIOUR	Fires are not likely to ignite. If they do, they are likely to go out without suppression action. There is little flaming combustion. Flame lengths in grassland and plantation forest litter lower than 0.5 m and rates of forward spread less than 0.15 kilometres per hour.	Fires likely to ignite readily but spread slowly. Flame lengths in grassland and plantation forest litter lower than 1.0 m and rates of forward spread less than 0.3 kilometres per hour.	Fires ignite readily and spread rapidly, burning in the surface layers below trees. Flame lengths in grasslands and plantation forests between 1 and 2m, and rates of forward spread between 0.3 and 1.5 kilometres per hour.	Fires ignited readily and spread very rapidly, with local crowning and short-range spotting. Flame lengths between 2 and 5 m, and rates of forward spread between 1.5 and 2.0 kilometres per hour.	Conflagrations are likely in plantation forests, stands of alien invasive trees and shrubs, sugar cane plantations, and fynbos. Long range fire spotting is likely in these fuel types. Rates of forward spread of head fires can exceed 4.0 kilometres per hour and flame lengths will be in the order of 5 – 15 m or more.
FIRE SUPPRESSION DIFFICULTY	Direct attack feasible: one or a few field crew with	Direct attack feasible: fires safely approached on foot. Suppression is	Direct attack constrained: fires not safe to approach on foot	Direct attack not feasible: fires cannot be approached at all and back burning, combined with	Any form of fire control is likely to be precluded until the weather changes. Back burning dangerous

INDICATIVE COLOUR	BLUE	GREEN	YELLOW	ORANGE	RED
	basic fire fighting tools easily suppresses any fire that may occur.	readily achieved by direct manual attack methods.	for more than very short periods. Best forms of control should combine water tankers and back burning from fire control lines.	aerial support are the only effective means to combat fires. Equipment such as water tankers should concentrate efforts on the protection of houses.	and best avoided.

Source: Willis et al. 2001

2.10. Veldfire Protection Management

Veldfire protection is defined as all those activities designed to protect an area (including human life, property, assets and values) from damage by wildfires. Chapter 2 of the Veldfire Act regulates the establishment, registration, duties and functioning of Fire Protection Associations. The duties of Fire Protections Associations (FPA's) are as follows:

- Develop and apply a veldfire management strategy for its area
- Provide strategy agreed mechanisms for coordinating actions with adjoining FPA's
- Make rules to bind members
- Identify ecological conditions that affect fire danger
- Regularly communicate the fire danger rating to its members
- Organise and train its members in fire fighting, management and prevention
- Inform members of equipment and technology available for preventing and fighting veldfires.
- Provide management services, training and support for communities in their efforts to manage and control veldfires
- Supply the minister with statistics about veldfires in the area, every 12 months.
- Furnish any information requested by the Minister in order
- Exercise the powers and perform the duties delegated to it by the Minister, and
- Appoint a fire protection officer, unless a municipality is a member.

2.10.1. Mutual Aid Agreement

Federal Emergency Management Agency (FEMA, 2002) defines mutual aid agreements and assistance agreements as agreements between agencies, organizations, and jurisdictions that provide a mechanism to quickly obtain emergency assistance in the form of personnel, equipment, materials, and other associated services. The primary objective is to facilitate rapid, short-term deployment of emergency support prior to, during, and after an incident (FEMA,

2002). In addition, the mutual aid speeds up the process of the delivery of private assistance at the appropriate jurisdictional level during incidents. Pre fire season activities involve cooperative action with collaborators, contractors and other groups or organisations in support of fire management programmes (FAO, 2006).

According to Wiley (2005) the mutual aid should at least include the following elements:

- Definitions of key terms used in the agreement
- Roles and responsibilities of individual parties
- Procedures for requesting and providing assistance
- Procedures for requesting and rules for payment, reimbursement and allocation of costs.
- Notification procedures
- Protocols for interoperable communications
- Workers compensation
- Treatment of liability and immunity
- Sharing agreements as required

There are three key words that one needs to remember when updating the mutual aid agreement: anticipate, prepare and practice. Anticipate the different forms of aid your organisation may require in the event of an emergency. Prepare and agree to a written mutual aid strategy with other organisation in surrounding communities. Practice the strategy by conducting drills with the organisations that have volunteered their assistance (Ohio EPA, 2007).

2.10.2. Fire Breaks

Chapter 4 of the National Veld and Forest Fire Act 101 of 1998 requires the landowner to establish and maintain firebreaks on the exterior boundaries of their property. If the firebreaks are to be maintained by the use of burning, the landowner has to notify the adjacent landowner and the FPA of his plan to burn (Teie, 2005). Section 13(a) (b) and (c) stipulate the requirement. Fire

breaks are to be designed: as a means of access for personnel and equipment, to serve as a control line and serve as a line from where a fire can be attacked by, for example, setting a back burn.

2.10.3. Equipments

Chapter 5 of the National Veld and Forest Fire Act 101 of 1998, states that all landowners whose land a fire may start or burn, or from whose land it may spread, must have equipment, protective clothing and trained personnel for extinguishing fires. Figure 8 shows one of the TCLM fire vehicle and below is the list of standard equipment for a landowner or municipality to have:

Table 3: List of Equipments

Fire Bombers	Have only one purpose, namely to deliver a fire suppressant to the fire line. Fire bombers are most effective on initial attack when the fire is small (Teie, 2005). It can deliver water, gel or other suppressant drops to knock down the fire so that ground forces can safely advance. As the fire gets larger, their usefulness drops significantly. At this moment it can only be used for specific targets, like spot fire control or protection of a high value property.
Helicopters	- is one of the most versatile tools in the manager's tool kit and it can be used to do the following: • Transport fire fighting personnel and equipment to remote locations quickly. • Drop water using a bucket or fixed tank. • Fire mapping and reconnaissance • Medical evacuation • Spotter duties
Spotter Planes and Pilots	In these cases the spotter plane and the pilot provide several functions on a fire. Teie (2005) calls it the "eyes in the sky" for the fire manager or boss. It provides the best view of the overall fire problem. It further operates as an aerial flight control centre, calling in bombers to hit specific targets and keeping them from running into each other and into things on the ground. The single-engine Cessna 182 and Cessna 206 are the most commonly used spotter planes in South Africa (Tee, 2005).
Bakkie Sakkie	Is one of the most versatile veld and forest fire fighting vehicle. It is a small, self-contained unit that provides a fast first on the scene fire fighter, capable of extinguishing or containing blazes until larger and slower backup equipments arrive to assist? These units have high-pressure self-priming pumps with live mounted hose reel.
Bulldozer	Are used to cut fire lines. The fire manager should use bulldozers when they are

	needed, but only when they control them to limit long-term damage. A Bulldozer is mostly used when the FDI is on higher levels.
Fire Trucks	Are specially designed and equipped for fire fighting. Furthermore, they are fire trucks that are specifically designed for veld and forest fire fighting.
Drop-on Tanks	Are popular and cheaper alternatives to fire trucks. On some plantations, these tanks are kept on strategic locations. This is to help fire managers with more options in case of a fire-especially if there is no water in a certain area of the plantation.
Safety equipment	All people working on the fire scene should have safety clothing protecting them from the elements and injury. In a case of someone getting hurt because she did not wear or was not issued with safety items, the fire manger will be liable for her injury by law.
First aid kit	The Safety Act stipulates that there must be a trained first aid person with a fully equipped first aid kit on the scene (Teie, 2005).
Spare radios and Batteries	On fire scene, communication is of the utmost importance and back up radio sets and batteries are necessary (Teie, 2005).

Figure 8: TCLM fire Vehicle

Source: from the researcher, 2011

2.10.4. Training

The Act states that all landowners need to ensure that their personnel are trained in fire fighting to an acceptable standard. A well trained and skilled veld and mountain fire-fighting force is an essential component of any veldfire management operation (Jayiya, 2007). For instant, the fire fighters may get a refresher course on the basic fire fighting and incident control management

2.11. Prescribed burning

Various fire techniques can be used to accomplish burning objectives. The technique chosen must be correlated closely with fuels topography and weather factors to ensure that goals are met while preventing undesired damage to forest resources (Rothermel, 1993). Below are figures 9 and 10 of the prescribed burning picture performed by the TCLM fire crew at Graskop on the 23 of July 2011.

Figure 9: prescribed burning at Graskop

Source: researcher, 2011

According to the behaviour and spread, fires move with the wind (heading fire), against the wind (backing fire) or at right angles to the wind (flanking fire) (Rothermel, 1993). Heading fire is the most intense because of its faster spread rate, wider flaming zone and longer flames. Backing fire is the least intense, having a slow spread rate regardless of wind speed. Flanking fire intensity is intermediate.

Figure 10: Fire fighter using drip torch for prescribed burning at Graskop

Source: researcher, 2011

2.11.1. Backing fire

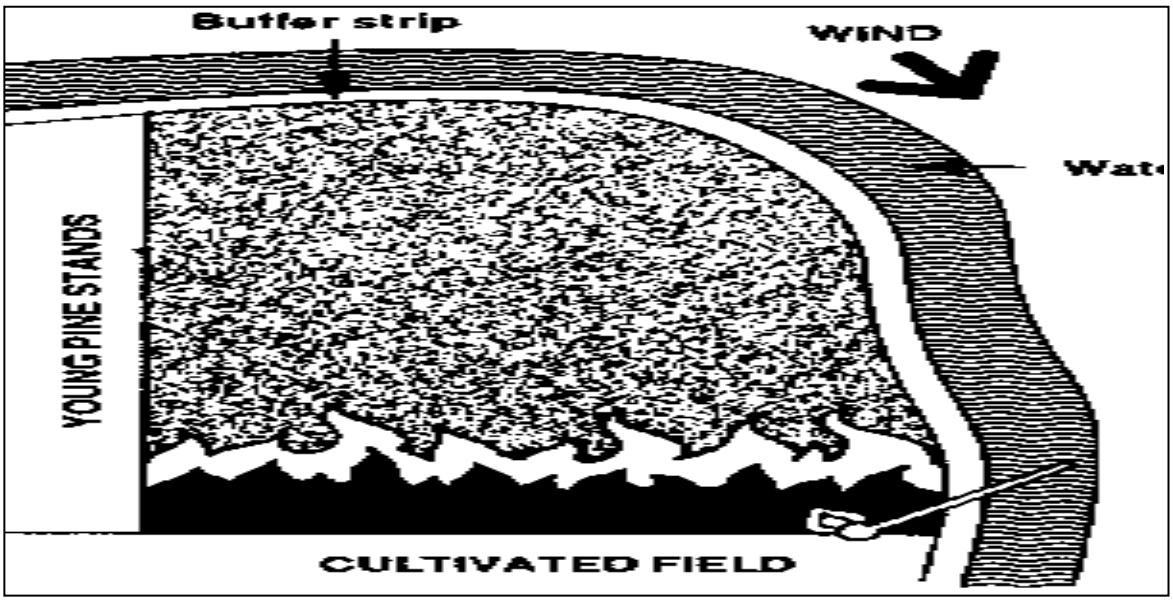
A backing fire is started along a baseline such as a road, plough line, stream or other barrier and allowed to back into the wind (McKevin & McKee, 1999). McKevin & McKee, further state that backing fire is the easiest and safest type of prescribed fire to use, provided, the wind speed and direction are steady. It produces minimum scorch and lends itself to use in heavy fuels and young pine stands. According to Lunsdford (1990) the disadvantages of backing fire include the slow

progress of the fire and the increased potential for feeder-root damage with increased exposure to heat if the lower litter is not moist enough.

2.11.2. Strip-heading fire

In strip-head burning, a series of lines of fire are set progressively upwind of a fire-break in such a manner that no individual line of fire can develop to a high energy level before it reaches either a firebreak or another line of fire (Teie, 2005). The distance between ignition lines is determined by the desired flame length. According to McKevin & Mckee (1999) the Strip-heading fires permit quick ignition and burnout and provide for smoke dispersal under optimum conditions. However, higher intensities will occur wherever lines of fire burn together, increasing the likelihood of crown scorch (Mcnab, 1998).

Figure 11: backing fire technique

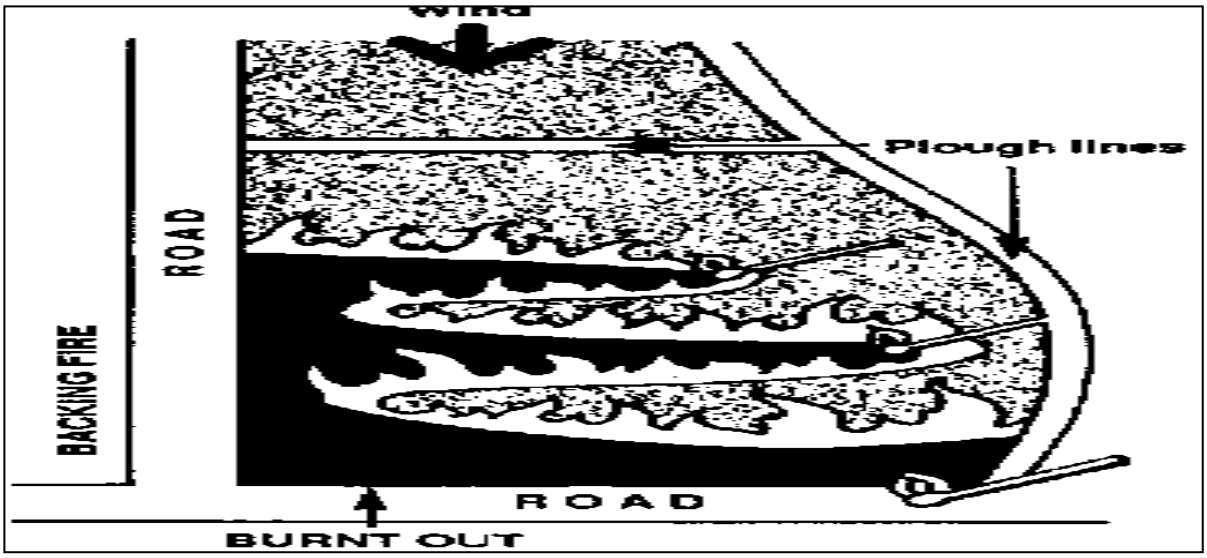


Source: McKevin & McKee, 1999

Occasionally, on areas with light and even fuel distribution, a single line of heading fire may be set along the upwind edge and be allowed to move over the entire area to accomplish the

objective better (McKevin & Mckee, 1999). However, caution must be exercised to ensure that this type of fire does not escape control.

Figure 12: strip-heading fire technique

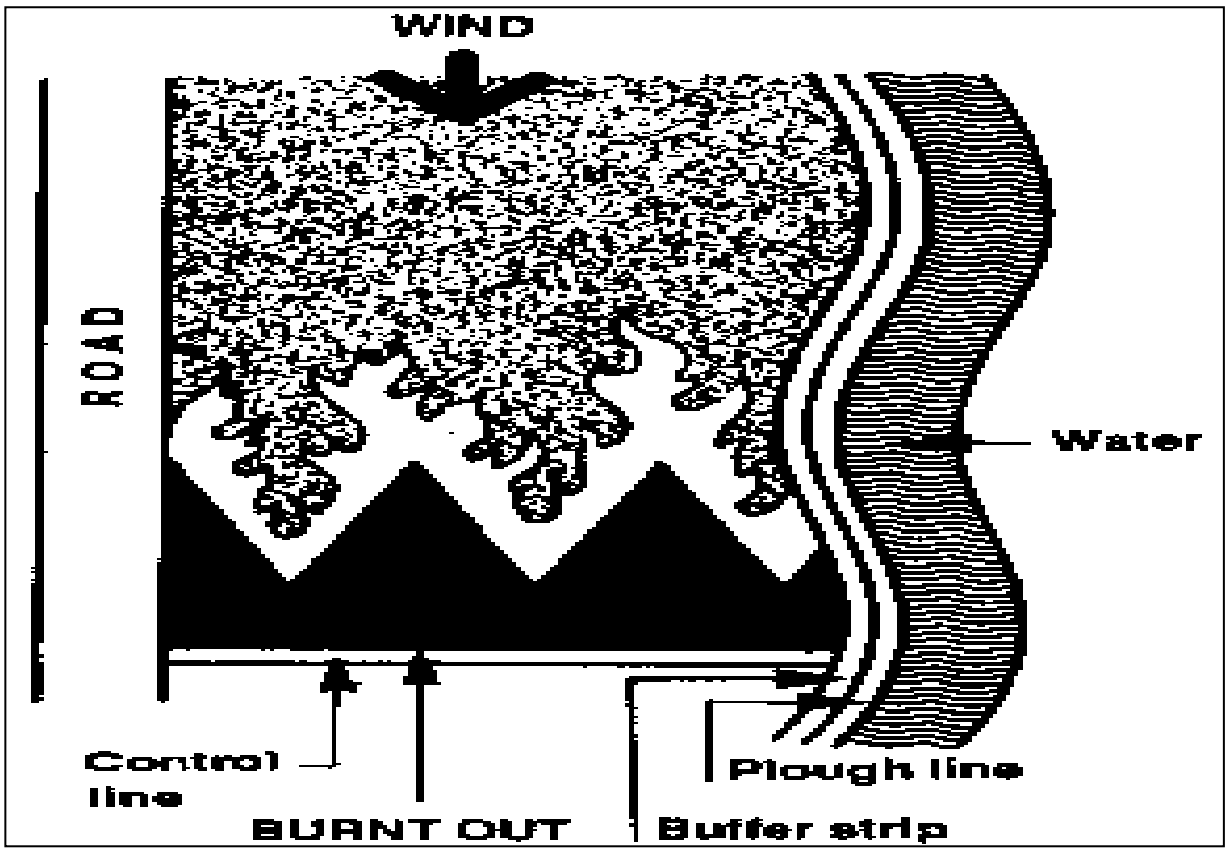


Source: McKevin & McKee, 1999

2.11.3. Flanking fire

The flanking fire technique consists of treating an area with lines of fire set directly into the wind (McPherson, Rasmussen, Wright & Britton, 1996). The lines spread at right angles to the wind. This technique requires considerable knowledge of fire behaviour, particularly if used by itself (Rothermel, 1993). Teie, 2005 further mentioned that flank fire is used quite often to secure the flanks of a strip-heading fire or backing fire as it progresses. It is sometimes used to supplement a backing fire in areas of light fuel or under particularly humid weather conditions (McPherson et al, 1996). It is useful on a small area to facilitate burning a large area in a relatively short time when a line-heading fire would be too intense. It should be noted that this method of firing can stand little variation in wind direction and requires expert coordination and timing (Sackett, 1998). See figure 13.

Figure 13: Flank fire techniques



Source: McKevin &Mckee, 1999

2.12. Suppression management

The greatest amount of time should be spent on fire prevention, planning, training and other pre-fire suppression activities (Teie, 2005). Effective and efficient forest fire suppression can be carried out only when appropriate preparations are made prior to the required suppression activity. The suppression measure can be seen as one of the mitigation measures which falls at the pre disaster risk reduction phase of the disaster cycle (Figure: 5). Pre-suppression includes preparation, staffing, organizing, equipments, funding and training of all people planned to do the suppression work (National guidelines on Forest Fire Management in Namibia, 2001). The establishment of cooperative mutual agreements between stakeholders can play an important role in this regard. Therefore, standard suppression procedures need to be established as to detection and early warning systems.

2.12.1. Direct Attack

Direct attack consists of a series of actions to cool, drown, smother, beat out, starve or extinguish the flames of a burning fire (Fuller, 1991). This kind of attack is conducted in lighter fuels, directly on flaming edge of the fire by creating fire lines which will halt the spread of fire. Furthermore, direct attack can be used with hand tools, fire trucks together with bombers and it is considered to be one of the safer attack modes, because one is directly working next to the fire and can use the "black" as a safety zone (Teie, 2005).

2.12.1.1 Advantages of Direct Attack

- Limited chance for fire to gain momentum or size
- Reduce damage to resources
- Uncertain elements in burning out are limited
- Safety; if necessary, you can escape into a burnt area.
- Full advantage is taken of burn-out areas

2.12.1.2 Disadvantages of Direct Attack

- Fire fighters can be hampered by heat, smoke and flames
- More mop-up and closer patrol are required
- More danger of breakthroughs and spot fires
- Control lines can be very long and irregular, because the line follows the edge of the fire
- May not take advantage of existing natural or existing barriers

Hence, if water is available, it should be used to cool the flames so that fire fighters can get in close to the fire (Goldammer & De Ronde, 2004). Most important is that safety comes first; the head of a fast moving fire should never be attacked.

2.12.2. Indirect Attack

According to Teie, (2005) the indirect attack method is used when a direct attack is not possible or practical. Moreover, it can be used when the burning intensity, rate of spread or working conditions (heat, smoke, terrain) are too extreme or if there are too few available personnel (Heikkila et al, 1993). For instant, when a fire is too large and spreading too fast, the fire line should be built safety away from the fire in a flanking attack, starting from anchor points and working around the head of the fire, avoiding sharp angles.

2.12.2.1. Advantages for Indirect Attack

- Fire fighters are not working in the heat and smoke.
- More time is needed to construct the line
- It eliminates irregularity of lines
- It permits taking advantage of the natural and man-made features
- It permits precision teamwork

2.12.2.2. Disadvantages for Indirect Attack

- It may be dangerous to fire fighters, because they are working some distance from the fire and can't observe it.
- Fire may change direction suddenly
- Backfire or burnout operations may go out of control.

2.12.3. Suppression Techniques

Once a fire suppression tactic is selected, the next step is to apply available resources in order to control the fire (Goldammer & De Ronde, 2004). Hand tools such as beaters, spades, chainsaws and rakes are the primary tools used for fire suppression. Thus, hand tools are used to cool and extinguish the fire and to build fire lines (Heikkila et al, 1993). Beaters and hoes are the primary tools to use in grass.

2.12.3.1. Fire Attack using water

Water is extremely effective against fire; if used correctly, water can cool large portion of flame (Fuller, 1991). Water bombers are most appropriate when fighting fire using water. Thus, during initial attack, water is mainly used to knock down the flames and allow personnel with hand tools to move in closer and prepare a fire line. Figure 15 is the picture of the researcher using water for mop up operations.

Figure 14: Fire fighters holding beaters

Source: researcher, 2011

Figure 15: Researcher using water for mop up operation

Source: Researcher, 2011

Outlined below are factors need to borne in mind when using water:

- The water stream should always be aimed at the base of the flame and on the fuel that is burning work in tandem with hand crews if possible and follow-up with a backpack pump behind a beater can be very effective**.**
- Fire fighters should work parallel to the fire line (less water wasted).

2.12.3.2 Helicopter Transport

One difficulty in fighting forest fires is transporting the fire-fighters to the fire. Unfortunately, forest fires occur in rather rugged terrain, so fire fighters have to be transported in by air and then walk with their equipment overland (Teie, 2005). Hence, it is wise for the fire manager to ensure that the aircraft has radio communication with ground crews and with head quarters (Heikkila et al, 1993).

Mentioned below are the ten golden rules that need to be followed during suppression:

- Keep informed of fire weather conditions and forecasts
- Know what the veldfire is doing at all times
- Base all actions on the current and the expected veldfire behaviour
- Plan your escape routes and make them known to everyone on the ground and in the air.
- Post a lookout for danger and safety aspects.
- Be alert, keep calm, think clearly, make clear decisions and act decisively
- Maintain good communications with the fire boss, crew leaders and fire fighters under your control
- Give clear instructions and have them repeated to ensure that they are understood
- Maintain control of your men and fire fighting operations
- Fight veldfire aggressively but put the safety of your fire fighter first.

Information extracted from (Forsyth & Bridgett, 2004)

2.13. Command structure

Incident Command System (ICS) is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries (US Forest Service, 1998). In addition, the ICS is flexible and can be used for incidents of any type, scope, and complexity (Thompson, 2000). In the early 1970s, ICS was developed to manage rapidly moving wildfires and to address the following problems:

- Too many people reporting to one supervisor;
- Different emergency response organizational structures;
- Lack of reliable incident information;
- Inadequate and incompatible communications;
- Lack of structure for coordinated planning among agencies;
- Unclear lines of authority;

- Terminology differences among agencies; and unclear or unspecified incident objectives.

The above information is extracted from United State National Response Team.

ICS is used by all levels of government: Federal, State, tribal, and local as well as by many non-governmental organizations and the private sector (FEMA, 2000). Hence, the ICS is also applicable across disciplines. It is typically structured to facilitate activities in five major functional areas: Command, Operations, Planning, Logistics, and Finance/Administration. All of the functional areas may or may not be used based on the incident needs. Below (figure 16) is the ICS structure indicating the five major management activities:

As a system, ICS is extremely useful; not only does it provide an organizational structure for incident management, but it also guides the process for planning, building, and adapting that structure. Using ICS for every incident or planned event helps hone and maintain skills needed for the large-scale incidents.

Figure 16: Incident Command Structure

Source: Teie, 2005

2.13.1. Summary of the function of each aspect

The **Incident Commander** is the person in charge of and responsible for the management of the incident. She is designed to develop, direct and maintain a viable organization and to keep that organization coordinated with other agencies, elected officials and the public (Teie, 2005).

The information officer's role is to develop and release information about the incident to the news media, to incident personnel, to other appropriate agencies and organizations. Only one information officer will be named to an incident this will cut down on confusion and conflicting information (Teie, 2005).

The safety Officer's role is to develop and recommend measures to the IC for assuring personnel health and safety and to assess or anticipate hazardous and unsafe situations. The assigned person ensures that safety is not being compromised (Teie, 2005).

The liaison officer's role is to serve as the point of contact for assisting and coordinating activities between the IC and various agencies and groups. This may include local government officials, working on fire personnel and investigators arriving on the scene. Other agencies or jurisdictions will often send resources to assist at an incident (Teie, 2005). Although, the liaison officer does not direct the operations of these other agencies, she serves as liaison between the Incident Commander and various Agency Representatives.

2.13.2. Operation

Operations staff is responsible for all operations directly applicable to the primary mission of the response. It is also seen as a "doer" in the organization, where the real work of incident control is accomplished. This person is responsible for the implementation of the incident's action plan (Teie, 2005).

2.13.3. Planning staff

Planning staff is in charge of collecting, evaluating and disseminating the tactical information related to the incident, and for preparing and documenting Incident Action Plans (IAPs). The primary function of this section is to develop the Incident Action Plan for each operational period, keep track of the status of all assigned resources, and track the fire (Teie, 2005). Another most important function of the planning section is to anticipate potential problems and events that may come up beyond the current operational period (US Forest Service, 1998).

2.13.4. Logistics Staff

Logistics staff is responsible for providing all of the personnel, equipment, and services required to manage the incident. For example, providing a chopper for the extinguishing of fires (Teie, 2005).

2.13.5. Finance and Administrative staff

Finance and Administrative staff is responsible for all financial, administrative and cost analysis aspects of the incident (Teie, 2005). For example, keeping disaster relief records to assure that cost and damage records are prepared in proper format to assure reimbursement of private and public costs.

2.13.6. Components of Incident Command System

a. Common Terminology:

ICS establishes common terminology that allows everyone to speak the same language. Thus, major functions are pre-designated and named, and the various organizational elements are standardized and consistent (Teie, 2005). Fire- fighting resources and facilities are also defined.

b. Modular Organization:

A modular fashion is based on the size and complexity of the incident, as well as the specific hazard environment created by the incident (Teie, 2005). Responsibility for the establishment and expansion of the ICS modular organization rests with the Incident Commander, who bases these aspects on the requirements of the situation. There must be one communication plan for the incident. The plan outlines the use of various radio networks, and may include a command net, several tactical nets, a support net, air-to- ground net and air tactics net (Teie, 2005).

c. Unified Command Structure:

Most disasters involve several jurisdictions. Unified command allows agencies with different legal, geographic and functional authorities and responsibilities to work together effectively without affecting individual agency authority, responsibility or accountability. It also ensures that there is one operational plan and integrated tactical operations are conducted, making maximum use of fire-fighting resources (Teie, 2005). The unified command structure is implemented under the direction of one individual, the operations section Chief.

d. Consolidated Action Plan:

The incident action plan establishes the objectives and strategies that will be used to control the emergency. It covers all tactical and support activities for the incident (Teie, 2005).

e. Span of Control:

It is a key to effective and efficient incident management. The span of control of any individual with incident management supervisory responsibility should range from three to seven subordinates. Thus, the type of incident, nature of the task, hazards and safety factors and distances between personnel and resources all influence span of control considerations'.

f. Designated Incident Facilities:

ICS designates several facilities that may be needed to manage the incident.

-*Command Post*: location from where the incident is managed

-*Incident Base:* location where most of the support activities are performed-

Camps: sites where fire-fighting resources may be fed, housed or packed

-*Staging Areas*: temporary parking areas or storage areas used by the operations section area to hold resources

-*Helibases:* helicopters are operated and supported from Helibases

-*Helipots*: landing sites for helicopters

g. Fire- fighting Resource Management:

Resources are categorized as single resources, task forces or strike teams (Teie, 2005). A single resource is a fire tender, bulldozer unit, hand crew, etc. A task force is a combination of resources grouped together to accomplish a specific given task (Teie, 2005). A strike team is a set number and type of resources. Accurate status of all the resources assigned to an incident is critical. There are three status conditions: assigned, available, and out of service.

2.14. Best practice for veldfire management

2.14.1 Australia

In most cases forest fires in Australia are caused by lighting and also increase rate of Arson (Godwin & Kobziar, 2006). The risk reduction strategies are quite well developed in Australia. Thus, the interface of education about fire and systems to reduce fire damage (engineering and managing human behaviour) are applied in all Australian states (fire management, 2006). However, Australia uses the CRM (Crew Resource Management) model to improve the coordination and open communication between teams in an effort to reduce the incidence of human error (Wildfire management, 2009). The CRM concept was introduced into Australian fire fighting culture at the crew leader level, and it now forms part of the basic foundations for any Australian fire fighting team (Wildfire management, 2009). CRM principles focus on fostering good teamwork and developing interpersonal skills to optimise the use of crew resources.

Homeowner education programs are a common tool for wildfire management in the Wildland Urban Interface (WUI) regions of the US, Australia and Canada. WUI is defined as an area "*where humans and their development meet or mix with wildland fuels*" (USDA Forest Service).

However, in United States, public relations and education programs have been a critical part of WUI fire management ever since the inception of the US Forest Service suppression campaigns.

Apparently, the WUI program is divided into three main sections in Australia, United States and Canada. These programmes are as follows: Fire wise, Fire smart and Prepare: Stay and Defend or Go Early (USDA Forest Service). Hence, these programs are aimed at communities and homeowners with the common goals of modifying their behaviours and preparing their properties to account for the reality that wildland fires may reach their doorsteps (Fire wise communities, 2007). The main objective of the program is to inform the public about wildfire dangers and suggest actions and tools individuals and communities can use to mitigate risks.

2.14.1.1 Prepare: Stay and Defend or Go Early

The concept of stay and Defend has gained international attention in recent years and has expanded Australia's influence in the field of fire management. This program encourages residents to consider the option of remaining on their property in the event of an approaching wildfire and defending their property from potential ignition.

2.14.1.2 Fire Wise

Fire wise is a non-profit United States federally funded program that advocates for infrastructure-based solutions to fire management problems for communities, homeowners and fire-fighters (Godwin & Kobziar, 2006). It also promotes that homeowners should evacuate if a wildfire threatens the area rather than actively participate in home defence. Communities must carefully consider a number of items including:

- Access and escape roads
- Vegetation removal from within 30 feet of structures
- Fuels reduction in nearby forests
- Water supplies (Should be dedicated for veldfire events)
- Exterior building materials

2.14.1.3. Fire Smart

The Fire smart Program was initiated in the 1990s in Canada and has since grown under the auspices of the non-profit NGO, Partners in Protection (Godwin & Kobziar, 2006). This programme is quite similar to Firewise program but, Fire smart focuses on developing multi-scalar community veldland fire protection plans that range from individual homeowners to communities, and include designs for fuel-breaks to protect entire cities (Godwin & Kobziar, 2006). It also advocates home fire protection methods and fuels management practices that should be completed in advanced of the wildfire season. Once a fire threatens the property, fire smart, like Firewise, instructs homeowners to prepare their homes by limiting interior access to embers and sparks, providing visible tools and water sources for fire fighters and evacuating to safety.

2.14.2. California, USA

California, promotes the use of the prescribed/controlled burning to minimize the amount of flammable material available for a potential veldfire (fire management, 2006). The controlled burns are reportedly to be the most effective treatment for reducing a fire's rate of spread, fire line intensity, flame length, and heat per unit of area (Godwin & Kobziar, 2006). Thus, the communities in the Philippines use fire lines 5 to 10 meters (16 to 33 ft) wide between the forest and their village and patrol these lines during summer months or seasons of dry weather.

2.14.3. Pakistan

In Pakistan, a community-based forest fire fighting system is being established with the assistance of the United Nations development programme (UNDP), which is providing fire fighting training and equipment to communities living in the forest (Global assessment, 2006). Community-Based fire management is an approach based on the inclusion of local communities in the proper application of fire, fire prevention, and in preparedness and suppression of wildfires (fire management working paper, 2006). Its approaches can play a significant role in fire management, especially in most parts of the world where human-based ignitions are the primary

source of veldfires that affect livelihood, health and security of people. However, the activities and knowledge that communities generally practise and apply are primarily associated with prevention (Global assessment, 2006). They include planning and supervision of activities, joint action for prescribed fire and fire monitoring and response, applying sanctions, and providing support to individuals to enhance their fire management tasks.

In Sri Lanka forest management plans do not include activities to prevent forest fires. Instead they focus mainly on training programmes for local officers and villagers in fire fighting to develop community involvement programmes such as Joint Forest Management (JFM) programme. South Asia uses community involvement in forest fire management. Nepal is using community involvement and participatory approaches (CBFiM).

In India community involvement is actively promoted through the creation of Joint Forest Management Programme (JFM).

2.14.4. Namibia:

Community involvement in fire management activities

An Integrated Forest Fire Management (IFFM) program was implemented in the north-eastern region (Caprivi) of Namibia in 1995 as part of the Namibian-Finland Forestry Programme (Jurvelius, 2000). The program consists of two parts. The first part of the program used successfully was the public awareness campaign via roadside billboards, local radio bulletins, pamphlets, village meetings and drama presentations. The campaign focused on school children because experience has shown that they are very successful in transmitting fire awareness to their parents and other members of the community (Global Forest Fire Assessment, 2000). The powerful extension tool used, for instance, is the fire-related open-air drama presented at schools and in rural communities by the Caprivi Theatre group. These plays met with an enthusiastic response because of the professionalism of the actors and participation by the school children. However, the second part of the programme was the construction of firebreaks in the different rural communities (Jurvelius, 2000). This involved constructing 10 to 15 meter wide cutline (two cleared strips with a burnt central portion) that have a dual role as a means of applying backfires

when controlling wildfires and in the application of controlled burns (Jurvelius, 2000). These programs played a vital role in influencing the behaviour and expanding knowledge of both the community leaders and members, more especially with the necessity for controlling fires and the role firebreaks.

2.14.5. Mexico

In Mexico fire prevention and control are a Federal responsibility and take place through the Secretary of Environment, Natural Resources, and Fisheries (SEMARNAP). SEMARNAP has 32 state delegations distributed throughout the country with personnel, crews, equipment, and infrastructures (Global Forest Fire Assessment, 2000). Thus, SEMARNAP has about 2000 fire fighters, more than 200 vehicles, about 800 radios and the tools and equipment necessary for fire control. Thirteen type of II helicopters are rented each year on the average (Global Forest Fire Assessment, 2000). In most cases, SEMARNAP receives the support from the military, other federal agencies, states governments and volunteers.

Fire prevention programmes are designed to educate the community and also inform people about the dangers of fires. TV, radio, posters, booklets, flyers, and press conferences are used to communicate and disseminate fire prevention message to the public (Global Forest Fire Assessment, 2000). Hence, the firebreaks and prescribed burns are also used to help limit the spread of fire and reduce the fuel hazard.

2.15. Conclusion

The veldfires situation has gone worst during the past 10 years in South Africa**,** meaning the current veld and forest Act and other relative legislative frameworks on fire control and management must be effectively enforced compliance and promote the use of prescribed burning and minimise breakaway fires. It is believed that South Africa has done a great job by adopting the use of National Veld and Forest Fire Act which provides systems to predict and prevent uncontrolled fires and most of all is to manage fire in general. Hence, the same Act also encourages landowners and communities to accept the responsibility of managing fires in their

areas. The NVFF Act is also in line with the Disaster Management Act 57 of 2002, which promotes the development and implementation of prevention and mitigation measures for all identified hazards. However, the management of veldfire is facilitated through the establishment of the Fire Protection Association as promulgated by the National veld and forest fire Act 101 of 1998. The duties of FPAs include the development and implementation of veldfire management strategies as well as the communication of fire danger ratings (NVFF, 1998).

Different views from different authors have proved that the best veldfire management plan is the one that comprises the fire prevention programmes which are designed to inform and communicate with the public about preventing the spread and impact of veldfires. Firebreaks and prescribed burns are used to help limit the spread of fire and reduce the fuel hazard. Whereas, the suppression tactics assist the fire fighters in executing the required expected tasks without endangering themselves during the operation it is clear that weather related factors together with topographic components and fuels have a direct effect on fire behaviour. Thus combination of both factors will result in devastating veldfires like the one that occurred in 2007 in Mpumalanga.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

This chapter describes and explains the methodology and research design used when conducting the research study. The chapter also outlines the demographic setting of the area study, population, sample and data collection instrument.

3.2. Research design

Polit and Hungler (1999) define research design as a blueprint, or outline, for conducting the study in such a way that maximum control will be exercised over factors that could interfere with the validity of the research results. The research design works as a systematic plan outlining the study, the researcher`s methods of compilation, details on how the study will arrive at its conclusions and the limitations of the research (Kenneth & Wills, 2010). Research design can be used as the logical structure that ensures that all collected evidence helps eliminate bias when evaluating theories and arriving at conclusion.

This study used Qualitative research and descriptive design methods. Descriptive research seeks to depict what already exists in the organisation and strive to answer the question "what is happening?". The purpose of descriptive research was to observe, describe and keep documents. Questionnaires and observation (personal engagement) was used during data collection. In contrast, the researcher was actively and directly involved when the fire crew from Thaba Chweu municipality prepared their municipal fire season, whereby they did what is called firebreaks or fire block to control and minimise the spread of veldfires.

3.3. Research study area

The research study area refers to the place where the data is collected. In this study, data was collected at Thaba Chweu local municipality (Graskop and Sabie satellite fire department offices).

3.3.1. Location and social amenities

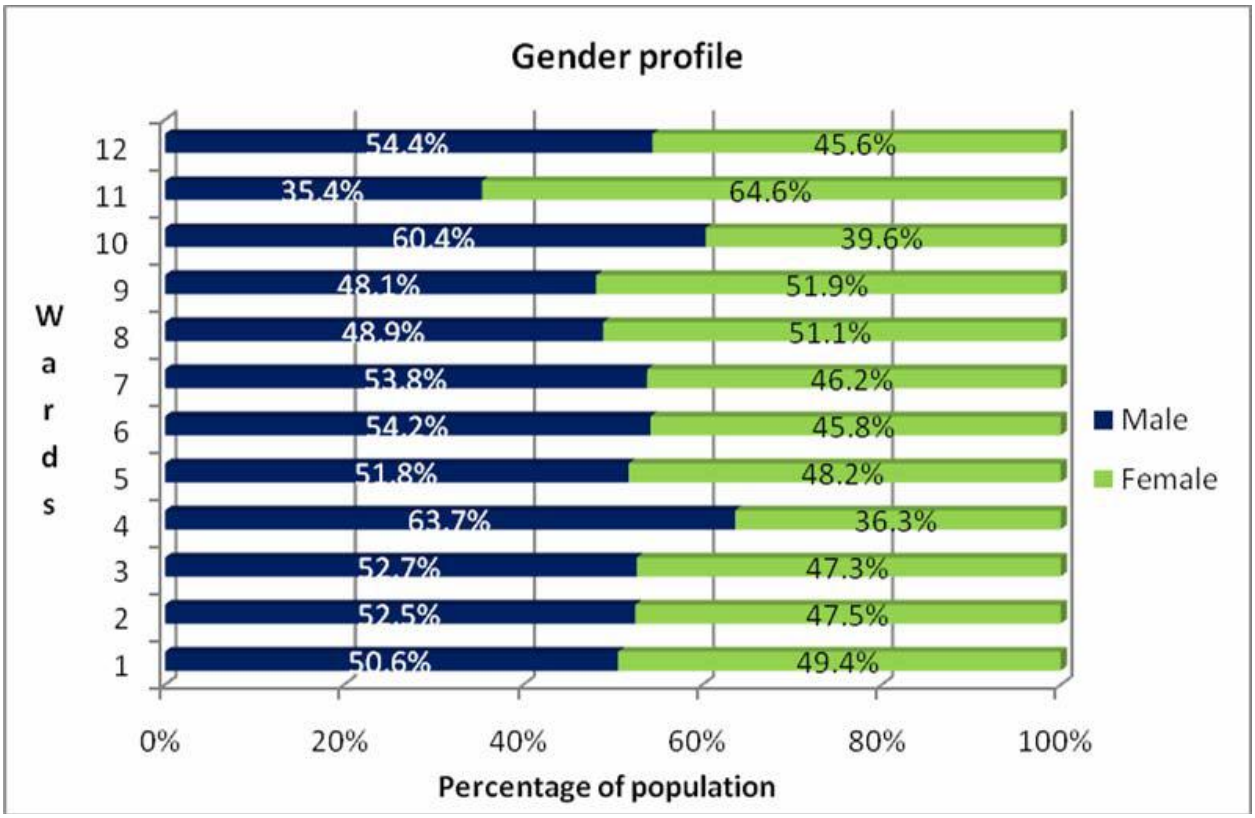
"*Thaba Chweu*" (White Mountain) is a Sotho word that refers to the occasional snow capped peaks of Mauchsberg, Formosa and Mount Anderson, three 2200m high mountain peaks between Sabie and Lydenburg (Wikipedia, 2011). Thaba Chweu Local municipality has a low density in terms of population, but has a high number of natural and forest conservation areas (Thaba Chweu IPD, 2009). The municipal area is situated on the Lowveld escarpment with an average elevation of 1400m above sea level and altitudes varying from 600 to 2100m. The municipality consists of the following towns and settlements: Badfontein, Blyde, Brondal, Buffelsvlei, Goedewil, Graan, Graskop, Hendriksdal, Klein-Sabie, Klipskool, Krogerspos, Leroro, Lydenburg, Maartenshoop, and Marambane, Mauchsberg, pilgrims Rest, Sabie, The berg and Vermon.

3.3.1.1 TCLM population distribution

According to TCLM IDP (2009), the current population of the Thaba Chweu Local Municipality is estimated at 426,475.25 and the projected population for 2012 will approximately be 191,000. According to findings from baseline and backlog survey (2009), the population for TCLM is distributed as follows:

In the majority wards the age groups 18-34 and 35-65 years appears to be dominant, whilst the population older than 65 years is in the minority. Hence, the overall age profile of the municipality shows that 24.7% of the population is younger than 18 years, 35.5% falls between 18 and 34 years, 35.7% is between 35 and 65 years and only 4.1% is older than 65 years of age (TCLM IDP, 2009).The overall municipal profile reflects that there are more males (52.0%) compared to females (48.0%).

Figure 17: Total population of TCLM by Gender



Source: Baseline and Backlog Survey 2009

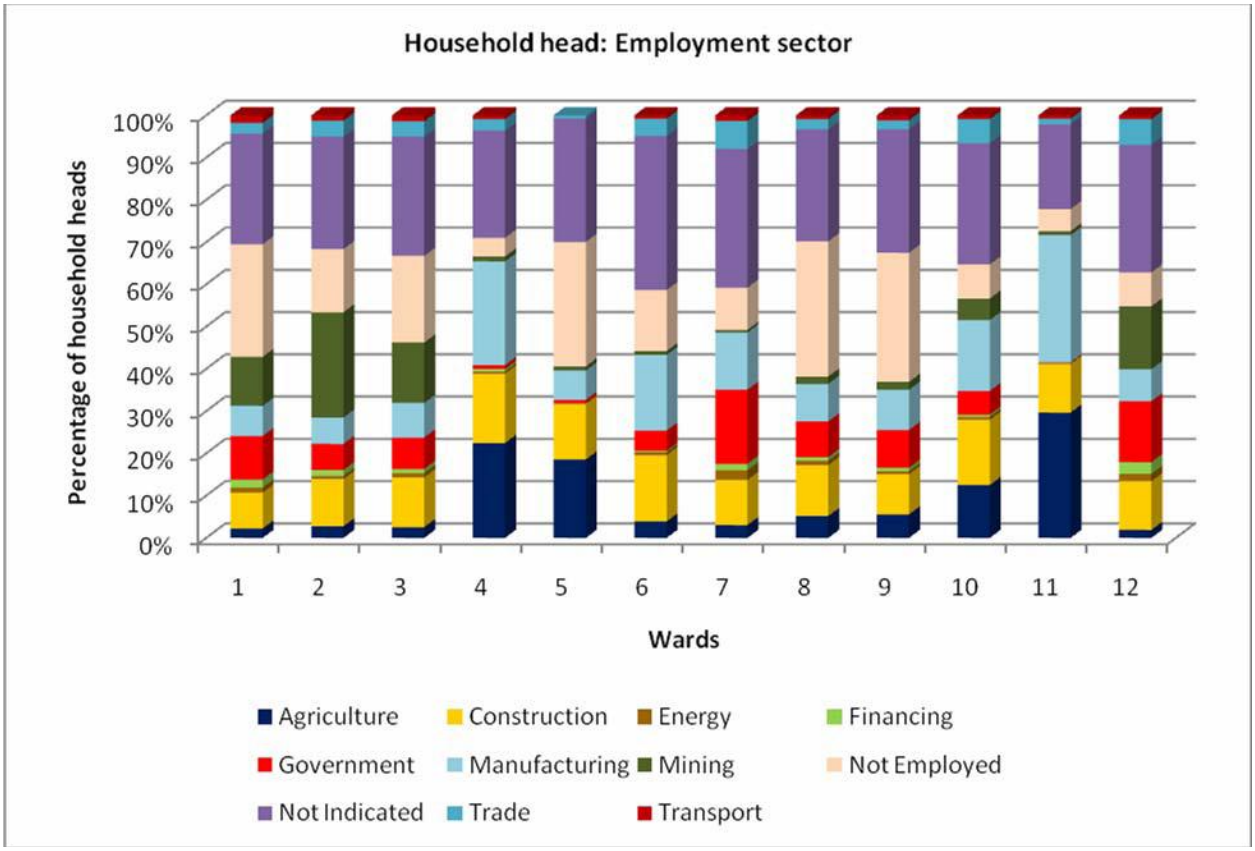
3.3.1.2 Employment Status of TCLM

Recent studies indicate that the unemployment rate in TCLM increased from 15.2% to 16.8% between 2001 and 2005 (TCLM IPD, 2009). The graph also illustrates that in total 49% of households had a monthly income of R1,500 or less, that 34.9% of households earned between R1,501 and R3,500, that 7.4% of households earned between R3,501 and R5,000, whilst only 8.7% of households had a monthly income in excess of R5,000 per month.

The agriculture and forestry sector was the largest employer in the municipality. The TCLM indicates that there was a total increase in employment in 2005 compare to 2001. While the agriculture and forestry sector experienced a decrease in employment other sectors such as mining and quarrying, and wholesale and retail trade saw an increase in employment (TCLM IDP, 2009).

The information shows, therefore, that 16.3% of household's heads was not employed. 14.9% was employed in manufacturing, 12.8% in construction, 10.7% in agriculture, 5.9% in government (public service) and 5.8% in the mining sector.

Figure 18: Household head employment status



Source: Baseline and Backlog Survey 2009

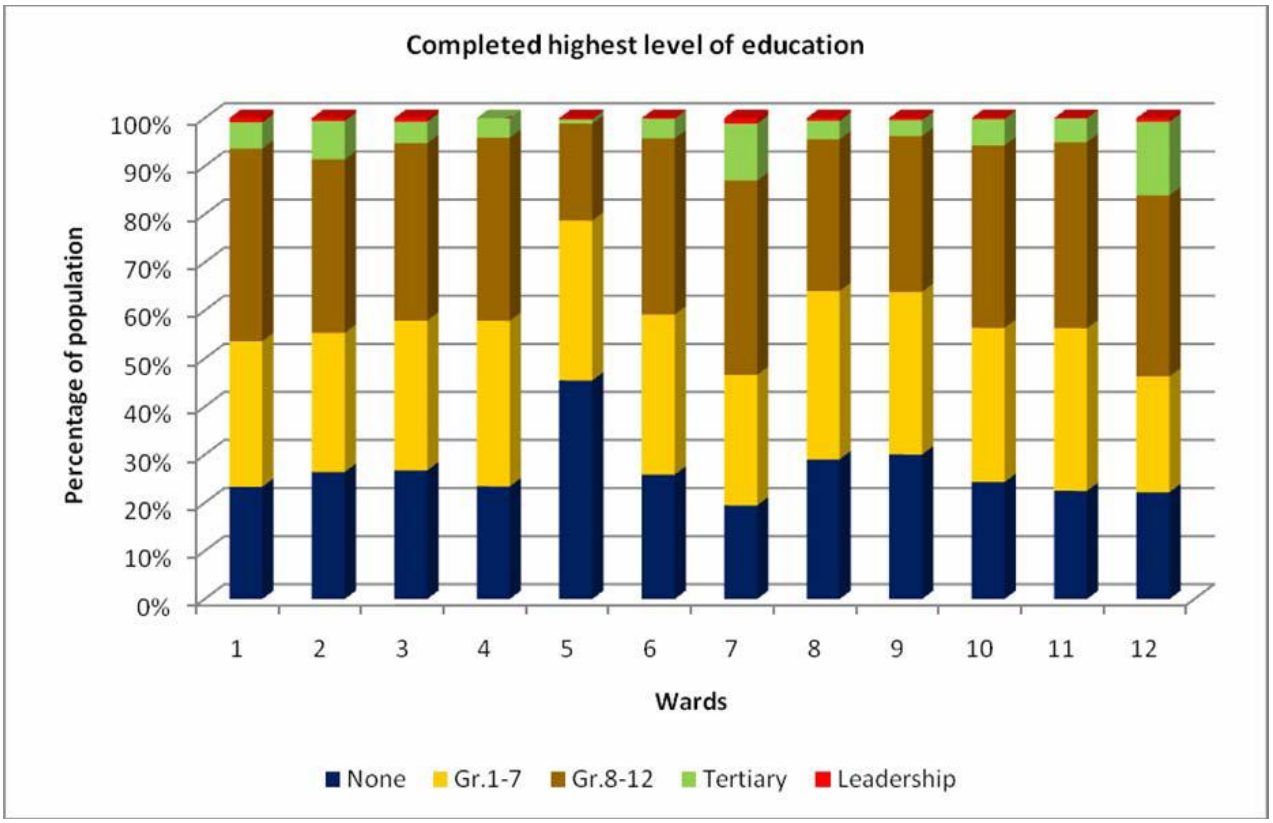
3.3.1.3 Level of Education

It seems 35.3% of the population completed Grade 12 (secondary schooling) as their highest level of education, 32.4% completed Grade 7 (primary schooling) and 5.1% completed tertiary education. More than a quarter of the population (26.8%) did not complete Grade 7 and thus have not completed any formal educational qualification.

3.4. Sample

Non-probability sampling represents a valuable group of sampling techniques that can be used in research that follows a qualitative, mixed methods, and even quantitative research design (Strydom, Fouche & Delport, 2005). It requires researchers to use their subjective judgements, drawing on theory (i.e. the academic literature) and practice (i.e. the experience of the researcher and the evolutionary nature of the research process. Non-probability sampling was used in the study, because it is much easier, quicker and cheaper when compared with probability sampling. The researcher chose purposive, also known as judgement sampling technique. The reason was that this municipality was one of the municipalities that experienced the worst veldfire of 2007 in Mpumalanga. Access to the municipality was gained through the use of formal letter requesting permission from the Chief fire officer to conduct the research study. The consent letter included the questionnaires that would be distributed to fellow fire fighters.

Figure 19: Highest level of education



Source: Baseline and Backlog Survey 2009.

3.5 Data collection

Struwig & Stead (2010) define data as information, such as pictures, words, and numbers that is gathered according to certain scientifically accepted procedures. Thus, in this study a set of structured questionnaires was used to collect data and it included both primary and secondary data collection. Primary data was collected in the form of questionnaires which were distributed to all 50 fire fighters on duty on the 21, 22 and 23 of June 2011. Whilst secondary data was collected in the form of obtaining the existing records of all veldfires that occurred from 2000-2011, Komatiland Company did assist in gathering the required data. A Camera was utilised to capture all motion picture performed .The researcher worked together with the fire crew and observed how they created firebreaks/prescribed burning for the preparations of the upcoming fire season. The researcher was assisted by a volunteer from the family to hand out the questionnaires during the operation days.

3.6 Data analysis

All completed questionnaires were captured and coded using the rating scale of one to five. A computer was used for capturing and coding of all completed questions. Thereafter, questions were analysed and interpreted using graphs.

3.7 Conclusion

The chapter covers the research methodology of the study by indicating all activities and research design used. These include the study area, population, instruments used when collecting data, type of sampling used, education level together with the employment status of the population. The next chapter will cover the data analysis.

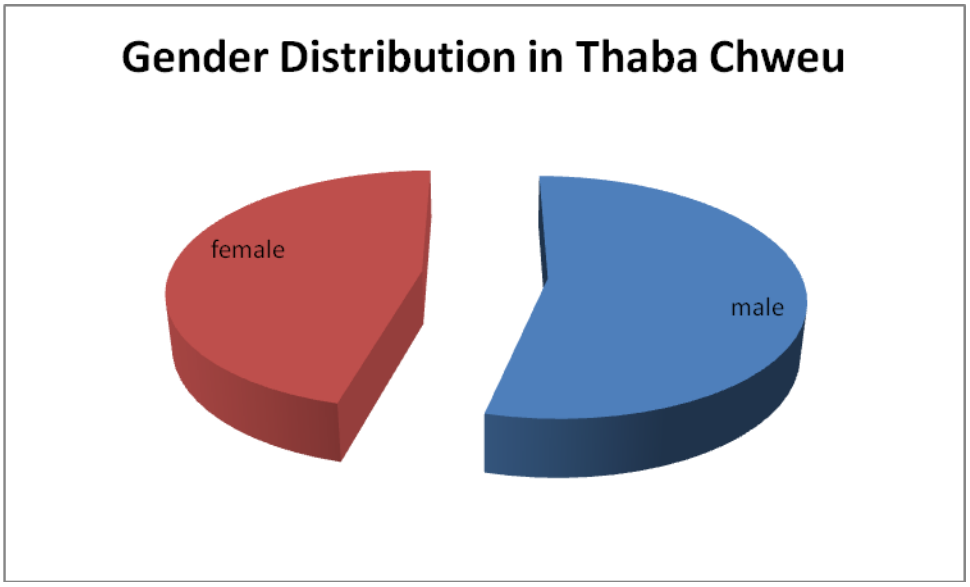
CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATIONS

4.1. Introduction

This chapter focuses on data analysis whereby graphs were used to analyse and interpret all questionnaires answered when collecting data.

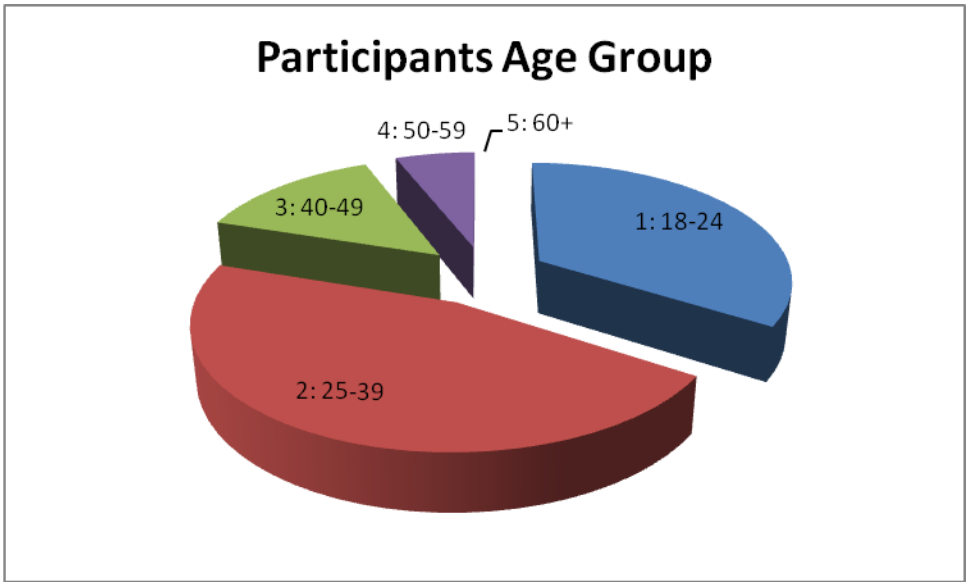
4.2. Personal profile

Graph 1: Gender Distribution



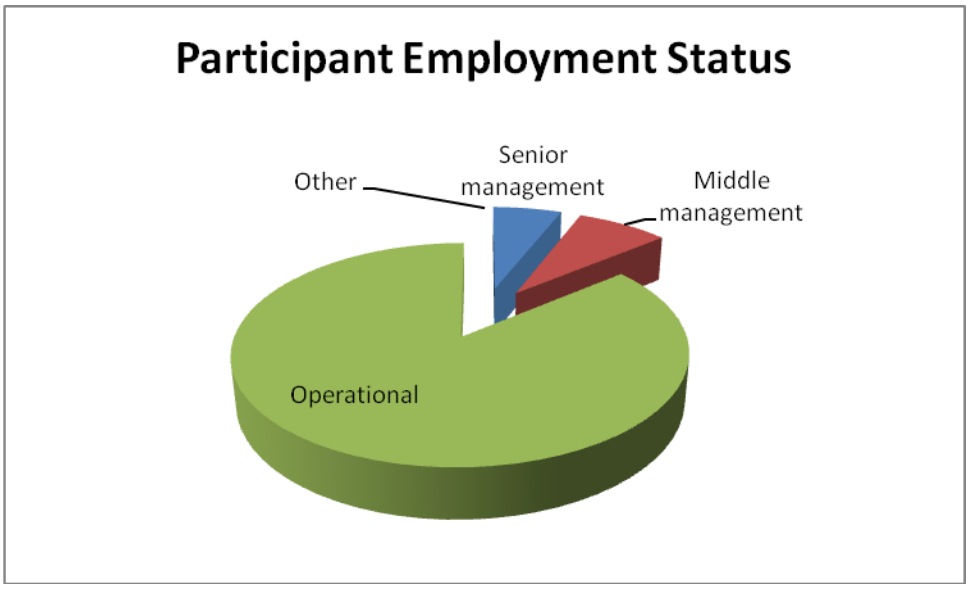
Out of a total number of 50 participants who were involved in this research, 54% were male and 46% were female.

Graph 2: Participants Age Group



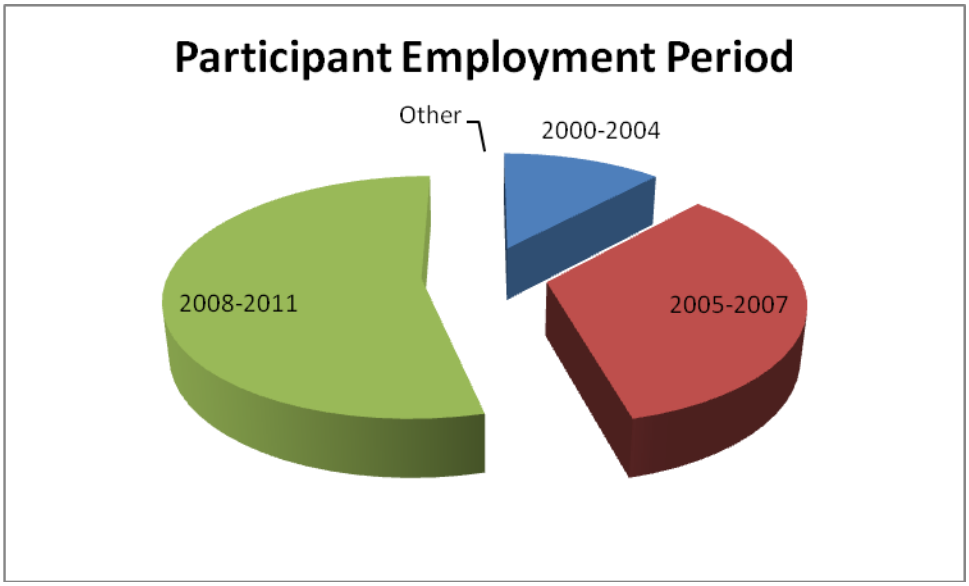
Graph 2 reflects that out of 50 respondants who participated in the study, 46% fell in the 25-39 age group. 34% of participants are between the 18-24 age group. 14% is between 40-49 age group. 6% 50-59 age group. There were no participants from the age of 60 and above.

Graph 3: Paricipant Employment Status



According to Graph 3, 86% of the participants are on the operational level which is the level of fire fighters. 8% of participants are in middle management which is the level of team leader. 6% of participants are from senior positions.

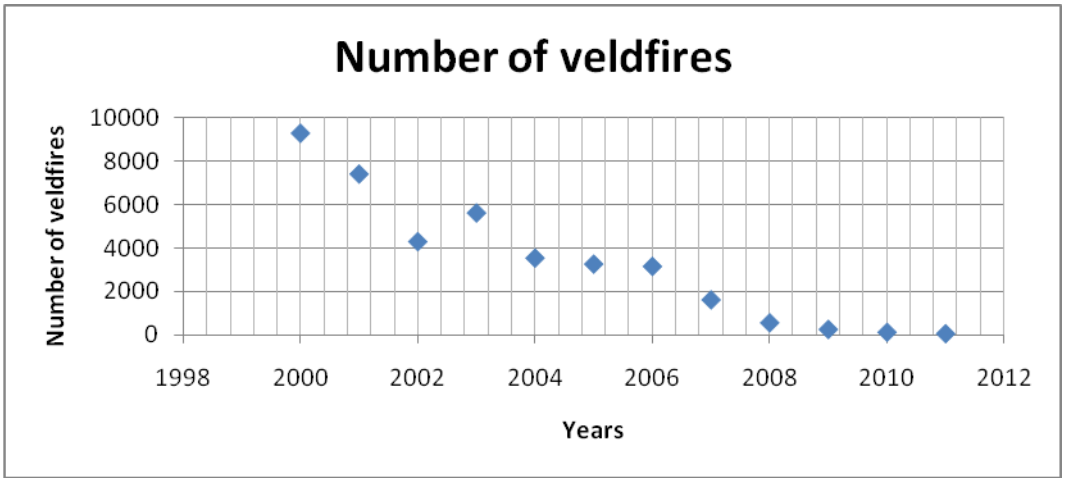
Graph 4: Participant Employment Period



Graph 4, reflects that 54% of participants joined the organiation between 2008-2011. 34% of participants joined between 2005-2007. 12% were between 2000-2004. Based on the above figures most of the fire fighters were employed after the 2007 veldfires.

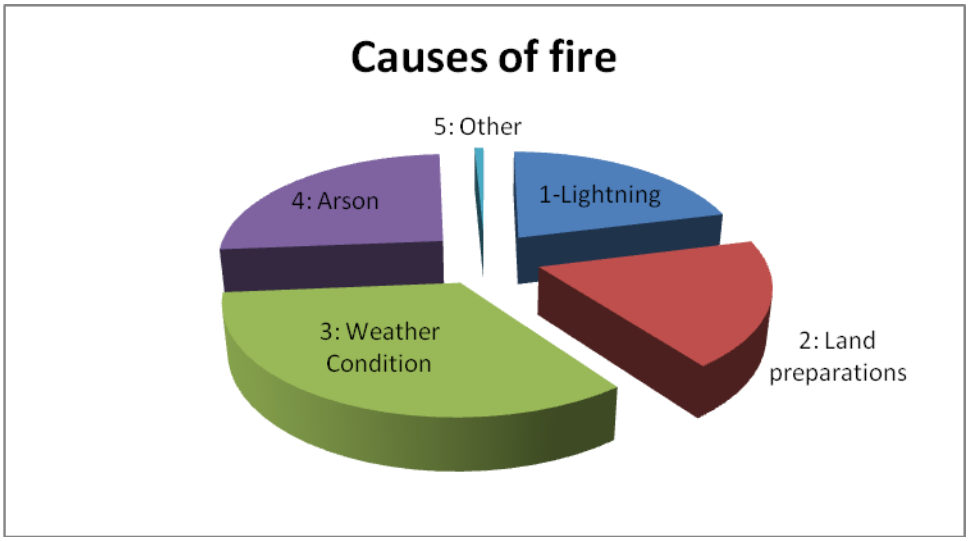
4.3 Historical information on veldfire

Graph 5: Number of veldfire occured



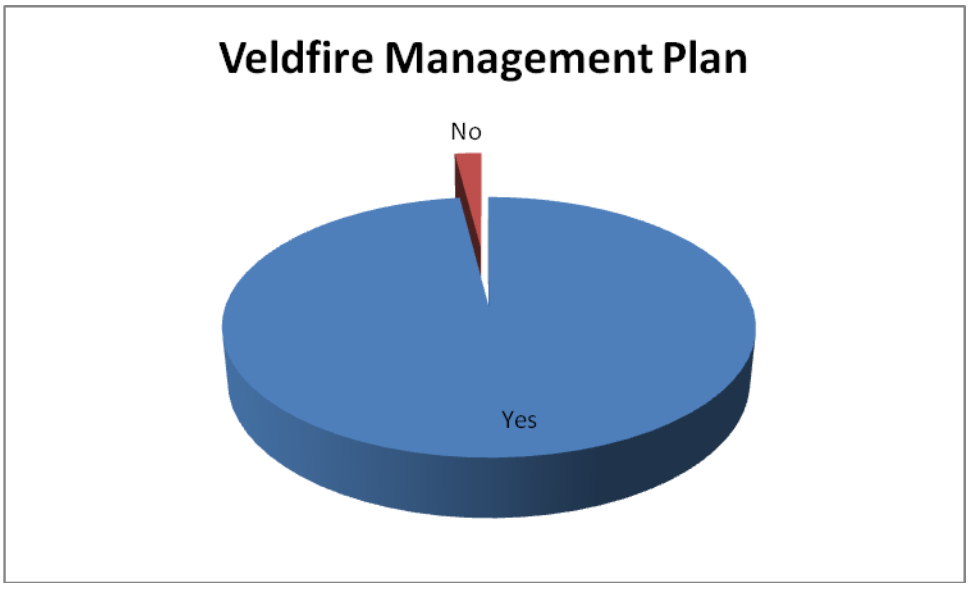
According to graph 5, the number of veldfires were high in 2000 than year 2011. The decrease was after the occurance of veldfire in 2007. this was the case due to the prevention measures implemented after 2007 to monitor and control veldfire.

Graph 6: Causes of fire



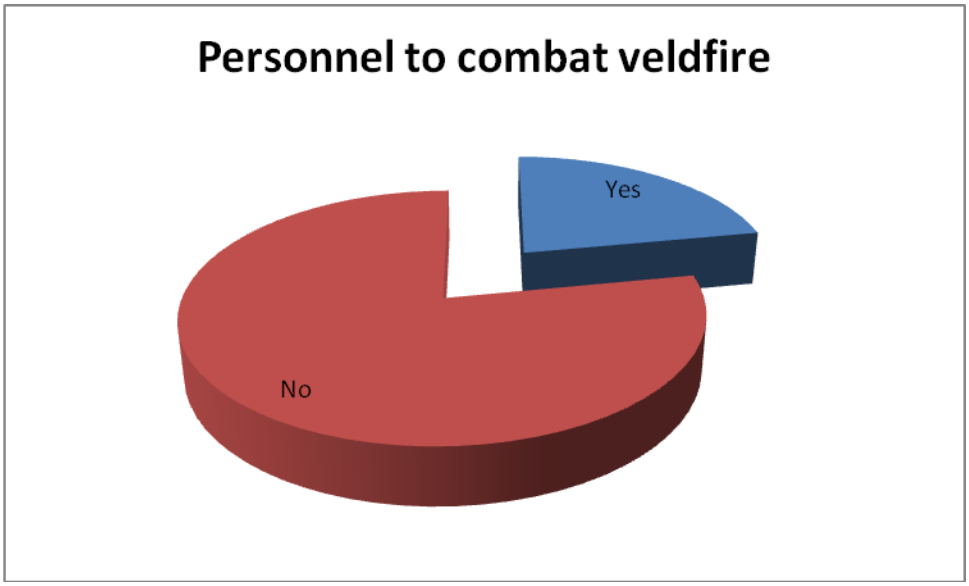
Graph 6, reflects that 34% of veldfires are caused by the weather condition and followed by arson with 25%. The lower percentage of land preparation is an indication that the fire department conduct awareness campaign to the community.

Graph7: Veldfire management plan



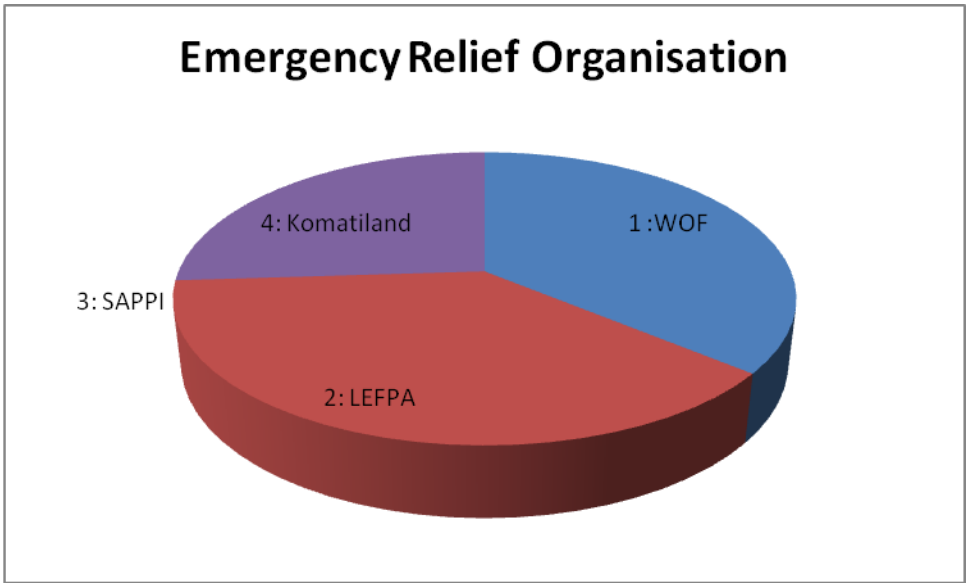
According to graph 7, 98% reflects that the municipality does have formal veldfire management plan in place at the time of veldfire incident, Which of 2% shows not having the plan.

Graph 8 : Personnel to combat veldfire



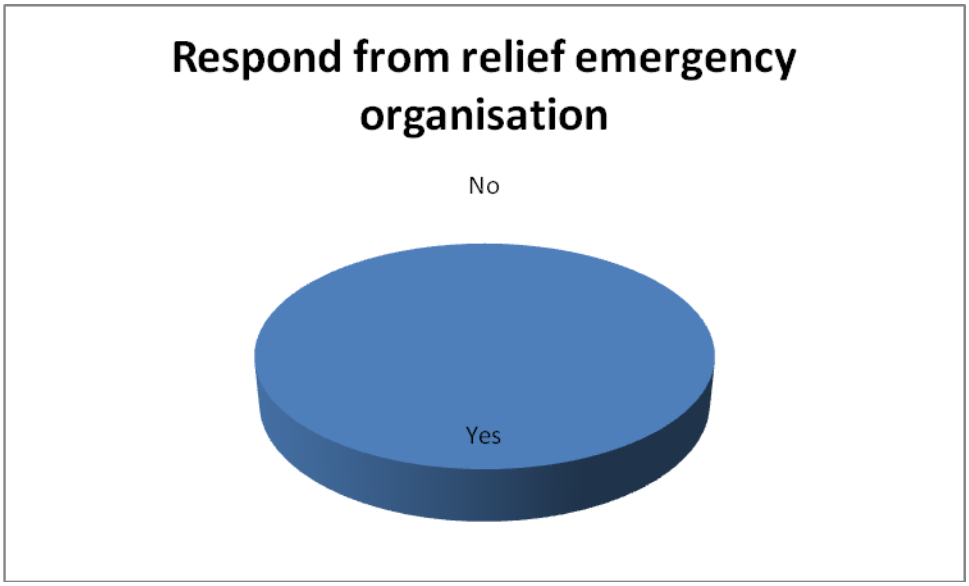
Graph 8, reflects that the organisation does have enough personnel to combat veldfire by 78% and 22% does not see the organisation having enough personnel.

Graph 9: Emergency Relief Organisation



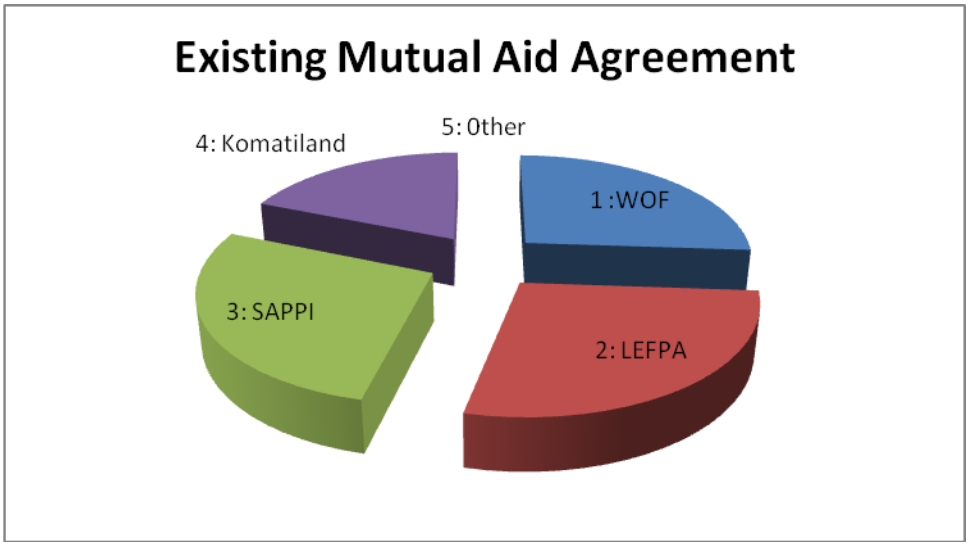
According to Gragh 9, 38% indicate that LEFPA is the organsation to assist the municipality when called for assistance. 36% reflects that WOF was also able to assist. 26% is Komatiland while Sappi reflect 0%.

Graph 10: Respond from relief emergency organisation



Gragh 10, 100% reflect that the requested organisation for assistance during veldfire/ emergency did respond to the call.

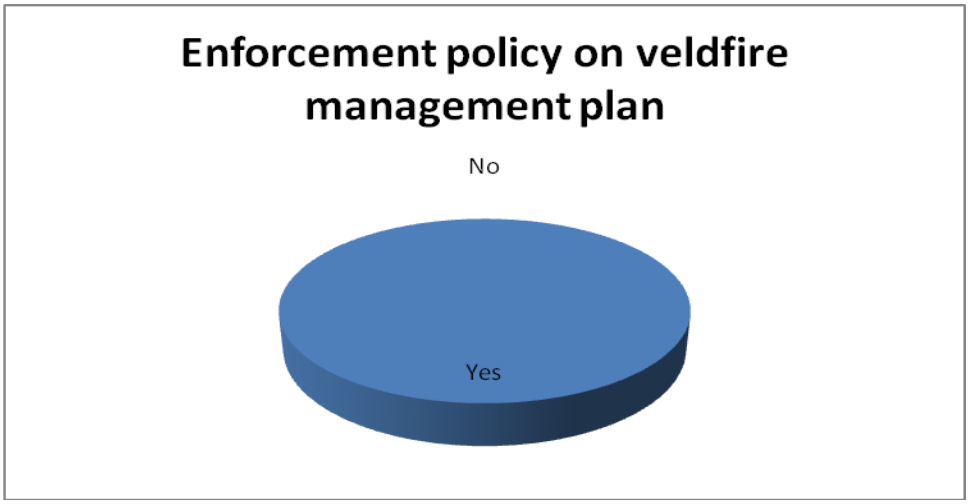
Graph 11: Existing Mutual Aid Agreement



According to graph 11, 43% of participants indicate that TCLM does have mutual aid agreement with LEFPA. 35 % reflects having mutual aid with Komatiland and 22% reflects having agreement with Working on Fire. The graph shows that the municipality does work hand in hand with the existing FPA (LEFPA) in the province.

4.4 Enforcement policy for veldfire management

Graph 12: Enforcement policy on veldfire management plan

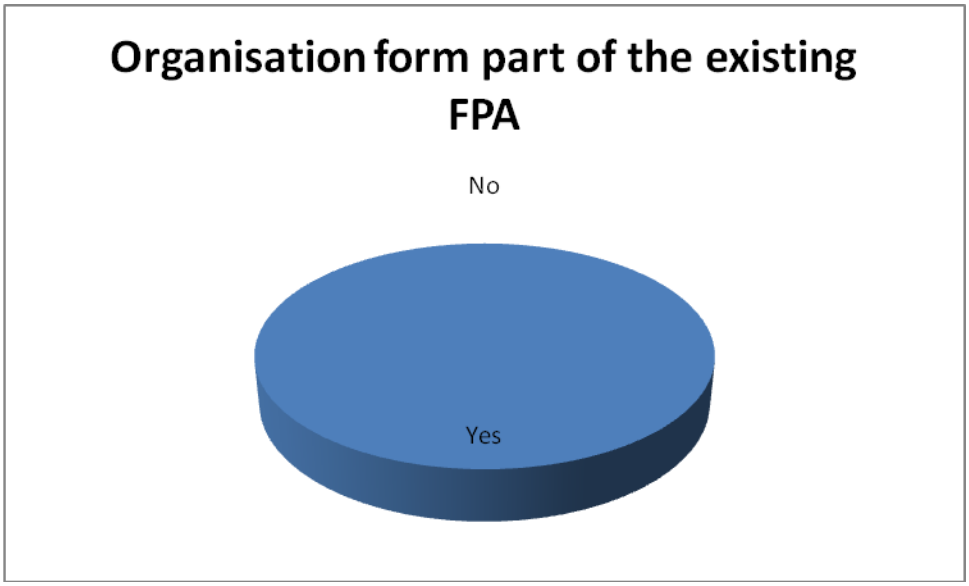


According to graph 12, 100% of participants reflect that the municipality does enforce the policy of veldfire management. That is why there has been less veldfire incidents since the 2007 to date

Question 13

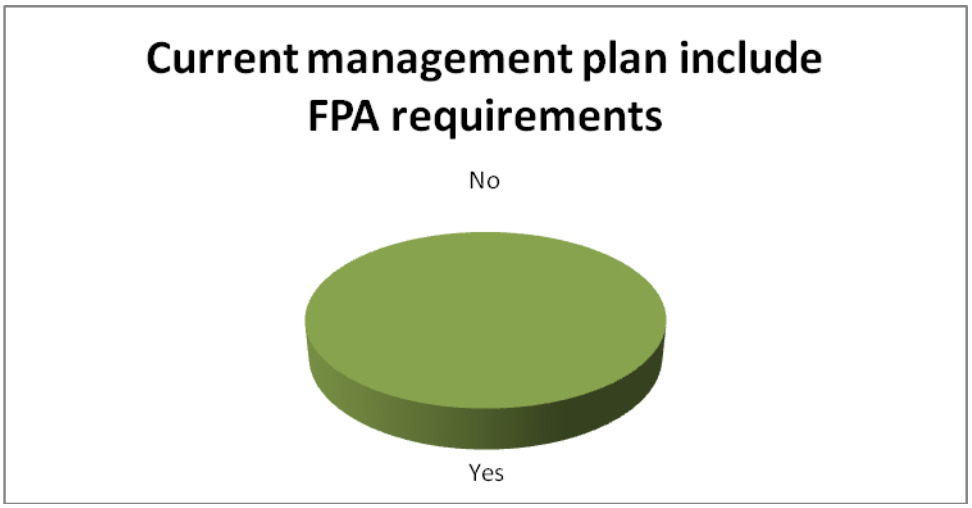
This question was not answered, since most of the participants answered yes on question 12 and hence this question was rendered redundant.

Graph 13: Organisation form part of the existing FPA



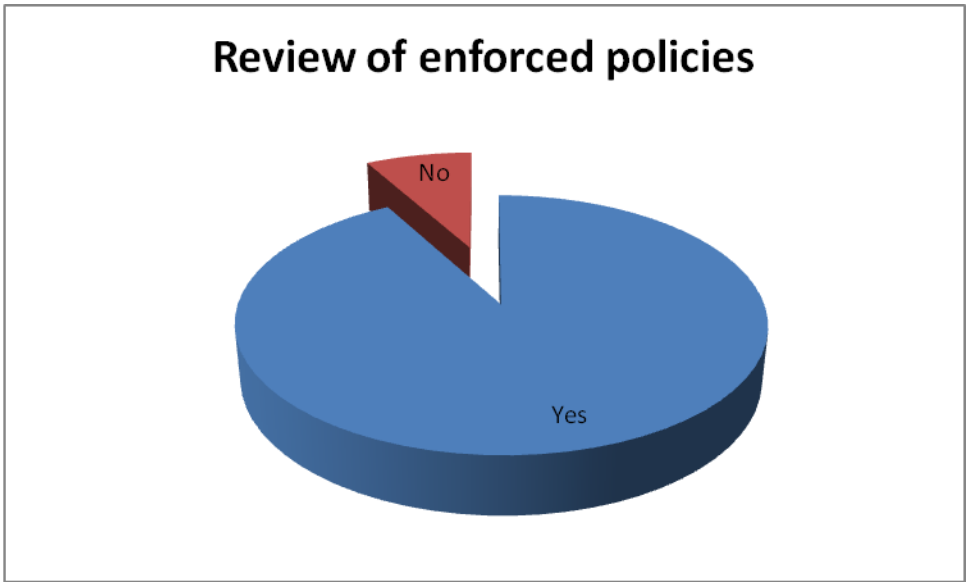
Graph 13, 100% reflects that the municipality is a member of the existing FPA in the province. Lowveld and escarpment fire protection association is the name of the FPA.

Graph 14: Current management plan includes FPA requirements



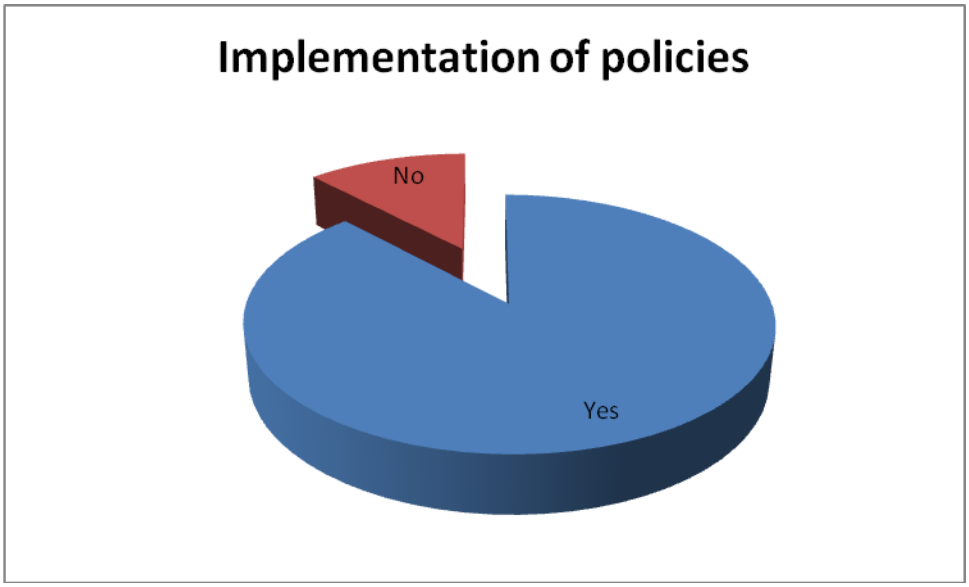
Graph 14, 100% reflects that the veldfire management plan does include the requirement, regulations and functions of FPA.

Graph 15: Review of enforced policies



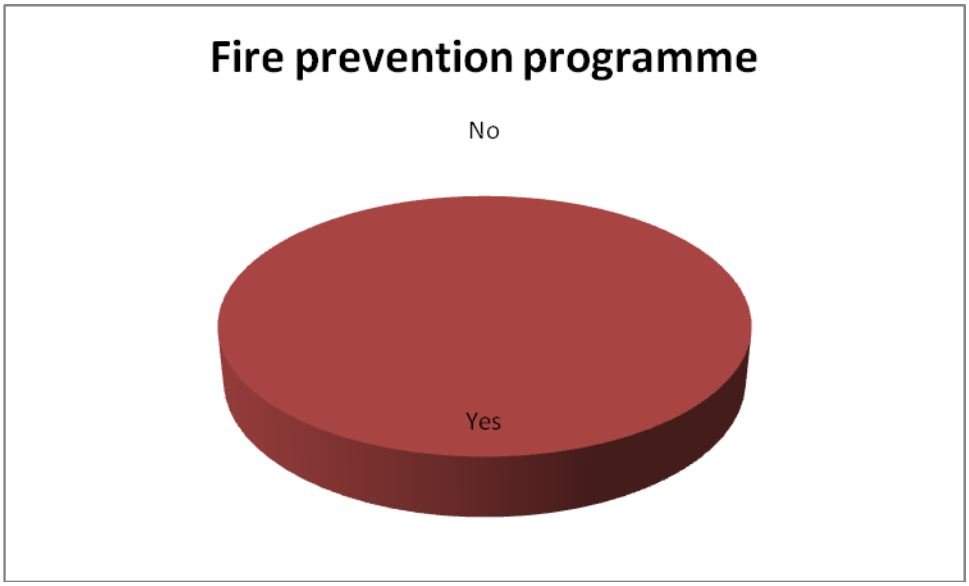
Graph 15, 92% reflects that the municipality does regularly review the enforced policy. 8% reflects that the enforced policies are not regularly reviewed.

Graph 16: Implementation of policies



Graph 16, 88% of participants reflects that the enforced policies are implemented and 12% does not see the municipality implementing these policies.

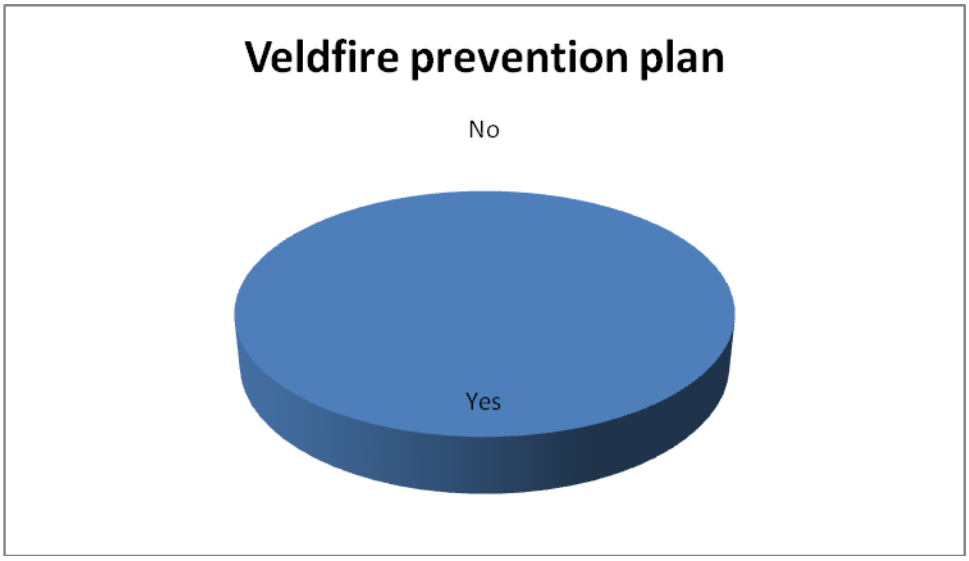
Graph 17: Fire prevention pogramme



Graph 17, 100% reflects that the current veldfire management plan does include the three elements of fire prevention programme.

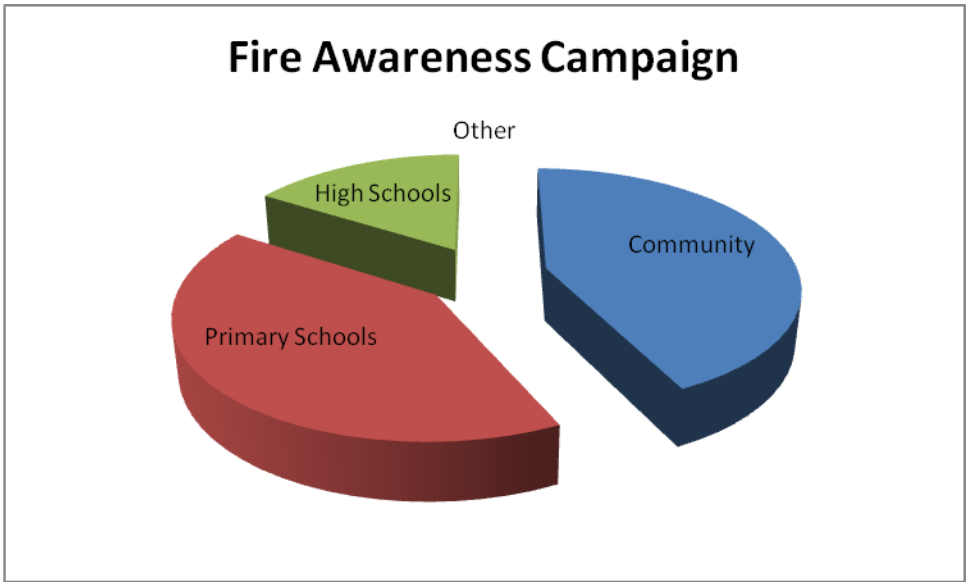
4.5 Fire prevention measures

Graph 18: Veldfire prevention plan



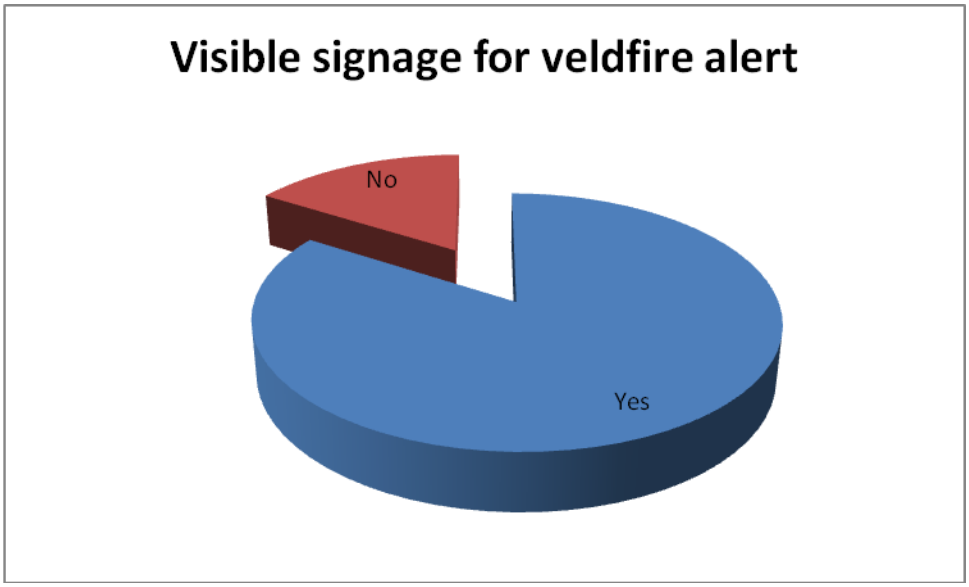
According to graph 18, 100% of the participants agrees to the fact that the municipality does have the fire prevention plan in place.

Graph 19: Fire awareness campaign



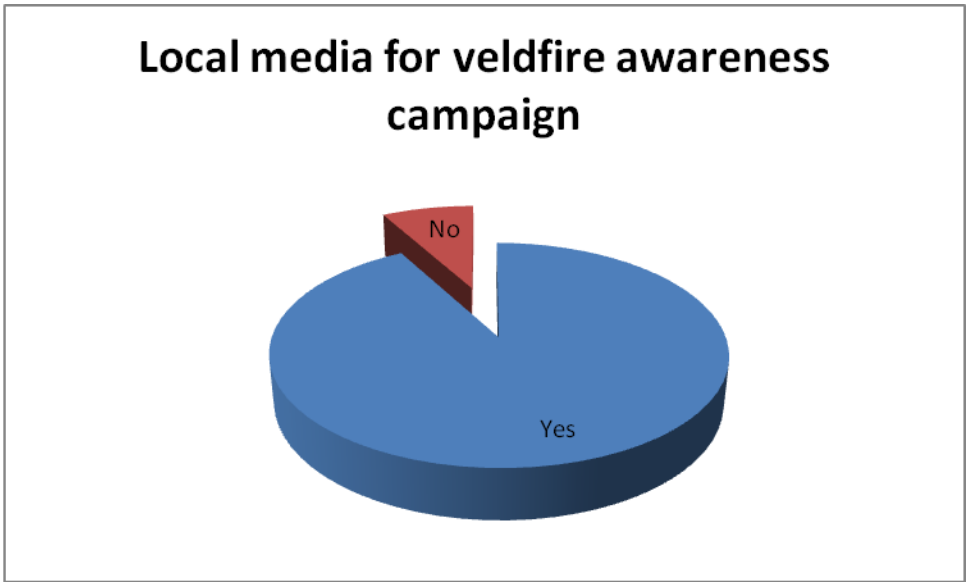
According to graph 19, 43% indicates that fire awareness campaigns are conducted to the community. 41% being conducted at primary schools and 16% in the high schools.

Graph 20: Visible signage for veldfire alert



Graph 20, reflects that 84% of participants does agree that the organisation has visible signage for veldfire alert where as 16% indicates that the organisation does not have visible signage for veldfire alert.

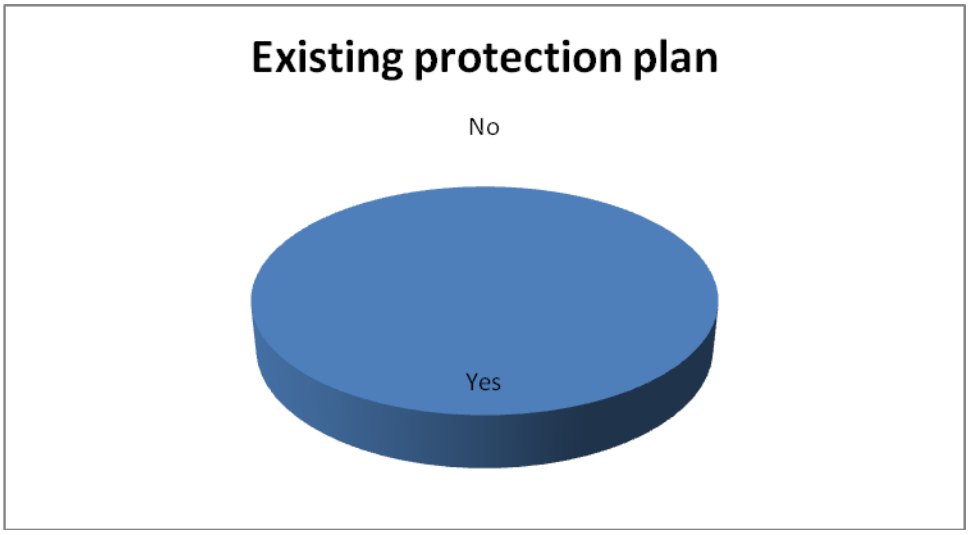
Graph 21: Local media for veldfire awareness campaign



Graph 21, indicates that 92% of the organisation does use local media for the promotion of veldfire awareness campaign. 8% indicates that the organisation does not use local media for veldfire awareness campaign.

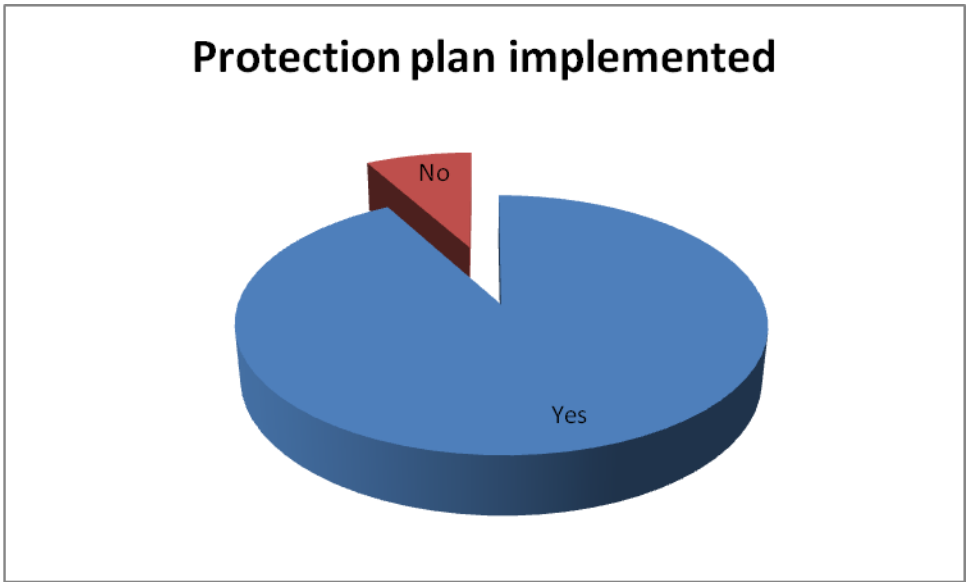
4.6 Fire protection measures

Graph 22: Existing protection plan



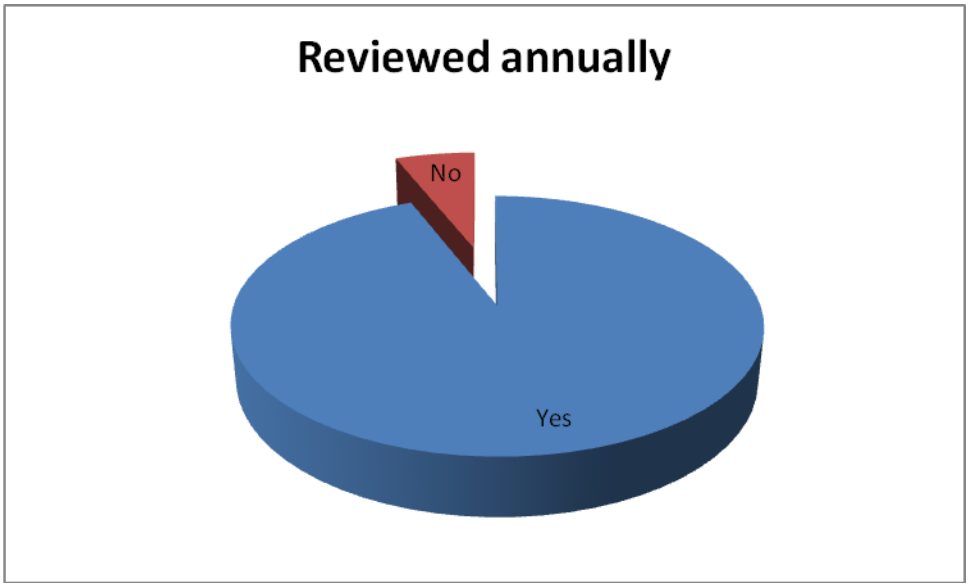
According to the graph 22, 100% of the participants agree that the organisation has existing fire protection plan indicating all necessary protection measures needed.

Graph 23: Protection plan implemented



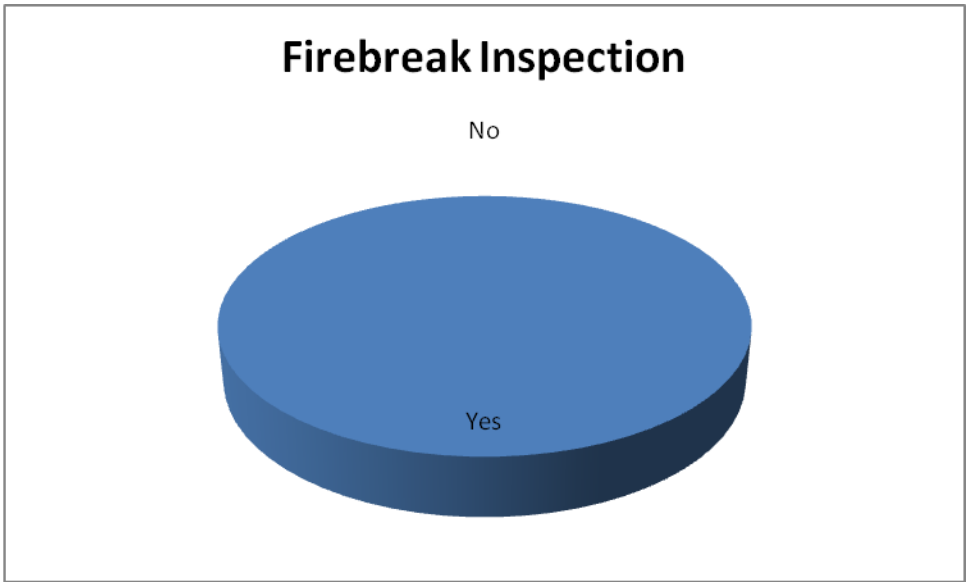
According to graph 23, 92% of the participants indicate the plan to be implemented and 8% protection plan not implemented.

Graph 24: Reviewed annually



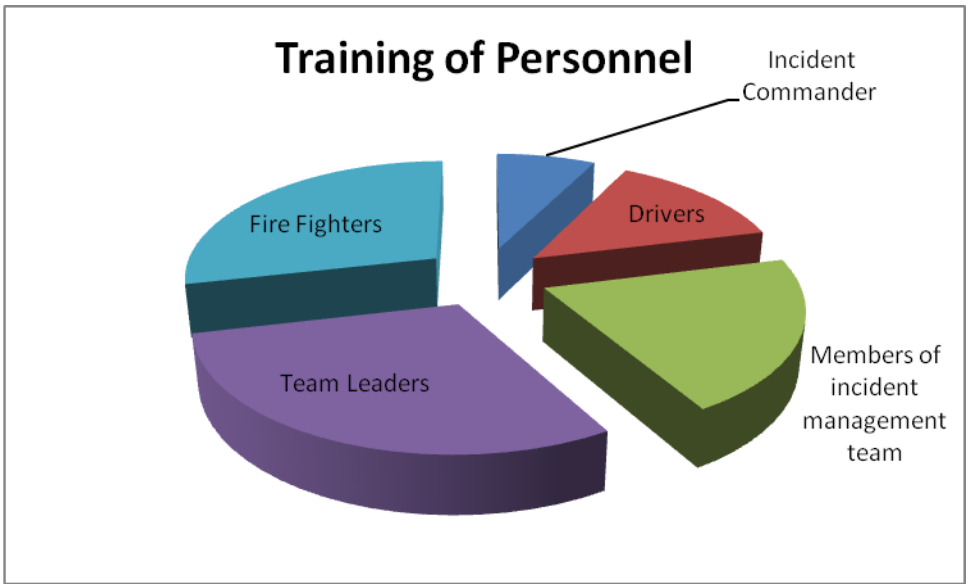
According to graph 24, 94% of the participants represent that the protection plan is reviewed annually. 6% believe that the fire protection plan is not reviewed annually.

Graph 25: Firebreak Inspection



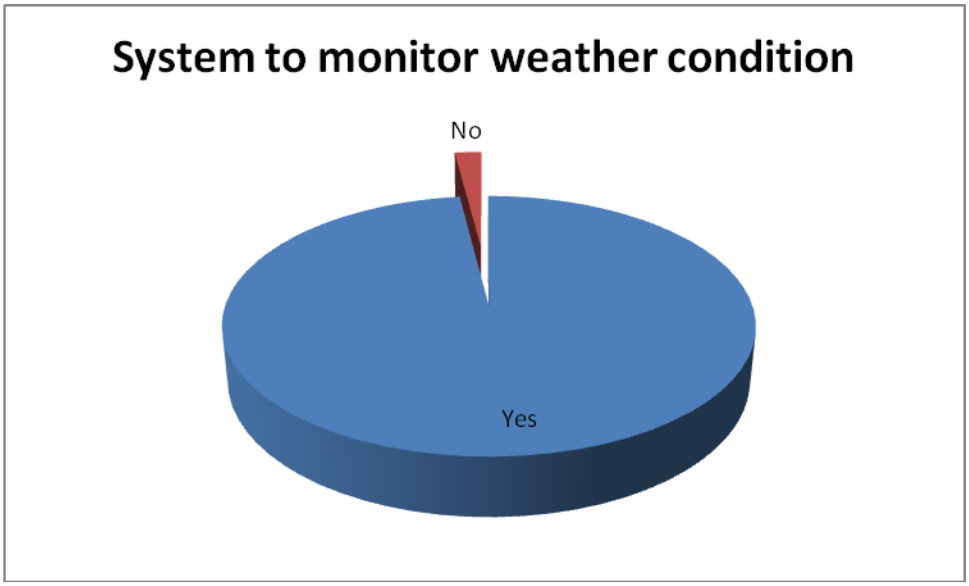
The graph 25, 100% of the participants represent that fire breaks are inspected prior to veldfire season.

Graph 26: Training of Personnel



Graph 26, reflects that 30% of team leaders do receive training. 29% of fire fighters receive training, 20% members of incident management team. 14% drivers does receive training. 7% incident commander also get training.

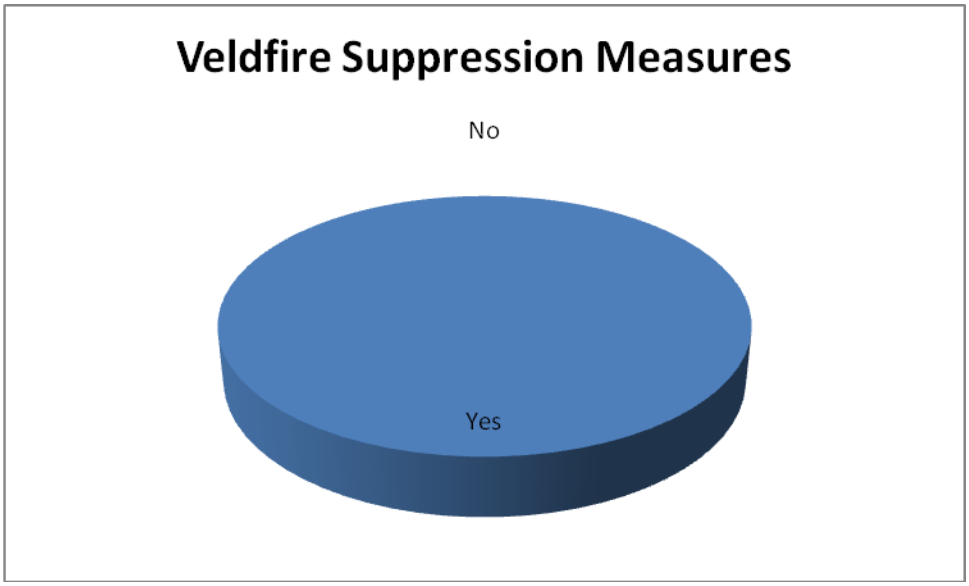
Graph 27: System to monitor weather condition



According to graph 27, 98% of the participants indicate that the municipality does have systems to monitor weather conditions for the purpose of veldfire alert.

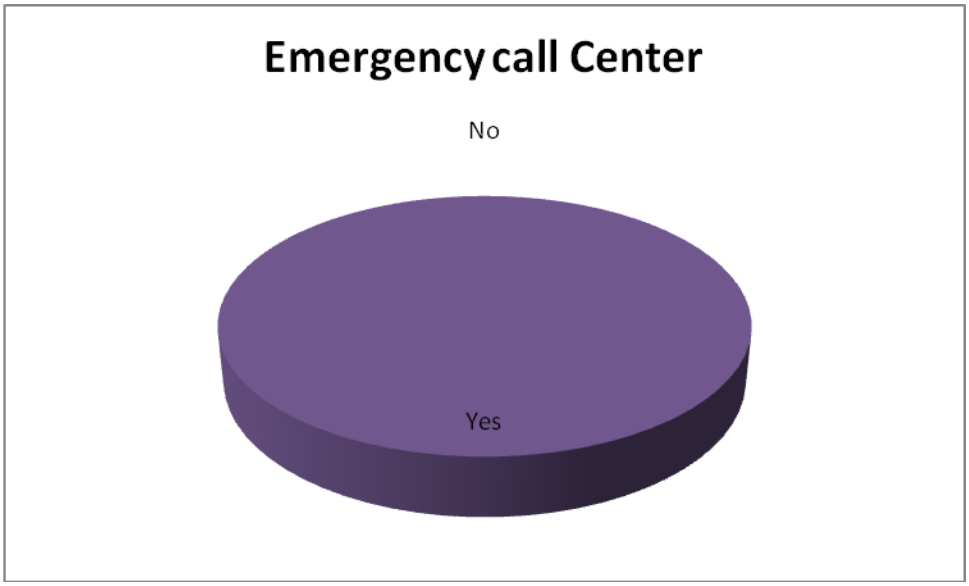
4.7 Fire supression measures

Graph 28: Veldfire Suppression meaasures



According to graph 28, 100% of participants indicate that the municipal veldfire plan does include appropriate fire suppression measures.

Graph 29: Emergency call Center

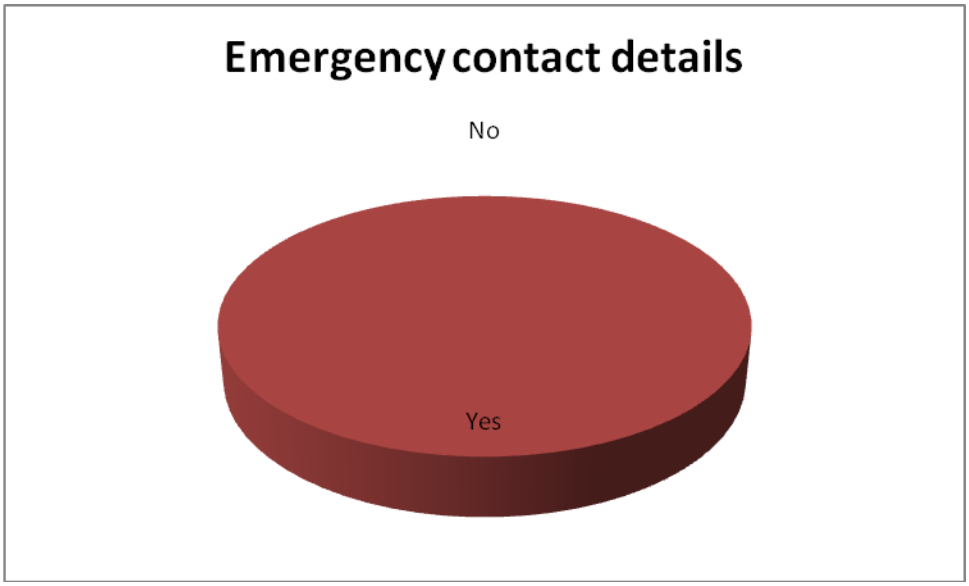


According to graph 29, 100% reflect that the municipality does have a call centre where fire can be reported on a daily bases.

Graph 30: Location of call center

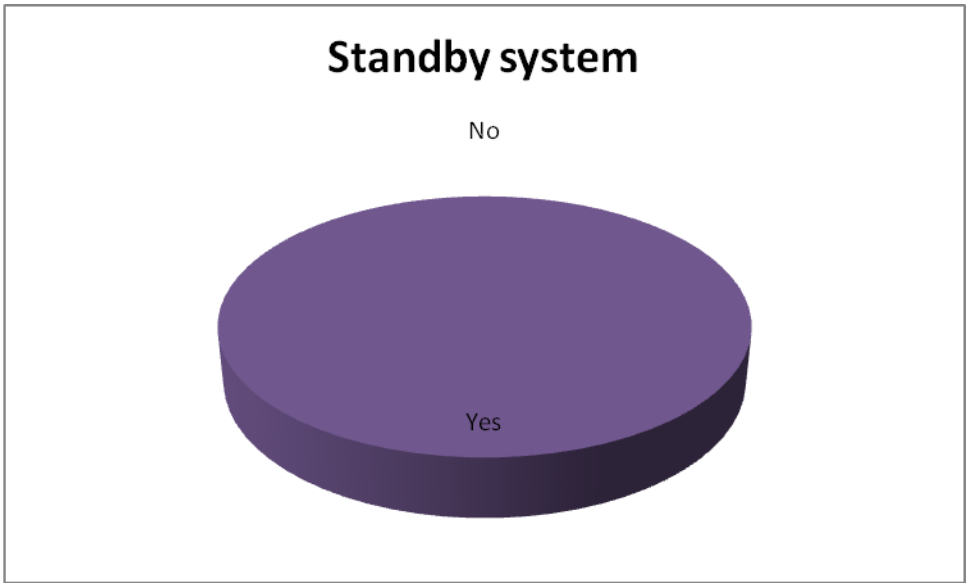
According to graph 30, 100% of the participants reflect that the community knows the location of the center.

Graph 31: Emergency contact details



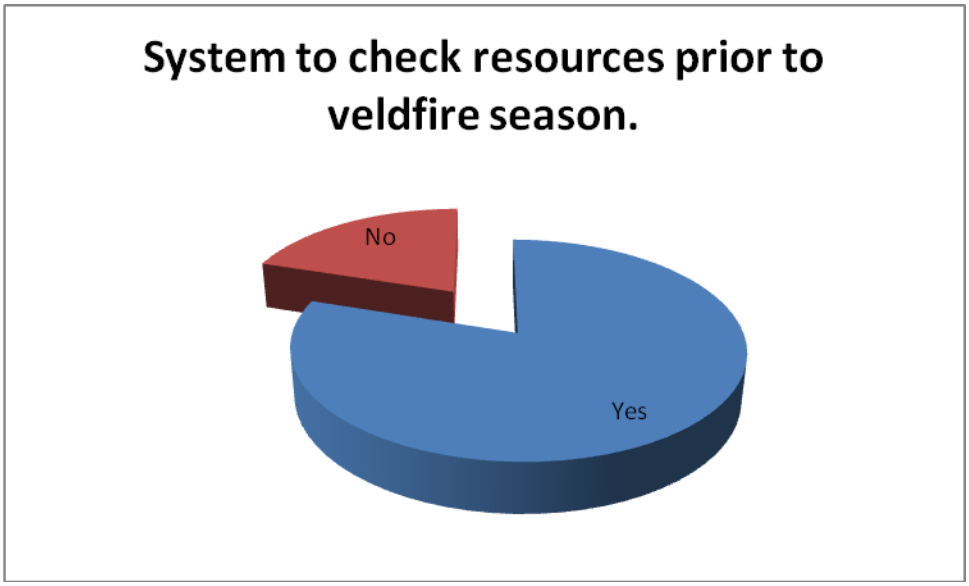
Graph 31, 100% of participants reflect that the community knows the emergency number or contact details to be used in case of veldfires.

Graph 32: Standby System



Graph 32, 100% of participants indicate that the organisations does use the standby system to place fire fighters on call after hours.

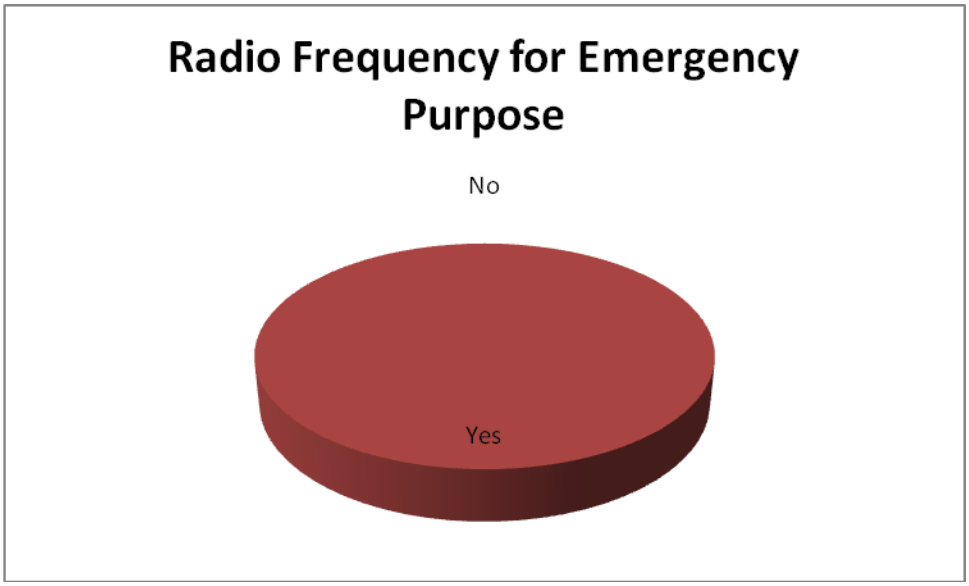
Graph 33: System to check resources prior to veldfire season.



According to graph 33, 80% of participants indicate that the municipality does have system in place to regularly check all available resources as part of preparedness. Whereas 20% of participants indicate that the municipality does not have system to check resources.

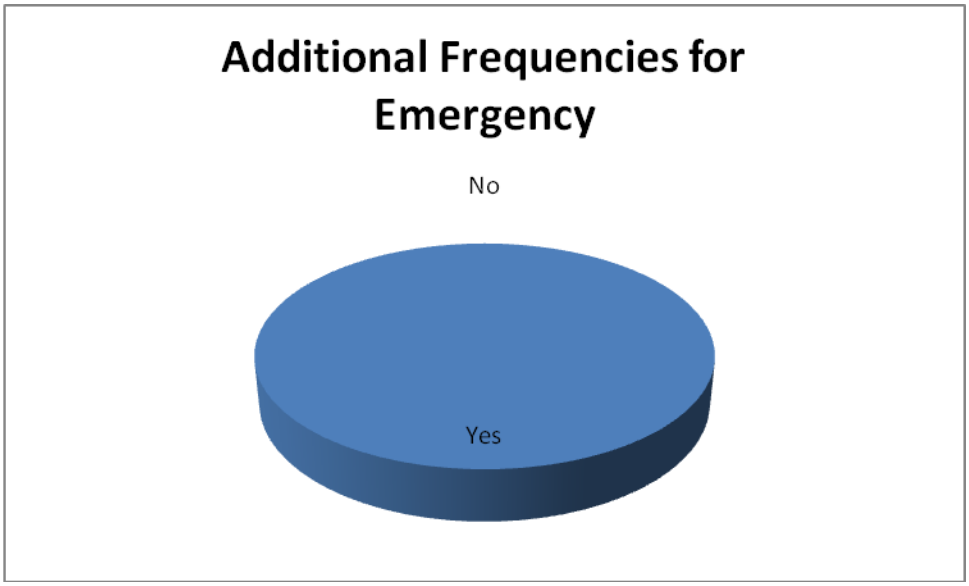
4.8 Fire operations

Graph 34: Radio Frequency Emergency purpose



Graph 34, 100% reflects that the municipality do have radio frequency to be used for emergency purpose.

Graph 35: Additional frequencies for emergency

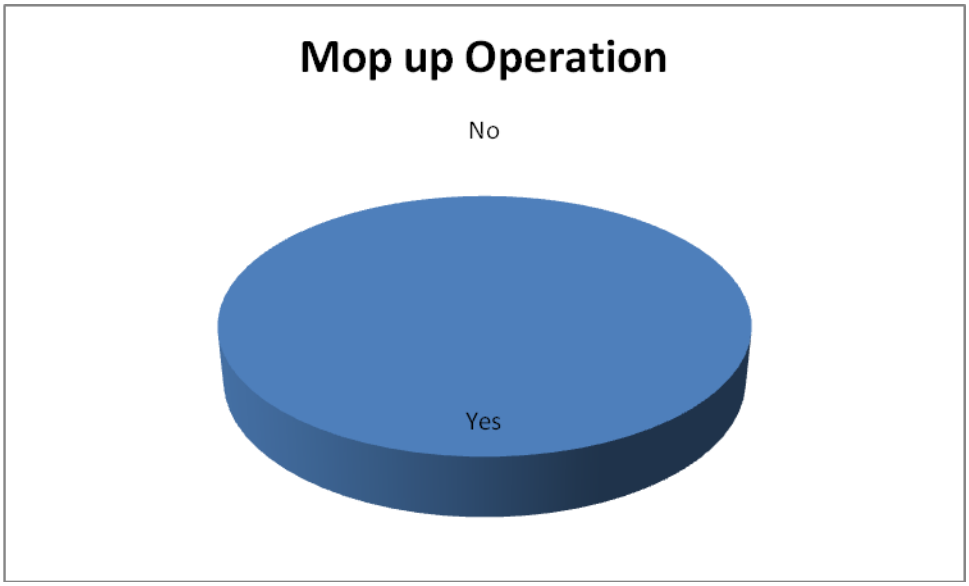


Graph 35, 100% of participants reflects the municipality to be having additional frequency for emergency.

Graph 36: Use of clear code language for communication

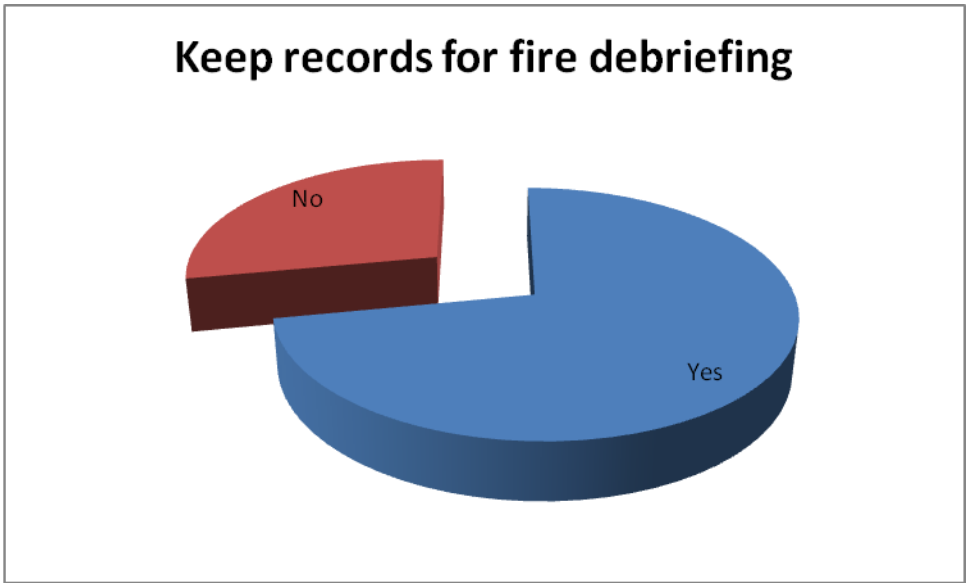
According to graph 36, 100% of the participants reflects the municipality as having clear code language for communication during emergency.

Graph 37: Mop up Operation



According to graph 37, 100% of participants indicate that the municipality does perform mop-up after operation.

Graph 38: Keep records for fire debriefing



Graph 38, 72% of participants indicate that the municipality does keep their records of veldfire incidents whereas 28% of participants indicate that the municipality does not keep records.

4.9. Summary

The analysed data was collected from the study area of TCLM (Graskop and Sabie). Thus, the used data analysis methods made it easier and simpler for the researcher to capture, analyse and interpret the collected data.

CHAPTER FIVE: DISCUSSION OF THE RESULTS

5.1. Introduction

This chapter discusses the results findings from the collected data. Its purpose is to link the relationship between the existing information by other authors and the actual findings of the research study.

5.2. Discussion of the results

5.2.1. Causes of fire

Most of the South African vegetation types are fire prone (Teie, 2005). The vegetation types are most likely to burn due to human action like malicious intent, burning for grazing, prescribed burning or due to natural causes (e.g. lightning strikes) mostly during the winter months (WOF,2003). According to the WOF firewise news letter over 90% of veldfires are caused by human negligence. According to Tarawi Nature Reserve (2004), veldfires occur due to both natural and anthropogenic causes, primarily lightning and land management. The findings of the study reflect that most veldfire cases are caused by weather conditions which include lightning. According to Goldammer & De Ronde (2004), effective fire prevention begins with the identification of the problem areas. Knowing the exact causes of veldfire is of great importance for management cognizance in addressing the prevention and control measures

5.2.2. Veldfire management plan

The results indicate that the municipality does have a veldfire management plan, which has not been approved by the Council. The review and assessment of the current veldfire management plan will assist the Fire Brigade Services, land owners and FPA to effectively and efficiently upgrade their plans and ensure that the plans meet legal requirements as promulgated by the national veld and forest fire Act (NVFF Act 101 of 1998).

The Act places a legal obligation on landowners on whose land a veldfire may start or from whose land it may spread, to prepare and maintain firebreaks on the boundaries of their property (NVFF Act 101 of 1998). Hence, the review of the current management plan provides opportunity to add value and meaning to experience regardless of the extent. Integrated veldfire management refers to an approach which does not only focus on veldfire suppression but a system that takes cognizance of other aspects of veldfire management such as fire prevention, protection, education and awareness (DAFF, 2003). Thus, a well-developed and appropriate plan should include strategies such as a well-planned firebreak system, a fire protection system, fire fighting safety policies and procedures and a resource management system (including equipment, communications and training of personnel). Adequate and appropriate fire management strategies are imperative to ensure that forest resource together with its ecological and other associated values is protected.

A veldfire management plan is one level below the resource management plan. That is, veldfire and resource management planning should be based on a legal, institutional, and policy framework. The framework provides the basis and structure for all strategic and tactical planning and implementation. However, the strategic actions for implementation are provided to assist planners and managers, land holders and local groups or communities of interest to manage fire in a more holistic manner. This strategic measure can also be used as a checklist for assessing organizational capacity.

5.2.3. Mutual aid agreement

The findings reveal that Thaba Chweu local municipality (TCLM) has mutual agreement with various organizations, for example, LEFPA, WOF and Komatiland. According to FEMA (2002), the primary role of mutual aid is to facilitate rapid, short-term deployment of emergency support prior to, during and after an incident. However, TCLM has agreement with WOF whereby WOF provides TCLM with personnel to assist with veldfire preparations during veld fire seasons and emergency situations. TCLM does not have enough fire personnel to combat veldfire without the support of other fire organisations. The WOF is an expanded PUBLIC WORKS programme established by the Department of Forest and Fisheries to support both the national veld and forest fire Act 101 of 1998 and the Disaster Management Act 57 of 2002. Since 2003 a national veldfire

prevention and wildfire fighting capability have been established and over 112 fire basses, each accommodating 22 well trained and equipped fire fighters have been set up throughout the country (Fire wise communities, 2007). Refer to figure 20 in the picture for Graskop base. The great partnership between TCLM and WOF has assisted in the development and implementation of an integrated approach to the fire management plan.

Figure 20: Graskop base picture

Source: researcher, 2011

5.2.4. Veldfire prevention programmes

The results show that Thaba Chweu local municipality conducts most of its fire awareness campaign at community, primary and high schools. FAO (2006) spells out that a well- informed public will be more likely to use fire carefully and adhere to policy and legal boundaries thus assisting in the prevention, detection and reporting of veldfire. One can realize that there is a decline of veldfire since TCLM have embarked on veldfire prevention and its practical management for example, working on fire has introduced a fire wise pamphlet for the benefit of the community in preparation for the fire season and the campaign was launched in 2006. The content of the pamphlet shows pictures of a house not protected against fire and burning down in veldfire, while another house that is protected against fire and do not burn. The fire wise programme aims at encouraging communities to work together in preventing veld fires from

hurting families and burning down houses. The cost of educating communities in the prevention of veldfire is significantly less than the overall devastation and damage caused by uncontrolled veldfire (FAO, 2006). The pamphlet further includes the fire danger index and the safety tips on assessing the risk to household.

Communities designed with the firewise concepts help preserve homes, a cherished lifestyle, natural settings for wildfire and recreation (WOF, 2007). Being firewise means leveraging fire protection and maximizing community and property owner`s value. Reference from Komatiland newsletter (2011), on the 1st of October 2010 community of the Tshitangani plantation spotted a fire in the Entabeni plantation. Approximately seven eager community members were busy fighting the fire and managed to put out the fire in a 26 year old compartment of Pinus Patula. The example serve as evidence that fire awareness programme, conveyed the right message to the community.

According to Goldammer & De Ronde (2004), an effective public awareness programme can help to prevent unwanted fires, build trust in the community for the fire management programme, and inform citizens of their responsibility in using fire wisely and carefully, including education and awareness programmes to school children with a structured set of lessons. Learning objectives will assist to spread the message on fire prevention and proper use of fire to the community, for example, the City of Tshwane has implemented disaster management primary school guide pack which is included in the school curriculum; they have structured lesson and learning objectives on fire spreading and flood prevention measures. The education should also include community-based education. A community-based programme will inform citizens on the technology of fire management, but the traditional knowledge of the community will go a long way in providing knowledge. (FAO, 2006). A public that is knowledgeable of the roles and uses of fire and the need for the community to participate in the protection of life, property and resources will be an effective partner in the total fire management programme.

The Lowveld and Escarpment fire protection association (LEFPA) has placed visible warning signage for veldfire alert with the emergency number in scripted, and thus, also assist in pro-active measures for fire prevention. Fire protection associations are registered in terms of the

provisions of chapters on the fire Act and its membership is voluntary for owners of state land. The FPAs are considered to be the vehicle and milestone that assists private landowners together with the municipalities to develop and implement an integrated veldfire management plan, as envisioned under the National Veld and Forest Act. According to the DAFF veldfire bulletin (2009), studies carried out point to the fact that these associations are very crucial in veldfire management, particularly when considering that South Africa is prone to veldfires with 70% of its areas classified as medium to extreme veldfire risk (DAFF, 2006). The priority of the establishment of FPAs has been given to regions classified as having high or extremely high risk of veldfires. These include the following provinces: Limpopo, Mpumalanga, Eastern Cape, KwaZulu-Natal, North West, Western Cape, Gauteng and Free State (DAFF, 2009). That is why there is LEFPA in Mpumalanga and one can realise that there is a decline of fire incidents after the establishment of the FPA. DAFF holds the view that only effective and efficient fire protection associations will be in a better position to reduce the impacts of unwanted veldfires (DAFF veldfire bulletin, 2009).

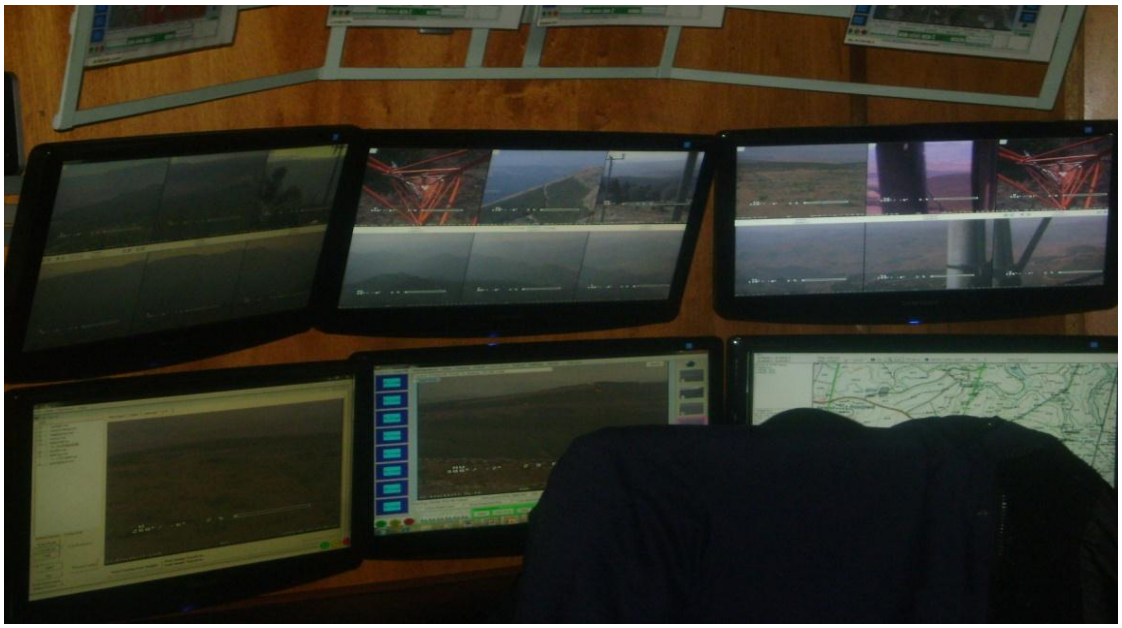
5.2.5. Training of personnel

It has been established that all levels of personnel do receive training based on veldfire management (FAO 2006). According to these findings it can be concluded that properly trained and equipped personnel at the proper locations can increase the effectiveness of any programme. Training is, therefore crucial towards preparedness and readiness to veldfire management. In addition, FAO (2006) highlights that the safety of fire fighters is dependent on their understanding of fire characteristics and the local weather. However, training in the effective use of equipment and fire suppression techniques is also important, while for supervisors and managers, it can help them better understand and effectively deploy a complex range of resources. For example, lack of training to personnel will result to more fatalities during operations. It is crucial for a well developed veldfire management plan to consider the safety of fire personnel and also ensure that training forms part of the preparedness plan.

5.2.6. System to monitor weather condition

The findings indicate that the municipality does have system to monitor weather condition through the fire danger index (FDI). Chapter three of the national veld and forest fire Act, 101of 1998 provides for the prevention of veldfire through a fire danger rating system. Its purpose is to provide a daily weather data to calculate veldfire potential by using forecasts, which serves as early warning provided many days in advance prior to a significant fire event (FAO, 2006). Active involvement of local communities in collecting fire weather information and disseminating the warnings will create ownership, increase local responsibility and the efficiency of the early warning system. The organization uses Envirovision solution (EVS) system to monitor, and keep track of veldfire (figure 21). The system interprets video from cameras to assist the operators in identifying severe weather conditions. It also keeps track of the progress of a plan prescribed burning and pinpoints the physical location of a fire on a map using the video image; and it can also detect the difference between video of trees blown by wind and smoke. For over a decade EVS have provided the service to TCLM, Komatiland and other forestry companies in protecting their assets by assisting with early detection of fires.

Figure 21: EVS monitoring system



Source: researcher, 2011

LEFPA has one official sitting at the EVS office for the issuing of burning permits to organizations (landowners) around Sabie, Graskop, Bushbuckridge and Lydenburg areas. In Appendix 1 the burning permit used by LEFPA for the control of veldfire is portrayed. According to (Goldammer & De Ronde, 2004) when a warning has been published, no person may light, use or maintain a fire in open air in the region where the fire danger is high. Thaba Chweu, for example, had to cancel one of the seasonal fire preparations (prescribed burning) because the FDI was in orange (64-74). Moreover, the LEFPA permit has 10 golden rules to adhere to when performing fire preparations.

5.3. Summary

It becomes evident that TCLM is adhering to the legal requirements of the NVFF Act, due to the fact that the findings indicate that the municipality is part of the existing FPA which is known as LEFPA; it has fire prevention programme and plan in place and it has existing protection plan that includes the inspection of firebreaks. It also has an emergency number and a call centre that is known by the community. The findings also show a 100% standby system for fire fighters availability. They also rate 100 percent availability of radio frequency and additional channels to be used during an emergency situation. The unit also uses clear and simple language for communication that other role players can understand.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

The chapter outlines the strongest and most important statement that the researcher can make from the findings. Recommendations provide the opportunity to outline all the necessary remedial action to solve the identified problem and to give directions for future investigations.

6.2. Conclusions

One of the research objectives is to ensure that the integrated veldfire management plan complies with the legal requirements of the NVFF Act. The research findings and results show the synergy between the disaster management cycle and implementation of the integrated veldfire management plan. The disaster cycle is divided into two phases: pre-disaster risk reduction and post disaster recovery phase. The pre-disaster phase includes strategic actions such as: pre-fire season activities, fire prevention, fire preparedness including technical training, fire detection and early warning systems. Organisations can start using the cycle in ensuring that all prevention, mitigations and preparedness measures are covered. In addition the first phase also encourages the implementation of law enforcement guided by the NVFF Act and other veldfire related Acts. The research findings indicate that the municipality does adhere to most of the legal requirements stipulated by the NVFF Act. This is because most of the research questionnaires were rated 100 percent when analysed. The research study was able to answer the identified research objectives and also propose remedial actions that will assist in articulating the problem.

6.3. Recommendations

The review and update of the integrated veldfire management plan must include the following strategic actions for fire and resource management planning:

- It has to be ensured that the veldfire management plan and activities are based on clear and comprehensive policy, legal and institutional framework.

- The plan should be prepared at an appropriate level of detail for every aspect of fire management including prevention, fuel management, detection, initial attack, large fire suppression and restoration.
- Policy that will put the safety of fire fighters and the public as the highest priority must be established.
- A Resource management plan should that includes an analysis of the actions that increase or decrease the risk and hazards affecting fire behaviour, fire damage or benefit, and impacts on the safety of fire fighters and the public should be made.
- Plans should be based on a realistic forecast of weather and climate and their effect on fire behaviour and suppression effectiveness.
- Organisations, agencies, governments, and communities should develop a process for involving local communities, communities of interest and other appropriate individuals when preparing resource and fire management plan.
- The plan should provide for a system of monitoring and evaluation, including a feedback process for amending or adapting the plans based on the evaluations or changing conditions.
- Pre-fire season agreements should be prepared that provide for assistance during large fires when local resources are fully committed.
- Data should be collected on frequency, specific causes, and locations of human caused fire, the reasons for starting the fire and area burned on a monthly and annual basis in order to establish circumstances exacerbating fire hazards. .

Furthermore, the fire department must employ enough permanent fire personnel which who be placed at all fire departmental offices in TCLM and secure enough funds for the purchase of the minimal required fire equipments, for example, fire engine.

APPENDIX A:

RESEARCH QUESTIONNAIRES

I am a student at the University of the Free State in Bloemfontein doing research on the assessment and review of the Veldfire Management plan for Thaba Chweu Local Municipality in the Province of Mpumalanga. I have designed this questionnaire in order to complete my research project which is part of the University requirement. The information collected will be used for academic purposes. No identification is requested from you and your responses are confidential.

The questionnaire is aimed at enhancing the knowledge and skill of veldfire management measures in your community. You are therefore requested to answer all the questions as truthfully as possible. Indicate your choice with an "X" and also put your answers in the boxes provided. You are also expected to add your comments in the spaces provided.

Name of organisation	
Date	

PART A: BACKGROUND INFORMATION

Question 1

Gender

1	Male	
2	Female	

Question 2

What is your age group in years?

1	18-24	
2	25-39	
3	40-49	
4	50-59	
5	60-+	

Question 3

What is your employment status?

1	Senior management	
2	Middle management	
3	Operational	
4	Other (specify)	

Question 4

When did you join the organisation?

1	2000-2004	
2	2005-2007	
3	2008-2011	
4	Other (specify)	

PART B: HISTORICAL INFORMATION ON VELDFIRES

Question 5

How many fire outbreaks occurred in the following periods?

YEAR	NUMBER	YEAR	NUMBER
2000		2006	
2001		2007	
2002		2008	
2003		2009	
2004		2010	
2005		2011	

Question 6

What has been the cause of fire?

1	Lightning	
2	Burning during land preparation	
3	Weather condition (extremely hot)	
4	Arson	
5	Other (Specify)	

Question 7

Did the local organisation have a formal veldfire management plan at the time of the veld fire incident?

1	Yes	
2	No	

Question 8

Does the organisation have enough personnel to combat fire?

1	Yes	
2	No	

Please motivate if your answer is No?

……

……

……..

Question 9

Which organisation did you call for assistance? (if any)

1	WOF	
2	LEFPA	
3	Sappi	
4	Komatiland	
5	Other (Specify)	

Question 10

Did the requested organisation respond?

1	Yes	
2	No	

Question 11

Which organisations did your organisation have valid mutual assistance agreements with, at the time of the veldfire?

1	WOF	
2	LEFPA	
3	Sappi	
4	Komatiland	
5	Other (Specify)	

PART C: INFORMATION ON ENFORCEMENT

Question 12

Does the organisation have enforcement policy on the Veldfire Management plan?

1	Yes	
2	No	

Question 13

If your above answer is No, please indicate how the organisation currently manages veldfires**?……**

……

…….

Question 14

Is the organisation part of the existing FPA`s in the province?

1	Yes	
2	No	

Question 15

Does the veldfire management plan include Fire Protection Association requirements, regulations and functions?

1	Yes	
2	No	

Question16

Are the enforcement policies regularly reviewed?

1	Yes	
2	No	

Question 17

Is the enforcement policy implemented?

1	Yes	
2	No	

Question 18

Does the current veldfire management plan include the three elements of fire prevention programme (education, fuel breaks & enforcement)?

1	Yes	
2	No	

PART D: FIRE PREVENTION MEASURES

Question 19

Does the organisation have a fire prevention plan in place?

1	Yes	
2	No	

Question 20

Where does the organisation conducts its fire awareness campaigns?

1	Community	
2	Primary school	
3	High school	
4	Other (specify)	

Question 21

Does the organisation have visible signage related to fire awareness?

1	Yes	
2	No	

Question 22

Does the organisation make use of local media like radio or local newspapers to conduct fire awareness campaign?

1	Yes	
2	No	

PART E: FIRE PROTECTION MEASURES

Question 23

Does the organisation have a fire protection plan indicating all the necessary protection measures needed?

1	Yes	
2	No	

Question 24

Is the plan implemented?

1	Yes	
2	No	

Question 25

Do you know if it is reviewed annually?

1	Yes	
2	No	

Question 26

Are the firebreaks inspected prior to the start of the veldfire season?

1	Yes	
2	No	

Question 27

Does the organisation supply training to the following people?

1	Incident commanders	
2	Drivers	
3	Members of incident management team	
4	Team leaders	
5	Fire fighters	

Question 28

Does the organisation have systems to monitor weather conditions?

1	Yes	
2	No	

PART F: FIRE SUPPRESSION MEASURES

Question 29

Does the management plan include fire suppression measures?

1	Yes	
2	No	

Question 30

Does the organisation have a call centre where fire can be reported on daily bases?

1	Yes	
2	No	

Question 31

Does the community know the location of the centre?

1	Yes	
2	No	

Question 32

Does the community know the contact details/ emergency number to use in case of veldfires?

1	Yes	
2	No	

Question 33

Does the organisation have a standby system to place the fire fighter on call after hours?

1	Yes	
2	No	

If yes, how do you do it?

…….

……..

Question 34

Does the organisation have a system to regularly check all available resources as part of preparedness?

1	Yes	
2	No	

PART G: FIRE OPERATIONS

Question 35

Does the organisation have a radio frequency designated only for emergency purpose?

1	Yes	
2	No	

Question 36

Does the organisation have additional frequencies that can be used during severe situations (this applies to frequencies for command, ground tactical & aviation operations)?

1	Yes	
2	No	

Question 37

Does your organisation use clear text language (codes) to communicate with other relevant stakeholders involved?

1	Yes	
2	No	

Question 38

Does the organisation have a system to ensure fire mop-up after the operation?

1	Yes	
2	No	

Question 39

Do the organisation keep accurate records for fire debrief or post mortem?

1	Yes	
2	No	

Any other comments:

……

……

……

……

……..

THANK YOU FOR YOUR PARTICIPATION

APPENDIX B:

FRONT PAGE OF BURNING PERMIT

LEFPA BURNING PERMIT № 20287

1 1.1 DATE 20/06/2011 07:43

1.2 IGNITION TIME 10:00 1.3 FINISH TIME: 18:00 H6

2 ***AREA TO BE BURNED***

2.1 LOCATION/REGION EXT10 A TESTINGROUND N BKLF RDP

2.2 FARM NAME THABA CHWEU SABIE ... 2.3 FARM NO.

3 ***FUEL TYPE***	***LIGHT - 1YR***	***MEDIUM - 2YRS***	***HEAVY - 3YRS+***
3.1 SHORT GRASS	—		
3.2 TALL GRASS			
3.3 SLASH			
3.4 OTHER			

3.5 SIZE OF AREA TO BE BURNED - HA 20 3.6 Agreed fire breaks or traces in place YES NO

4 ***RESOURCES / MANPOWER*** JOHN 072 670 3600

4.1 VEHICLES

4.2 BAKKIE SAKKIES	4	4.3 TRACTOR UNIT		4.4 FIRE TENDERS	1
4.5 FIRE BEATERS	3	4.6 KNAPSACKS	2	4.7 BASIC FIRE FIGHTERS	10
4.8 FIRE FIGHTERS	10	4.9		4.10	

4.11 LOOKOUT TOWER INFORMED: ~~YES~~ NO

4.12 1ST NEIGHBOUR INFORMED: YES ~~NO~~ 4.16 2ND NEIGHBOUR INFORMED: YES ~~NO~~

4.13 Date informed 4.17 Date informed

4.14 Name 4.18 Name

4.15 Tel / Cell / Fax 4.19 Tel / Cell / Fax

WEATHER AND FDI ON DAY OF BURNING:

BLUE	***GREEN***	***YELLOW***	***ORANGE***	***RED***
0-19	**20-44**	**45-59**	**60-74**	**75-100**

5.1 Forecast on day of burn **10H00** **14H00**

CONDITIONS:

1. **Burning will be allowed when the forecasted FDI is less than 45 for slash burns and block burns, burning of fire breaks will be allowed if the forecasted FDI is less than 50 unless otherwise required.**
2. **Additional and adequate precautions are taken in terms of available manpower and minimum equipment.**
3. **Adequate liaison with surrounding landowners and issuing officer or FPO has taken place.**
4. **The area to be burned is surrounded by an adequate firebreak or tracer lines are in place.**
5. **No burning on a holiday or on weekends from Friday, special burning permit must be obtained to be signed by all adjacent neighbours.**
6. **You are responsible to prevent a fire from spreading to neighbouring properties.**
7. **Don't leave a fire unguarded / unattended before it is properly extinguished and if the next day the forecasted FDI is orange or red.**
8. **According to the National Veld and Forest Fire Act No. 101 of 1998, carelessness with fires is considered a criminal offence.**
9. **Report back after successful burning operation is completed to all relevant parties.**
10. **Responsibility still lay with the Landowner / Applicant.**

COMMENTS:

APPENDIX C:

BACK PAGE OF THE BURNING PERMIT

10 GOLDEN RULES TO ADHERE TO

1. **Make effective fire breaks on your property borders**

   This protects your property and prevents a fire spreading to neighbouring properties.

2. **Warn neighbours if you plan to burn fire-breaks**

   Use a written notice to inform neighbours of your intentions.

3. **Plan your fire-breaks programme with your neighbours.**

   Get your neighbour's approval of your plan of action. Should neighbours find it impossible to come to an agreement, provision is made that the local magistrate may act as arbiter. His ruling will then be binding by both landowners.

4. **Insist on your neighbour's presence when fire-breaks on boundary belts are being made.**

   This will ensure that all parties take responsibility for any eventualities. Should a fire occur on a property, and it is suspect of posing a threat to man, animals or property, any person may enter property and apply necessary reasonable measures to prevent the fire from spreading, or to extinguish the fire. These measures may even include setting fire to crops, fire-breaks etc.

5. **Ensure that weather conditions are acceptable for burning firebreaks.**

   You could consider burning fires at night when weather conditions are usually favourable for burning. Check the Fire Danger Rating and regulations for your region.

6. **Burn fire-breaks early.**

   Burning restrictions are enforced in certain regions-ensure that you're aware of these.

7. **Don't light fires in the open air if you cannot control it.**

   Ensure that you have enough help and equipment to cope with all eventualities. Lighting a fire within a road reserve, except in fireplace built for that purpose, is also prohibited in terms of the National Veld and Forest Fire Act No 101 of 1998.

8. **You are responsible for doing all you can to prevent a fire from spreading to neighbouring properties.**

   If a fire spreads it can cause extensive damage and the landowner from where the fire originates, can be held liable for damages.

9. **Don't leave a fire unguarded / unattended before it is properly extinguished.**

   Unexpected winds can reflame cinders.

10. **According to the National Veld and Forest Fire Act No 101 of 1998, carelessness with fires is considered a criminal offence.**

    Unexpected winds can reflame cinders.

LEFPA CO-ORDINATION CENTRE - NELSPRUIT

HOT LINE NUMBER	**: 079 879 0808**
REPORT WILD FIRE	**: 0860 66 3473**
PERMIT OFFICER	**: 082 388 2874**
LEFPA OFFICE	**: 082 566 2728**

APPENDIX D:

PROPOSED VELDFIRE MANAGEMENT PLAN FOR THABA CHWEU LOCAL MUNICIPALITY

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

The Fire Brigade Services of TCLM needs to update and implement an integrated veldfire management plan which includes all the elements of fire prevention, fire protection, fire suppression and fire recovery. This plan will provide direction for fire management at TCLM. A well-developed and appropriate plan should include strategies such as a well-planned firebreak system, a fire protection system, fire fighting safety policies and procedures and a resource management system (including equipment, communications and training of personnel). Thus, adequate and appropriate fire management strategies are imperative to ensure that forest resource together with its ecological and other associated values are protected and comply with the legal requirements of the National Veld Fire and Forest Act No. 101 of 1998.

The purpose of the National Veldfire and Forest Act No. 101 of 1998 is to prevent and combat veld, forest and mountain fires throughout South Africa. This document describes and outlines all appropriate and necessary strategies that Thaba Chweu Fire Brigade Services should include when updating and implementing the veldfire management plan.

1. INTRODUCTION

1.1 Background

In 1998, South Africa promulgated the National Veld and Forest Fire Act (No. 101 of 1998), which is currently administered by the Department of Agriculture Forestry and Fisheries. The Act aims to prevent and combat veld, forest and mountain fires throughout the Republic of South Africa. It provides for a variety of institutions, methods and practices, such as the formation of Fire Protection Associations (FPA`s), preparation and maintenance of the National Fire Danger Rating System (NFDRS), veldfire prevention through firebreaks and the need for landowners to meet readiness standards for fire fighting. The Act places a duty on all owners of land, private, state or communal, to implement integrated veldfire management plan on their own properties (NVFFA 101 of 1998). The Act specifically states that land owners have the first and primary responsibility not only for ecological fire management, but also for the prevention and control of veldfires on their properties, within reasonable bounds.

The Thaba Chweu local municipality is predominantly by the different types of forest plantations and other heritage assets that add value to the economy of the municipality. It is, therefore, recommended that the municipality has an integrated veldfire management plan that will protect the environment and valuable assets of the municipality against veldfire.

1.2 Objectives

The objectives of this veldfire management plan are as follows:

- To protect people, forest plantations, historic heritage sites, natural and cultural features from veldfires.
- To minimise or prevent the likelihood of unwanted, damaging fire through knowledge, training, participatory planning, preparation, appropriate suppression and mitigation systems.
- To minimise the potential spread of veldfires through the establishment of firebreaks.
- To allocate resources based on the probability of ignition and expected fire behaviour and balancing the costs of fire prevention, preparedness and suppression.
- To developing guidelines for planned burning that fit within the veldfire legal framework and policies.

2. LEGISLATIVE REQUIREMENTS FOR THE VELD AND FOREST FIRES

2.1 Constitution of South Africa (Act No. 108 of 1996)

Section 24 (a) (b) preludes that everyone has the right to an environment that is not harmful to their health or well-being: and to have the environment protected, for the benefit of present and future generations, through reasonable legislature and other measures that prevent pollution and ecological degradation, and promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

2.2 National Veld and Forest Fire Act of 1998 (Act No.101 of 1998)

The main purpose of this Act is to prevent and combat veld, forest and maintain fires throughout the public. These provisions are in line with the National Disaster Management policy, and in many cases with international trends. This Act places the duty on every owner on whose land a veldfire may start or burn, or from whose land it may spread, to prepare and maintain a fire break on his or her side of the boundary between his or her land and the adjoining land.

The Act further makes provision for the establishment of a Fire Protection Association, which is designed to lay down minimum standards to be maintained by members in relation to all aspects of veldfire prevention and readiness for fire fighting and to regulate controlled burning to conserve ecosystems and reduce fire danger. Chapter 3 of the Act provides for the prevention of veldfire through a fire danger rating system. The Act further outlines that when the fire danger is rated as high in any region, warning must be published at the earliest possible opportunity in all main languages used in that particular region. Chapter 5, places a duty on all land owners to acquire equipment and avail personnel to fight fires. It provides for agreement to be reached between the minister and the Fire Protection Association, or between such associations to assist each other in case of a fire.

The act also set out relevant offences and penalties that may be applicable.
Section 25(1) outline that any person who lights, uses or maintains a fire in the open air in contravention is guilty of first category offence. Such person may be liable on conviction for a fine of two years imprisonment or both.

Hence section 25(3) preludes that any person who does the following is guilty of a second category offence. Such person is liable for a fine or two years imprisonment or both if she

- fails to prepare a firebreak when obliged to do so in terms of section 12(1) or 14
- fails to give notice of intention to burn a firebreak in terms of section 12 (2) (b)
- burns a firebreak when a fire Protection Association has objected in terms of section 12 (4) (a)
- fails to inform adjoining owners of the matter referred to in section 12 (5)
- fails to meet the standards of readiness for fire fighting

- fails to notify the persons
- refuses to assist a Fire Protection officer or a forest officer
- hinders or obstructs a Fire Protection officer from executing her duties.
- leaves the fire which she lit, used or maintained unattended before that fire is extinguished
- lights, uses or maintains a fire, which spreads and causes injury or damage with or without permission of the owner
- throws, puts down or drops a burning material or other burning material or any other material capable of spontaneous combustion or self-ignition and by doing so, makes a fire which spread and causes injury or damage.
- lights, uses or maintains a fire in a road reserve

Any owner, occupant or person in control of land on which a fire occurs and fails to take reasonable steps to extinguish the fire or to confine it to that land or to prevent it from causing damage to property on adjoining land is guilty of a first category offence. Any person who prevents a Fire Protection Officer , forest officer or an officer appointed in terms of section 5 or 6 of the Fire Brigade Services Act , 1987 (Act No.99 of 1987) from acting in terms of section 27, 28 or 29. is liable for a fine or 6 months imprisonment or both.

2.3 Disaster Management Act 57 of 2002

The Act provide for an integrated and co-ordinated Disaster Management policy that focuses on preventing or reducing the risk of disasters, mitigating the security of disasters, emergency preparedness, rapid and effective response to disaster and post-disaster recovery. Section 53 (1) outlines that each municipality must

- prepare a DM plan for its area according to the circumstances prevailing in the area
- co-ordinate and align the implementation of its plan with those of other organs of state and institutional role players
- regularly review and update its plan
- anticipate the types of disasters that are likely to occur in the municipal area and their possible affects

- place emphasis on measures that reduce the vulnerability of disasters prone areas, communities and households.
- provides for appropriate prevention and mitigation strategies
- facilitate maximum emergency preparedness
- contains contingency plans and emergency procedures in the event of a disaster, providing for the allocation of responsibilities to the various role- players and co-ordinators in the carrying out of those responsibilities.

2.4 Occupational Health and Safety Act (Act 85 Of 1993)

The Act provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety, and to provide for matters connected therewith.

2.5 Fire Brigade Service Act No. 99 Of 1987

The Fire Brigade Services Act provides for the establishment, co-ordination and standardisation of fire brigade services. Local authorities are allowed to establish and maintain a fire brigade service for the following different purpose:

- Preventing the outbreak or spread of a fire
- Fighting or extinguishing a fire
- The protection of life or property against fire or other threatening danger.
- The rescue of life or property from a fire or other dangers.

2.6 National Environmental Management Act of 2004

Land owners need to assure compliance with the principles outlined in chapter 1 of the Act. It stipulates that people and their needs must be placed at the forefront of veldfire management, as a field of environmental management. Veldfire management, as part of sustainable development, should avoid, minimise or remedy the disturbance of ecosystems and loss of biological diversity and pollution or degradation of the environment.

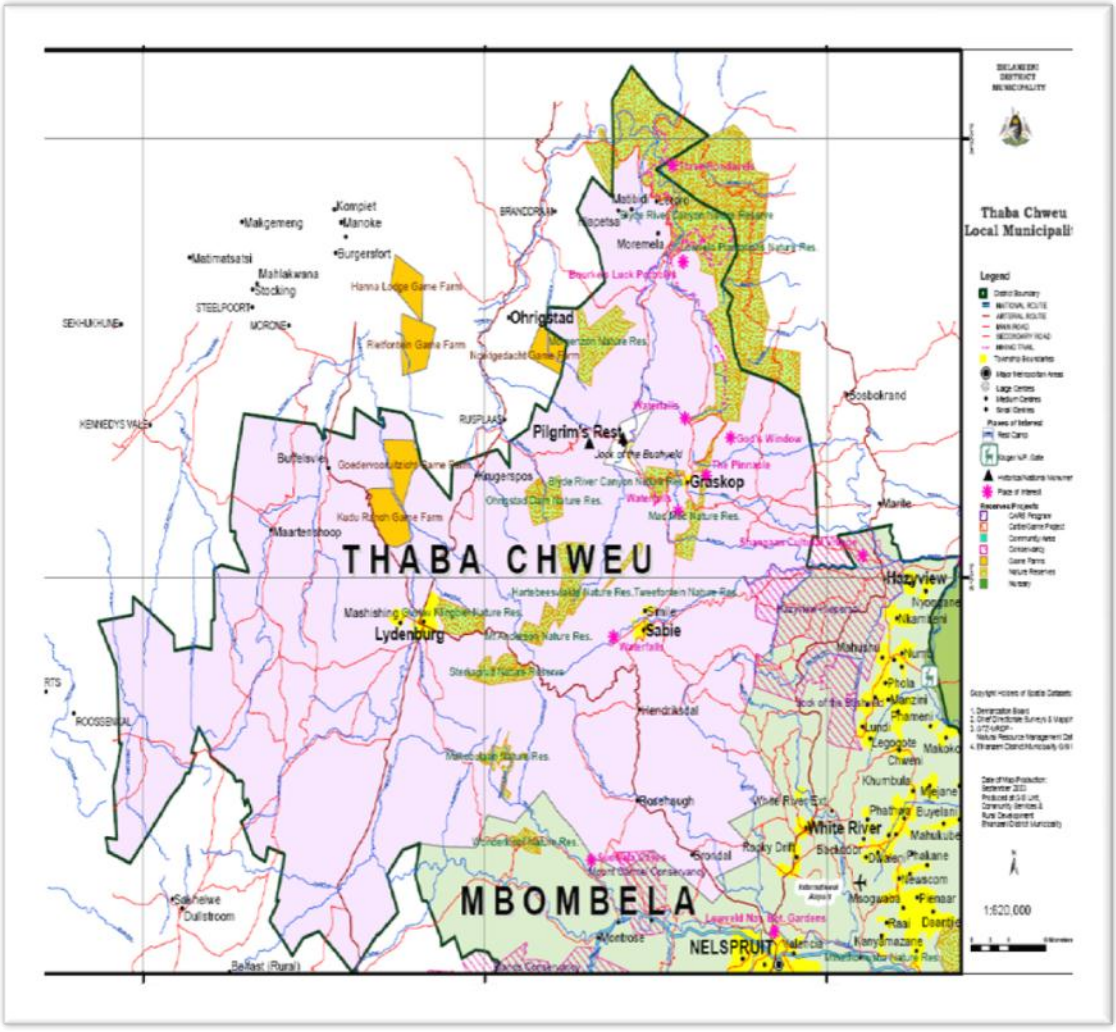
2.7 The Municipal Systems Act No. 32 of 2000

This Act places several duties upon municipalities. Those immediately relevant to veldfire management are:

- To promote and undertake development in the community and
- To promote a safe and healthy environment in the municipality.

3. DESCRIPTION OF THE MUNICIPALITY

3.1 Location of the Thaba Chweu Local Municipality



Source: TCLM IDP, 2009

Thaba Chweu local municipality is situated in the north western part of Mpumalanga on the escarpment. Major towns in the area are Sabie, Graskop, Pilgrim`s Rest and Lydenburg. Warm summers and moderate winters characterise the climate of the area. The area of

6034km² is covered mainly by grassland, with small patches of savanna in the north. The large eastern parts of the area are covered with exotic (Gum and Pine) forest plantations. The total area coverage of the municipality is 5719, 06km² and it has a population of 87,545 (statistics S.A, 2007).

3.2 Agriculture, Forestry and Fishery

Agriculture, forestry and fishery are the largest economic sectors in the municipal area making up 24.35 of the Thaba Chweu economy. Forestry is the largest contributor to this sector and takes up approximately 151,877ha or 30% of the Thaba Chweu area. Commercial agriculture takes up 35,600ha or 7% of the area.

3.3 Climate and Fire Weather

The Lowveld is subtropical, due to its proximity to the warm Indian Ocean and due to its latitude. The Drakensberg escarpment receives most precipitation, with all other areas being moderately well-watered by mostly summer thunderstorms. Most of the rain falls between October and April with the highest rainfall in January and February (170 - 190mm per month). Winter rainfall is rare, except for some drizzle on the escarpment.

3.4 Fauna and Flora

The escarpment is a mosaic of rocky hillsides, mountain grassland and pockets of Afromontane-mist belt forest. Natural habitats are fragmented by vast plantations of exotic pine and eucalyptus trees. The mountain grasslands contain a rich diversity of plant species, many of which are protected species. During the summer months these lush grasslands, especially the wetlands with their rich carpet of flowers, are a delight to behold. A diverse variety of mammals occur in the wooded valleys and mountain grasslands. Most notable is the elusive black leopard - seen by but a privileged few.

3.5 Heritage Assets

The TCLM is a tourism hotspot in Mpumalanga owing to its wonderful natural sights. These heritage sites include places such as Three rondawels, the Blyde river canyon, Bourke`s Luck

potholes, Mac-Mac falls, Pinnacle Rock, God`s window, Echo caves, Three big swing Panorama falls and the pilgrim`s rest village heritage site.

3.6 Capital Assets

The entire heritage sites mentioned above are considered to be the capital assets of the municipality due to the fact that they contribute to the economy of the TCLM. These assets, therefore, need to be protected against veldfire.

4. VELDFIRE MANAGEMENT PLAN

4.1 Veldfire Prevention Management

Veldfire prevention includes all those activities concerned with minimising the incidence of veldfire, particularly those of human origin. Prevention activities include public awareness, law enforcement and the reduction of the veldfire risk.

Thaba Chweu local municipality must ensure that all necessary veldfire prevention measures are in place in order to comply with the National Veld Forest and Fire Act No. 101 of 1998. The prevention measures should include the following:

- Fire Danger Rating
- Awareness programmes for both the public and staff
- Reporting

4.1.1 Fire Danger Rating

Chapter 3 of the NVFF Act provides for the prevention of veldfires through a fire danger rating system. Fire danger rating is a fire management system that integrates the effects of selected fire danger factors into one or more qualitative or numerical indices of current protection needs. It is used to express an assessment of fixed and variable factors such as fire risk, fuels, weather and topography, which determines whether fires will start, spread or do damage and also the degree of difficulty of control to be expected. Everyday in South Africa, the South African Weather Services publishes a fire danger rating for the country. When the fire danger is rated HIGH in any region (Table 1), the Minister must publish a warning at the

earliest possible opportunity in all the main languages used in the region. When a warning has been published, no person may light, use or maintain a fire in the open air in the region where the fire danger is high. Thus, the fire danger rating system must take into account the relevant peculiarities of each region, including:

- The topography
- Type of vegetation in the area
- Seasonal climatic cycle
- Typical weather conditions
- Recent weather conditions
- Where reasonably possible, current weather conditions
- Forecasted weather conditions and
- Any other relevant matter

Table 1: Classification of fire danger and the description of actions to be followed once fire weather has been classified as (Low, Medium & High)

Classification	*Description of Classification*
Insignificant	The fire danger is so low that no precaution is needed
Low	Fires including prescribed burns may be allowed in the open air on condition that persons making fires take reasonable precautions to prevent fires from spreading
Moderate	The fire danger is such that no fires may be allowed in open air except those that are authorised by the Chief Fire Officer of the local fire service and those in designated fireplaces; authorised fires may include prescribed burns
High	The fire danger is such that no fires may be allowed under any circumstances in the open air
Extremely High	The fire danger is such that no fires may be allowed under any circumstances in the open air, and special emergency fire preparedness measures must be invoked.

Table 2: Recommended management actions with regards to Fire Danger Rating. The South African Weather Services provides daily fire weather for all the regions of South Africa.

MANAGEMENT OBJECTIVE	To prevent fire by being aware of the prevailing fire weather conditions in the TCLM area on any particular day in order to: Provide the basis for fire warning Prepare fire fighting readiness levels Communicate fire weather forecast
MANAGEMENT ACTIONS	• To access the fire weather forecast published daily by the South African Weather Services. • To ensure that farming community and people on the property are aware of the prevailing fire weather conditions particularly on High or Extreme fire weather and plan accordingly. • To further plan the levels of the availability of the fire reaction teams especially for after hours, weekends and holidays.
TIMING	From 1st May -31st October
PERFORMANCE INDICATOR	The daily weather conditions published by the LEFPA and South African Weather Services needs to be considered.

4.1.2 Veldfire Awareness

Awareness campaign is a method that is used to deliver the fire message to the community. A well informed public in veldfires will be more likely to use fire carefully and also adhere to policy and legal boundaries. Campaign method is an excellent way to increase public awareness and to gain support from the community. A combination of visual, verbal and written methods can be used to deliver fire prevention messages.

The following are the recommended actions for fire awareness and education of the community:

- Fire awareness and educational programmes should be developed and targeted to specific audiences and communities;
- Programmes should be sensitive to the culture and social norms of the community, including the application of fires to agriculture, forestry, biodiversity and traditional uses or to other basic needs;
- Fire awareness and educational materials should be gender sensitive and should reflect local literacy levels, including oral presentation where printed material or local language barriers limit effective communication;

- Age appropriate information and educational materials should be developed cooperatively by technical experts and educational specialists and provided to all levels, introducing ecological and fire management concept into local schools;
- Primary and secondary schools, universities, non-governmental organisations and other institutions should be encouraged to develop locally and ecologically appropriate fire management programmes for teachers and other educators, based on local conditions and beliefs.

Table 3: Recommended management actions for veldfire awareness for the TCLM.

MANAGEMENT OBJECTIVE	Its main objective is to prevent fire through an awareness programmes designed to communicate information about veldfire facts to the following: Landowners within the municipality Neighbouring landowners Community members
MANAGEMENT ACTIONS	Veldfire communication by using the following: • Books, News release, magazine articles • Television programme • Radio messages • Signs, posters, exhibits • Handouts
TIMING	1st May-31st October which is the fire season, but the campaign can be done throughout the year.
PERFORMANCE INDICATOR	Ensure that veldfire prohibiting posters and signage are more visible throughout TCLM roads and communities. These veldfire posters can be obtained from the regional Working on Fire Office, Department of Forestry and Fisheries or local FPA (LEFPA) at no cost.

4.1.3 Reporting

As stated in the NVFF Act, it is important that records of veldfires are kept and these details are furnished to the FPA of the area. Chapter 2 of the Act (section 5); the FPA is entrusted with the mandate to supply the Minister at least once every 12 months with statistics about veldfires in its area. In order to ensure improvement of veldfire management techniques and methods within the municipality, it is vital that data is collected on a regular basis and monitoring is continuous.

4.2 VELDFIRE PROTECTION MANAGEMENT

Veldfire protection is defined as all those activities designed to protect an area (including human life, property, assets and values) from damage by wildfire.

The municipality must ensure that veldfire protection measures are in place. The recommended veldfire prevention management actions are as follows:

- Firebreaks
- Equipment and facilities
- Training
- Prescribed burning
- Fire Protection Association

4.2.1 Firebreaks:

Firebreak is an artificial barrier constructed before a fire occurs, specifically as a line of defence along which fires may occur, can be stopped, checked or attacked. Chapter 4 of the NVFF Act states that every owner on whose land a veldfire may start or burn or from whose land it may spread must prepare and maintain a firebreak on his or her side of the boundary between his or her land and any adjoining land. If the firebreaks are to be maintained by the use of burning, the landowner has to notify the adjacent landowner and the FPA of his plan to burn. Section 13(a)(b) and (c) of the NVFF Act mentions the requirements of constructing a firebreak:

(a) Care must be taken to ensure that a firebreak does not cause soil erosion and that
(b) It is reasonably free of inflammable material capable of carrying a veldfire across it.

Table 4: Recommended management actions with regards establishment of firebreaks

MANAGEMENT OBJECTIVE	Establish firebreaks in order to reduce the spread and intensity of any veldfire that may occur in or enter the TCLM area. It will assist in protecting all valuable assets within the municipality.
MANAGEMENT ACTIONS	Establish (10-15m) wide enough and long enough firebreaks that will prevent veldfire from spreading to or from neighbouring land. Ensure it does not cause soil erosion. All firebreaks should be completed a month before fire season. If not possible, the landowner must request exemption from the local FPA office or DAFF.
TIMING	Once established. All firebreaks need to be checked at least a month before the veldfire season.
PERFORMANCE INDICATOR	Ensure there are enough firebreaks that will stop fire from spreading from one point to another. Firebreaks are to be designed as a means of access for personnel and equipment, to serve as a control line and serve as a line from where a fire can be attacked.

4.2.2 Equipment and facilities:

Chapter 5 of the National Veld and Forest Fire Act 101 of 1998, states that all landowners from whose land a fire may start or burn, or to whose land it may spread, must have equipment, protective clothing and trained personnel for extinguishing fires. Section 8 of the occupational health and safety Act 85 of 1993, states that every employer shall provide and maintain a working environment that is safe and without risk to the health of its employees. It also gives provision and maintenance of the systems of work, plant and machinery that, as far as is reasonably practicable, are safe and without risks to health.

Table 5: Recommended management actions for veldfire equipment and facilities for TCLM.

MANAGEMENT OBJECTIVE	To increase veldfire fighting capability and readiness
MANAGEMENT ACTIONS	Acquire and dedicate the following broad equipment and facilities • Protective clothing • Vehicles with tanks • Communication equipment
TIMING	Check two months before fire season and every day/week during fire season.
PERFORMANCE INDICATOR	Ensure the facility and the fire fighting equipments meet the minimum requirements of the Fire Brigade Services. Ensure that fire fighters are trained on the use of the equipment and regular servicing of the equipment.

Protective equipment recommended for people working on the fireline:

- 100% cotton overalls
- Leather safety boots without steel cap
- Safety helmet with visor
- 100% cotton T-shirt
- 100% cotton balaclava
- Standard pigskin gloves
- Fire resistant goggles

Hand tools:

- Rake Hoe : a combination of hoe and rake used primarily for preparing fireline/tracers
- Fire beater: A wooden handle fitted with conveyor belting cut in a specific shape with either holes or fingers. It is used to smoother the fire by overlying the beater flaps in rhythmic beating by trained fire fighters.
- Knapsack fire pump: is the simplest and most portable pump available in South Africa. It is a 20 litre tank that is used to control fires in light grass and during mop up.

Ignition tools:

When burning belts, blocks or doing a back burn, it is necessary to have reliable ignition tools that will produce a sufficient flame to start the fire.

- Drip torch: is used on most plantations and works well if it is kept clean. It works best with a fuel mix of one third petrol and two thirds diesel oil.
- Chessa stick: is a metal stick with a wooden handle that supports a maize cob. It is a can filled with diesel mix which is used with the chessa stick. The cob is soaked in the diesel mixture and lit. This ignition tool is used to burn firebreaks and back-burns.
- Matches: Is used to ignite grass, which is dragged with the rake-hoe, to spread the fire into new areas.

Mechanical Equipment:

- Fire trucks: is specially designed and equipped for fire fighting. There are fire trucks that are specifically designed for veld and forest firefighting.
- Bakkie Sakkie: Is one of the most versatile veld and forest firefighting vehicles. The bakkie Sakkie is a small, self-contained unit that provides a fast first on the scene fire fighter, capable of extinguishing or containing blazes until larger and slower backup equipment arrives to assist.
- Bulldozer: are indispensable for clearing a fireline at major fires and it is used on high fire danger index (FDI) days. Extremely caution is needed if a bulldozer is working on slopes above personnel, as it tends to dislodge rocks or other things that can roll.

Aerial firefighting:

- Spotter planes and Pilots: The spotter plane and pilot provide several functions on a fire. They are the "eyes in the sky" for the fire boss. They serve the best view of the overall fire problem. It also operates as an aerial flight control centre, calling in bombers to bit specific targets and keeping them from running into each other and other things on the ground. The spotter pilot can also map the fires and patrol areas not covered by a lookout to detect fires.
- Fire Bombers: It have only one purpose, namely to deliver a fire suppressant to the fire line. It is the most effective on initial attack when the fire is small. As the fire gets larger, their usefulness drop significantly.
- Helicopter: Is one of the most versatile tools in the fire manager`s tool kit. Helicopters can be used to: Transport firefighting personnel and equipment to remote locations quickly,

4.2.3 Training

Chapter 5 of the NVFF Act states that every owner on whose land a veldfire may start or burn or from whose land it may spread must have such equipment, protective clothing and trained personnel for extinguishing fires. Therefore, a well trained veldfire fighting force is an essential component of any veldfire management operation.

Table 6: Recommended management actions for the training of fire fighters

MANAGEMENT OBJECTIVE	To train and capacitate fire fighters in prevention, protection and suppression tactics.
MANAGEMENT ACTIONS	Train a fire fighters in the following: • Basic fire fighting techniques • Fire suppression • Fire safety
TIMING	Training or refresher training should be offered annually.
PERFORMANCE INDICATOR	Ensure that offered training to personnel is accredited with South African Qualification Authority.

4.2.4 Prescribed burning

Prescribed burning is the controlled application of fire under specified environmental conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives.

Table 7: The recommended management actions for prescribed burning

MANAGEMENT OBJECTIVE	The goal is to reduce or prevent the fire hazard caused by fuel build up.
MANAGEMENT ACTIONS	Establish strong firefighting leadership skills for both the supervisor and fire fighting personnel. Perform the prescribed burning prior to fire seasons.
TIMING	Prior to fire season (April –June) of each year.
PERFORMANCE INDICATOR	Established prescribed burning intervals with the aim of reducing fire hazard and stimulating biodiversity.

4.2.5 Fire Protection Association

Fire protection refers to all activities designed to protect an area (including life, property, assets and values) from damage by fire. Chapter 2 of the Veldfire Act regulates the establishment, registration, duties and functioning of Fire Protection Associations. The duties of Fire Protections Associations (FPA's) are to:

- develop and apply a veldfire management strategy for its area
- provide in strategy agreed mechanisms for coordinating actions with adjoining FPA's
- make rules to bind members

- identify ecological conditions that affect fire danger
- regularly communicate the fire danger rating to its members
- organise and train its members in fire fighting, management and prevention
- inform members of equipment and technology available for preventing and fighting veldfires.
- provide management services, training and support for communities in their efforts to manage and control veldfires
- supply minister every 12 months with statistics about veldfires in the area.
- furnish any information requested by the Minister in order
- exercise the powers and perform the duties delegated to it by the Minister, and
- appoint a fire protection officer, unless a municipality is a member.

Table 8: Recommended management actions

MANAGEMENT OBJECTIVE	To become an active and influential member of the local fire protection association.
MANAGEMENT ACTIONS	Join a local Fire Protection Association in order to influence and make recommendations at all FPA meetings.
TIMING	Throughout the lifespan of the municipality
PERFORMANCE INDICATOR	Attendants of FPA meetings.

4.3 Fire Suppression management

Fire Suppression is defined as all those activities connected with extinguishing and restricting the spread of wildfire following its detection and making it safe.

The suppression of veldfire includes the safety of all personnel during fire fighting operations. The following are the ten golden rules that fire fighters need to bear in mind when conducting fire suppression operation:

- Keep informed of fire weather conditions and forecasts
- Know what your veldfire is doing at all times
- Base all actions on the current and expected veldfire behaviour
- Plan and make known escape routes for everyone on the ground and in the air
- Post lookouts when there is possible danger

- Be alert, keep calm, think clearly, make clear decisions and act decisively
- Maintain prompt communications with the fire boss, sector supervisors, crew leaders and fire fighters under your control
- Give clear instructions and have them repeated to ensure that they are understood
- Maintain control of your staff and fire fighting operations
- Fight veldfire aggressively but put the safety of your fire fighters first

The goal of fire suppression is to minimise or prevent damage caused by a veldfire in the most cost-effective means possible, while prioritising safety, providing for safety first.

4.3.1 Fire fighting safety

This is the most important element in any firefighting exercise. It is intended to reduce loss of life of the men and women participating in fire fighting.

Table 9: The recommended management actions for ensuring fire safety at all times as follows:

MANAGEMENT OBJECTIVE	To ensure safety of fire fighters at all times during fire
MANAGEMENT ACTIONS	The person in command will have to: • Plan and make known escape routes for everyone on the ground post and lookout for danger and safety aspects • Maintain prompt communication with the crew leaders and fire fighters • Give clear instructions and have them repeated to ensure that they are understood • Maintain control of your men and fire fighting operations
TIMING	Throughout all the years
PERFORMANCE INDICATOR	No loss of life to fire fighters.

4.3.2 Command structure:

Regardless of the size of fire, certain basic management actions are required in order to establish rapid and efficient control, and minimise risk, damage and costs. One of the basic management actions is the establishment of a well defined and appropriate fire fighting command structure.

Table 10: Recommended management actions with regards the firefighting command structure

MANAGEMENT OBJECTIVE	To set up positive and clear lines of authority quickly, and launch a dependable and rapid response during suppression.
MANAGEMENT ACTIONS	Establish a basic and efficient command structure consisting of: • Overall commander • Senior Supervisor • Crew leader
TIMING	Life time
PERFORMANCE INDICATOR	Establish a well developed command structure.

4.3.3 Procedures for control

Once firefighting team structure has been established, the next step in fire suppression is the setting up of control lines. It must be very clear as to who is in control of a fire situation; there cannot be many bosses at the fire scene. The procedures for control are based on the firefighting team structure.

Table 11: The recommended management actions in setting up procedures for control are as follows:

MANAGEMENT OBJECTIVE	Define clear procedures for control during a veldfire.
MANAGEMENT ACTIONS	Establish procedures for control of: • Supply of resource • Planning and reporting • Overall control of suppression activities • Maintenance and service of equipment
TIMING	Review annually
PERFORMANCE INDICATOR	Have well defined control procedures that would be used during a fire suppression exercise.

4.4 Post fire recovery management

Post-fire recovery is defined as a phase where damaged assets are salvaged, repaired or replaced; sites disturbed by fire control operations are rehabilitated; the natural response of the ecosystem is monitored, and managed if necessary; health and safety issues arising from the fire control operation are addressed; and lessons learned from the incident are incorporated into planning for future veldfire events.

There are a number of procedures that need to be adhered to after a prescribed or veldfire has been extinguished. The main purpose of this management action is to ensure continuous improvement of veldfire management. The following is the management procedures which need to take place as quickly as possible at the end of a veldfire:

Table 12: Management recommendations for post fire recovery

MANAGEMENT OBJECTIVE	To record all the activities and improve future veldfire management activities and equipment/facilities.
MANAGEMENT ACTIONS	Immediate actions after a prescribed action or veldfire: • Post fire equipment maintenance • Restocking of supplies • Mapping of the area burnt • Compilation of a fire report • Review and Submission of report
TIMING	Immediately after a veldfire operation
PERFORMANCE INDICATOR	Veldfire reports for all fires. An annual analysis of fire data and a review of procedures if required.

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