#### ALFRED NZO RISK ASSESSMENT

# **GENERAL DESCRIPTION OF STUDY AREA**

Alfred Nzo District Municipality is located in the north-eastern area of the Eastern Cape Province and stretches from the Drakensberg Mountains, bordering Lesotho in the North, Sisonke District Municipality in the East and the OR Tambo District Municipality in the South. In preparation for the 2011 local government elections, the Demarcation Board in terms of the Demarcation Act of 2008 (as amended), declared changes in some municipalities (inter-boundaries) whereby certain LMs were to be moved from some DMs to others. There were also amendments to some municipality and boundaries. As a result of these changes, two LMs from the OR Tambo District Municipality (Mbizana and Ntabankulu) were incorporated into the Alfred Nzo District Municipality.

Alfred Nzo District Municipality was historically part of the Transkei homelands. The district is largely rural in nature, with village settlements defined by the district's geographical footprint through mountain ranges and river systems. Agriculture and tourism make up core components of the local economy. The ANDM consists of four local municipalities, containing seven towns and many smaller settlements. The ANDM has a population of about 900 000 people, distributed unevenly between the 4 municipalities:

Local Municipalities	Area km <sup>2</sup>	Towns	Comments
Matatiele	4,532	Matatiele	The Matatiele municipality is close to the
		Maluti	Lesotho/South Africa national border and has two
		Cedarville	urban nodes – the towns of Matatiele and Cedarville.
			Matatiele acts as a service node to the agrarian
			based economy of the area, while Cedarville serves
			as a secondary service centre
Umzimvubu	2,506	Mount Ayliff	Umzimvubu municipality hosts the district's
		Mount Frere	administrative capital in Mt Ayliff and the district's
			largest economic node in Mt Frere. The N2 traverses
			the course of this local municipality, and can be seen
			as its most prominent defining trait
Ntabankulu	1,455	Ntabankulu	Ntabankulu municipality has small urban
			settlements at Ntabankulu town and Cacadu village.
			This local municipality has a strong rural presence
			and is geographically defined by several mountain
			ranges.
Mbizana	2,806	Bizana	Mbizana municipality is the district's gateway to
			the Wild Coast and has a medium sized town in
			Bizana.
Alfred Nzo	11,119		

#### 1 KPA 2: RISK ASSESSMENT

Disaster risk assessment is the first step in planning an effective disaster risk reduction programme. It examines the likelihood and outcomes of expected hazard events, including the vulnerability conditions that increase the chances of loss.

Disaster risk assessments supported by good monitoring and evaluation are essential for:

- effective disaster risk management and reduction planning;
- sustainable development planning;
- identifying potential threats that can compromise the success and sustainability of developments and thereby making it possible to incorporate disaster risk reduction measures in the design of a project;

- informing disaster risk reduction programmes for specific threats;
- identifying periods and conditions of high risk; and
- informing emergency preparedness planning.

The risk assessment done for the purpose of this Disaster Management Plan included a literature review, the identification and consulting of sources of historic information, and workshops and focus groups with subject specialists and Disaster Management stakeholders within each of the Local Municipalities within the District.

Disaster risk assessment is a process that determines the level of risk by:

- identifying and analysing potential hazards and/or threats,
- assessing the conditions of vulnerability that increase the chance of loss for particular elements-at-risk (that is, environmental, human, infrastructure, agriculture, economic and other elements that are exposed to a hazard, and are at risk of loss);
- determining the level of risk for different situations and conditions;
- assisting in setting priorities for action;

# 1.1 Risk Profile of the Alfred Nzo District Municipality

Various disaster risks have been identified and assessed during 2009 to 2011, as set out in detail in the various Risk Assessment Reports<sup>1,2</sup>. The guidelines accompanying this document describe the risk assessment methodology. Parallel to this risk assessment that was performed in Umzimvubu and Matatiele, a risk assessment was performed in Mbizana and Ntabankulu local municipalities as well.

The first step in developing a risk profile is achieved by identifying all hazards and their subsequent consequences. A hazard is a potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. This process entails defining and describing hazards by characterizing their probability, frequency, and severity and evaluating adverse consequences, including potential losses and injuries. A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards.

The first step in developing a risk profile is hazard identification. A hazard is a potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards are typically categorised into Natural, Technological and Environmental hazards.

HAZARD CATEGORIES	HAZARD
NATURAL HAZARDS	Communicable Animal Diseases
These are natural processes or phenomena occurring in the biosphere that may constitute a damaging event. Natural Hazards are typically classified into three	Communicable Human Diseases
groups:	Pest Infestations (Alien Vegetation)

<sup>&</sup>lt;sup>1</sup>Disaster Risk Assessment Report. 2011. Final Report prepared for the OR Tambo District Municipality. November 2011. <sup>2</sup>Towards a Disaster Management Plan for the Alfred Nzo District Municipality. 2011. Disaster Risk Assessment, Version 1.0. March 2011.

- Biological Hazards: Biological hazards, which cover a range of hazards of organic origin, can cause significant loss of life, affecting people and animals at the population level, as well as plants, crops, livestock, and endangered fauna and flora, and can lead to severe economic and environmental losses. They include pathogenic microorganisms, and toxins and bioactive substances that occur naturally or are deliberately or unintentionally released. Bacteria, viruses, parasites, venomous animals and mosquitoes carrying disease-causing agents are also examples of biological hazards. Pathogenic microorganisms and toxins have unique characteristics that can make them particularly challenging to identify and manage, such as agent diversity (many different microorganisms and toxins) and different routes of transmission (airborne and droplet, infestation, ingestion, animal vectors and blood borne). These hazards may also pose a high risk for epidemics and pandemics, particularly from microorganisms that are highly virulent. Other disasters, such as from natural hazards, may exacerbate conditions for biological hazards, including damage to water infrastructure and the introduction of a novel pathogen to a susceptible community. Biological hazards may also increase in incidence and lethality, and in geographic localisation and seasonal patterns due to sensitivity to climate or changes in land use
- Geological Hazards: Geohazards are hazards with a geological origin. They
  have been divided into three hazard clusters, two of which seismogenic and
  volcanogenic are the result of Earth's internal geophysical processes, and a
  third shallow geohazards are the result of surface or near-surface
  processes, generally resulting in erosion or some type of mass movement.
  Seismogenic hazards, commonly referred to as earthquakes, give rise to
  specific hazards such as ground shaking, subsidence or ground rupture, but
  can also trigger hazards such as tsunamis or rockfalls. Some geohazards may
  be partially induced or exacerbated by human activity, such as coastal erosion
  from deforestation.
- **Hydro-Meteorological Hazards**: Meteorological and hydrological hazards are those resulting from the state and behaviour of the Earth's atmosphere, its interaction with the land and oceans, the weather and climate it produces, and the resulting distribution of water resources.

#### **TECHNOLOGICAL HAZARDS**

Technological hazards arise from the possibility of failure of an existing technology as well as from emerging technologies. These are increasing due to the scope of technological expansion and are relatively untested and subject to unintended uses. Technological hazards involve all transport systems (land, sea, air) and can affect the infrastructure that supports these systems as public and private services.

#### **CHEMICAL HAZARDS**

Use of chemicals has increased dramatically in many sectors, including industry, agriculture and transport, with people exposed to chemicals both of natural and human origin in the environmental and technological domain. Corrosive, flammable, and toxic chemicals pose several types of hazard.

Coastal Er	osio	on	
Earthquak Hazards	e	/	Seismic
Tsunami			
Floods			
Storm Sur	ge		
Lightning/	Τh	und	erstorms
Heat Wave	es		
Drought			
Wildfires			
Severe We	atł	ner	
Snow			
Sea-Level	Ris	е	
Cold Front	s		

Dam Failure	
Hazardous	Material
(Transporta	tion)
Major	Hazardous
Installations	(Industrial
Accidents)	
Marine Pollu	ution
Air Pollution	1
Land /	Ground
Pollution	
Water Pollu	tion
Disruption:	Electricity
Supply	-
Disruption:	Waste and
Illegal Dum	ping
Disruption:	Sewerage
and Drainag	je

<b>ENVIRONMENTAL HAZARDS</b> Environmental hazards arise through degradation of the natural systems and ecosystem services upon which humanity depends. Ecosystem services including air, water, land, biodiversity, and some key earth processes are threatened by	Disruption: Water supply and Security Structural Fire Aviation Hazards Road Hazards Indiscriminate Land Use Desertification Endemism: Loss of Biodiversity Alien Invasive Species
environmental degradation, here defined as loss of utility. Degradation can be a very gradual process and be hard to discern on a day-today basis. This includes biodiversity loss. Globally distributed contaminants in the atmosphere and oceans are having major impacts on the Earth's climate systems and food chains, and plastics are now a major cause of environmental degradation. Degradation can also be very rapid as with sudden contamination, deforestation or other disturbance. Degradation may also be accelerated by human activity. Storm surge impacts are exacerbated by the destruction of coastal and marine ecosystems. The impacts of environmental degradation are often seen most clearly through other hazards. For example, landslide susceptibility is increased by deforestation and the intensity and frequency of floods, droughts and heat waves are influenced by changes in climate and land cover.	(Fauna/Flora) Predation Soil Erosion
	Civil Uprost
Societal hazards are brought about entirely or predominantly by human activities and choices, and have the potential to endanger exposed populations and environments. They are derived from sociopolitical, economic activity, cultural activity and human mobility and the use of technology, but also of societal behavior – either intentional or unintentional. Societal hazards also have the potential to result in disasters and cause significant numbers of deaths, illness, injury, disability and other health effects, disruption to societal systems and services, and social, economic and environmental impacts.	Major Events (religious, cultural, political) Xenophobia

To identify the typical hazards in the ANDM, two methods were combined: one being a scientific assessment and the second being the integration of the Community Disaster Vulnerability and Capacity Assessment: Alfred Nzo District Municipality which was completed in 2016.

**Review findings** 

The present DM Plan review included a process of identifying the priority hazards and disaster risks and the findings are set out below:

# **IDENTIFIED HAZARDS**

List of Hazards identified by stakeholders in Mbizana, Matatiele, Ntabankulu, Umzimvubu and the Alfred Nzo District at the data gathering community workshops on 2 – 4 September September 2016.

Number	Hazards	Mbizana	Matatiele	Umzimvubu	Ntabankulu	District
1	Veld/forest fires	X P=2	X P=1	X P=2	X P=4	X P=1
2	Structural fires	Х	х	Х	Х	Х
3	Floods: river	Х	Х	Х	Х	Х
4	Extreme weather; Hail, high winds	Х	X P=4	X P=1	X P=1	X P=3
5	Snow	Х	Х			Х
6	Soil erosion	Х		Х	Х	

7	Drought	Х		Х		Х					
8	Motor vehicle accidents	Х	P=1	Х	P=3	Х	P=3	Х		Х	P=2
9	Bad roads	Х		Х							
10	Mist	Х									
11	Stray Animals on roads	Х		Х						Х	
12	Meat poisoning	Х				Х					
13	Wild pigs damage crops	Х								Х	
14	Air pollution	Х									
15	Human diseases	Х	P=4	Х	P=2	Х		Х		Х	
16	Stock theft	Х	P=3	Х	P= 3	Х	P=4	Х	P=3	Х	
17	Ground water pollution	х								Х	
18	Drug abuse	Х	P=5	Х							
19	Domestic violence	Х									
20	Male circumcision	Х				Х		Х	P= 5	Х	P=4
21	Teenage pregnancy	Х		Х		Х	P=5				
22	Sexual assault: rape	Х		Х							
23	Herbal intoxication	Х		Х	P=5						
24	Suicidal attempts (tank pill)	Х									
25	Drought leading to starvation	Х		Х							
26	High unemployment	Х		Х							
27	Mist	Х									
28	Assaults	Х									
29	Alien plant infestation	Х								Х	
30	Shortage of nurses and doctors	Х									
31	Abortions	Х									
32	Spillages	Х								Х	
33	Child abuse	Х									
34	Animal diseases			Х							
35	Xenophobia			Х							
36	Illegal border crossings			Х		Х				Х	P=5
37	Violent protests					Х		Х		Х	
38	Deforestation					Х				Х	
39	Sewerage spillage					Х					
40	Lack of clean water					Х		Х	P=2		
41	Mud flows/road falls									Х	

P = Priority

Summary of findings

The hazards classified as high identified across the ANDM:

	2020	2016
1.	Human disease;	Severe weather patterns
2.	Motor Vehicle Accidents;	Drought
3.	Severe Weather;	Biological hazards
4.	Drought and	Motor vehicle accident

5.	Veld Fire with a breakdown of severe	Veld fires
	weather hazards.	

Proposed action or changes

# 2016 Risk Assessment/Risk Profile

- Veldt/forest fires
- Extreme weather;
- Motor vehicle accident.
- Stock theft
- Human disease: TB; HIV; Cholera

2020 Risk Assessment/Risk Profile

- Drought
- Veldt/forest fires
- Extreme weather;
- Motor vehicle accident
- Human disease: TB; HIV; Cholera

It is recommended that ANDM focus on the 5 priority hazards, develop risk reduction plans, integrate into IDPs and develop response plans where after ANDM can develop and implement according to available capacity.

# 1.1.1 Scientific Component: Risk Assessment

# 1.1.1.1 Hazard Assessment

## Flood Hazard

Flooding events in the district are as a result of high volume and intensity convective precipitation events. The daily CHIRPS and ARC2 datasets were used to identify the individual days comprising the highest single precipitation events over the district since 1981 to present as the following days:

YEARS USED TO ANALYZE FLOOD HAZARDS						
01-Mar-88	10-Mar-88	16-Mar-90	16-Feb-91	11-Feb-96		
13-Feb-96	13-Nov-97	26-Jan-00	13-Dec-01	02-Mar-14		

The spatial distribution of rainfall of each of these days varied affecting different parts of the district to varying degrees. The ensemble of all of these days was used to determine the high-intensity precipitation hazard distribution for the analysis. It is worth noting that the highest peak events (95<sup>th</sup> percentile volume) have changed over time from 1981 to the present. It is therefore likely that flooding events in the future will be of a higher magnitude.



Figure 1: The 10 days exhibiting the peak precipitation over the district (right two panels), ensemble of the extreme states (left)



Figure 2: Change in 95th Percentile Precipitation Events from 1983 to Present

#### **Drought Hazard**

The Self-calibrating Palmer Drought Severity Index (sc-PDSI) uses anomalies to assess the severity of drought and wet spells with indexes of +0.5 to +4.0 being representing wet years, and -0.5 to -4.0 representing increasingly severe drought years. As droughts being chronic rather than acute in nature, a long-term assessment is required over individual months or even years. Indications of future trends would be the servere drought noted from 2012 – 2018, but also the droughts noted in the early 1980s, 1990s and 2000s. The characteristic of the data shows short events with high rainfall and then prolonged periods of lower than average, particularly in the latter part of the data. This gives a strong trend towards more frequent and more severe drought events.



Self-calibrating Palmer Drought Severity Index (ave 1901 - 2018)



Figure 3: Average sc-PDSI from 1901 to 2018



Figure 4: Changes in the Self-Calibrating Palmer Drought Severity Index (sc-PDSI) from 1950 to Present

**Alien Vegetation** 

Invasive alien vegetation was assessed though the SANBI average density data set. The assessment calculates the percentage of a 250m x 250m area that is covered with one of more alien species. Species assess include:

ASSESSED ALIEN VEGETATION WITH ALFRED NZO DISTRICT					
Acacia saligna	Agave species	Arundo donax	Caesalpinia decapetala	Cereus jamacaru	
Cestrum species	Chromolaena odorata	*Eucalyptus species	Hakea species	Jacaranda mimosifolia	
Lantana camara	Melia azedarach	Opuntia species	*Pinus species	Populus species	
Prosopis species	Psidium guajava	Rosa rubiginosa	Salix babylonica	Senna didymobotrya	
Sesbania punicea	Solanum mauritianum	Tamarix chinensis	*Wattle species		

The \*major alien species distribution is shown below.



Figure 5: Average alien species distribution density (top left), Eucalyptus species (top right), Pinus species (bottom left), and Wattle species (bottom right)

#### Fire Hazard

Fire density assesses the number of ignitions detected remotely, over time from 2001 to present. The average density distribution is presented below:



Figure 6: Average fire density as detected from 2001 to present using MODIS C6 sensors

# **Environmental Degradation**

The Hotspots of tree losses are shown in the change over time map below. This highlights the areas where there are significant and continuous tree losses. Data assessed is Hansen forest data from 2000 to the present.

Figure 7: Tree loss hotspots from 2000 to present from Hansen - Global forest watch



#### **Strong Winds**

The wind strength serves as a proxy for extreme wind events as these are not well documented. Below is the map of peak wind speeds.



Figure 8: Average wind strength as determined from the global wind atlas

# Lightning

The lighting climatology highlights strike density from the TRMM LIS sensor. The map below shows the strike distribution.

Figure 9: Average Lightning climatology from TRMM LIS



1.1.1.2 Cumulative Hazards To Ward Level The ensemble of all the hazards is used to create the cumulative hazard map to ward level below:



Figure 10: Cumulative hazard ward maps

#### 1.1.1.3 Vulnerability

There are a number of factors that will increase populations vulnerability to various hazards. The assessment of these vulnerabilities is done through the 2011 StatsSA Census data as it provides a high-resolution view of varying local vulnerabilities.

### **Dwelling type**

The type of dwelling in which people stay may influence their vulnerability. For instances, families living in Traditional dwellings/hut/structure made of traditional materials Informal dwellings (shack; in the backyard), Informal dwellings (shack; not in the backyard, e.g. in an informal/squatter settlement or on a farm), or Caravans/tents will be subject more severely to extreme weather and less able to defend themselves or belongings in the case of a flood for instance.

#### Age demographics

The dependency ratio will influence both the physical exposure of populations with the young and elderly being more susceptible to impacts, but also have an increased ratio of non-working age people in a community will limit the financial resilience of a community.

#### **Access to Sanitation**

Areas have reduced access to proper sanitation facilities will increase the likelihood of contracting various diseases and populate the environment. As such areas with higher ratios of Pit toilets with ventilation (VIP), Pit toilets without ventilation, Bucket toilets, or none are considered more vulnerable.

#### Access to Clean Water

Access to clean water is fundamental to human health and wellbeing. As such, areas with high ratios of dependence on Borehole, Spring, Rainwater tanks Dam/pool/stagnant water, River/stream, Water vendor/tanker are considered more vulnerable as each of these is more likely to fail than municipal piped water.

## **Access to Refuse**

Access to sufficient water and refuse removal services is essential for healthy communities and clean environments. An area where there is a higher ratio of reliance on own refuse dump or No rubbish disposal is, therefore, more vulnerable.

There is a total of five (5) landfill sites within Alfred Nzo District. These include two (2) at Umzimvubu LM; one (1) at Matatiele LM; one (1) at Mbizana LM and one (1) Ntabankulu LM. All are operational except at Mbizana LM which is still under construction.

Rural areas are generally not serviced by municipalities due to the remote locations of some areas. Waste produced in these areas are disposed of by community members either by means of on-site burning and burying or establishing small, poorly managed communal waste disposal sites.

#### Low-Income areas

Families with low or no income will be less able to cope with the shocks from severe hazards such as replacing clothes or school uniforms in the event of a fire destroying the home. The StatsSA income brackets of Low No income, R1 - R 4800, R 4801 - R 9600, R 9601 - R 19 600 annually are therefore considered at higher vulnerability.

Alfred Nzo District is considered the poorest district in the province and in the country (COGTA, 2020). In 2019, there were 628 224 people living in poverty, using the lower poverty line definition, across the Alfred Nzo District which accounts for 71.5% of the total population (COGTA, 2020). This is significantly higher percentage of the population when compared to the Eastern Cape provincial figure which was at 54.3%. Ntabankulu and Mbizana local municipalities are ranked first and second most poor local municipalities in the country with 78% and 77.3% of the total population living in poverty (COGTA, 2020). Umzimvubu and Matatiele local municipalities are at 67% and 63.8% of the population living in poverty respectively. As a consequence of the poverty levels in the district, there is a cumulative total of 364 205 grant dependents in the district (COGTA, 2020).

#### Cumulative vulnerability to ward level

The ensemble of all the vulnerability is used to create the cumulative vulnerability map to ward level below:



Figure 11: Cumulative vulnerability ward maps

# 1.1.1.4 Capacity

**Higher-income areas:** Areas with a higher ratio of populations with higher incomes are more able to cope with - and recover from disruptions caused by hazardous incidents. The StatsSA income bins of R 153 801 - R 307 600, R 307 601 - R 614 400, R 614 001 - R 1 228 800, R 1 228 801 - R 2 457 600, R 2 457 601 or more are deemed as higher income and more resilient to impacts.

**Area Accessibility**: The economic and man-made resources that build resilience and wellbeing for communities are not distributed evenly across the world but are rather clustered in settlements and more so in cities. Areas with reduced access to cities and settlements as a function of distance, transport infrastructure, will be limited in opportunities and services offered by urban centres is a major barrier to improved livelihoods and overall development. By contrast, those areas that have access to the services offered by cities will have greater opportunity and developmental capacity. According to the Research Study, a combination of the distance to certain areas and poor road infrastructure renders difficulty for certain areas in need of assistance (Taylor, 2016). The roads in certain areas become impassable during rainy periods making it extremely difficult for emergency services as well as community members to get in and out during these periods (Taylor, 2016).

**Fire stations:** Areas that are served by Fire stations will have an increased capacity in the event of disasters and hazards occurring. According to the Research Study (Taylor, 2016) about a third of respondents do not know where their nearest fire department is located. Furthermore, over 50% of respondents in the study lives more than 10 kilometres from their nearest fire department.

**Police:** Areas that are served by Police stations will have increased resilience to crime and will benefit from the order provided by police during disasters and hazard event occurring.

**Medical** – **Clinics and Hospitals**: Areas that are served by clinics and hospitals stations will directly benefit from the medical care in the event of disasters and hazards. These areas will have increased capacity to recover over areas that do not have these services.



#### 1.1.1.5 Risk

The Risks within the district are the product of the noted historical hazard occurrence, the area's vulnerability to said hazards and their capacity to cope with the outcomes of the hazard:



Figure 13. Relative Risk of the district (left), cumulative Hazard (top right), Vulnerability (middle right), and capacity (bottom left) indices

Hazards are distributed throughout the district with notable impacts occurring in the far north, central and coastal area. The individual hazard assessments show this variation with flood and alien vegetation hazard being southerly focused, Drought hazards being focused in the central areas of the district, and fires being focused in the far north and the southern areas. Disaster risk planning will need to apply interventions in the spatially apocopate locations to match these hazards

**The Vulnerability maps** indicate a high vulnerability in the southern areas in most of the vulnerability factors, it is worth noting that this does tend to follow population peaks. The area capacities are also defined by this factor with the majority of fire, police and medical capacities being focused in the southern areas leading to a lack of capacity in the far northern area.

**The cumulative risk map** when combined with the hazard, vulnerability and capacity components shows lower risk in the central, and eastern areas but higher risk exposure to the north and at the southern coastal area.

Any **risk mitigation interventions will need to assess the local context** when deciding to go forward with development investment. Factors to consider are the population density which will inform the local beneficiaries and enhance the effectiveness of interventions. The agriculture distribution as a key livelihood in the area as well as the general land cover and river systems for targeted intervention developments.



Figure 14. Relative Risk of the district (top left), population density (top right), Agricultural area/type (bottom left), physical context (bottom right)

#### 1.1.2 Community-Based Risk/Vulnerability Research Survey (2016)

The above research study that was applied in the Alfred Nzo District was descriptive in nature for the purpose of it was to describe the vulnerabilities of communities in the Alfred Nzo District and their subsequent exposure to hazards occurring in the district, as well as the associated impact of these hazardous events. The research provided an analysis of the current state of affairs as they existed within the Alfred Nzo District.

Based upon consultations with the ANDM: DMC it was agreed that ten households per ward would be interviewed and four wards per municipality, and therefore as such 16 wards across the District would to translate to a total of 160 households which would ultimately paint a realistic picture for the District in terms of hazard exposure.

The hazards included in below were chosen based on recommendations from the ANDM DMC and include the five priority risks of the ANDM:

- Human disease;
- Motor Vehicle Accidents;
- Severe Weather;
- Stock Theft and
- Veld Fire with a breakdown of severe weather hazards.
- Drought was also included as it was considered a priority risk for the district before the 2014 update of the district DMP.



The snow, stock theft and lightning hazards are generally area specific. The municipal hazard breakdown will be made clear in the municipal level findings. Hazards named in this question which require more attention in risk reduction strategies and may need more investigation include: hail, earthquakes and tornadoes.



# 1.1.2.1 Matatiele Local Municipality

Matatiele municipal area is composed of the towns of Matatiele and Cederville as well as the R293 township of Maluti. These areas are surrounded by commercial farms, dispersed rural settlements and subsistence farmlands. Matatiele is the largest municipality in the district constituting 58% of the total district area (Municipalities of South Africa (a), 2017); (Statistics South Africa, 2012).



Figure 15: Matatiele Hazards

Matatiele faces a wide range of hazards throughout the year. Every hazard, from the selection given, has been identified as an issue by at least 20% of respondents.



Figure 16: Matatiele Other Hazards

The most prevalent hazards which affect the municipality – and were not included in the selection – are crime/rape and earthquakes. The high instances of crime/rape are discussed in the district level findings. The identification of earthquake hazards in the municipality requires further investigation to determine the frequency and intensity of this geological hazard.



Figure 17: Hazards Affecting Matatiele Households in the Past 10 Years

Rain and wind are the most common causes of hazard impacts on households in the Matatiele municipality. Stock theft, damage related to snow and veld fires are the next most common causes of hazard impacts in the municipality.

# 1.1.2.2 Mbizana Local Municipality

Bizana town is the main hub in the Mbizana municipality and is surrounded by mostly rural households. Over 90% of the Mbizana population resides in rural villages with the rest residing in urban areas. Mbizana is the only ANDM municipality which boasts a coastline and is the largest municipality in the district by population size (Municipalities of South Africa (b), 2017); (Statistics South Africa, 2012).



Figure 18: Mbizana Local Municipality Hazards

The response rate in the Mbizana hazard analysis is low, however, the number of respondents in Mbizana (48) is almost 20% higher than any other municipality. Thus, data collected does show which hazards are prevalent in the municipality. As can be expected in the municipality there is almost no chance that snow will affect households. Veld fire, lightning, rain, wind, drought and stock theft are the most common hazards identified by respondents. Other hazards which were identified by respondents include: hail; crime/rape and wild pigs. Wild pigs have been destroying crops and endangering livelihoods as a result of sugar cane fields in the area being closed down; this hazard is limited to Ward 16. Due to the fact that no coastal households were included in the sample there is no data related to coastal hazards within this study.



Figure 19: Hazards Affecting Mbizana Households in the Past 10 Years

The most common sources for hazard impacts in Mbizana are, much like Matatiele, rain and wind related. Lightning and hail impacts are almost exclusively linked to the Mbizana municipality. Although drought is identified as a hazard in all four municipalities, Mbizana has the highest number of respondents reporting having their livelihoods affected due to drought.

#### 1.1.2.3 Ntabankulu Local Municipality

Ntabankulu is the smallest of the four ANDM municipalities by population and size. Accounting for just 13% of the total area, this municipality is characterised by mountainous terrain and predominantly rural households (Municipalities of South Africa (c), 2017); (Statistics South Africa, 2012).



Figure 20: Ntabankulu Local Municipality Hazards

Drought, veld fire, lightning and wind hazards are the most encountered for the Ntabankulu area. Stock theft and rain hazards are second most. The steep decline of rain related hazards, as compared to other municipalities, is seen in this area. Wind is the most common hazard in the municipality. When asked whether respondents homes were built on either a flat, shallow or steep gradient, the highest percentages of those living on a steep gradient, within each municipality, was recorded in Ntabankulu and Matatiele. Other hazards which were identified in the municipality include: crime; drug use; HIV and TB; rock falls; hail and tornadoes. The tornado hazard is seen to be on the rise as a large number of respondents stated they felt the tornado hazard was increasing in frequency.



Figure 21: Hazards Affecting Ntabankulu Local Municipality Households in the Past 10 Years

As with all the municipalities already reviewed, the wind and rain hazards in Ntabankulu have been the cause of most hazard impacts on households or persons. Although rain was not selected as a hazard in the area to the degree of other municipalities respondents whom have suffered an impact from rain impacts remain high. This area also has a high number of tornado related hazard impacts. Further research into the increase of tornado hazards and possible risk reduction strategies is needed.

# 1.1.2.4 Umzimvubu Local Municipality

Umzimvubu is the third largest municipality in the district by population size and the second largest by area. While the majority of households are rural the municipality has seen an influx of residents to the urban centres of Mount Frere and eMaxesibeni (Municipalities of South Africa (d), 2017) and (Statistics South Africa, 2012).





Much like the three other municipalities in the district, Umzimvubu respondents agree that the most common hazard they face is high winds. Umzimvubu and Matatiele are the only municipalities in the district which face a persisting threat from snow. These two municipalities also show the highest numbers for respondents viewing MVAs as a hazard of concern.



Figure 23: Hazards Affecting Umzimvubu Households in the Past 10 Years

Wind is the most prevalent cause of hazard impacts for Umzimvubu followed by rain. Tornado impacts here are the highest in the district with five instances of tornadoes damaging homes – just more than Ntabankulu.

Identifying the risks that particular communities are exposed to, based on their physical location is vital for the ANDM DMC in prioritising DRR interventions, it also showcases the importance of creating municipal DM plans that are tailored to dealing with the specific hazard types found within each municipality. The researchers of this study believe further research into tornadoes and earthquakes in the ANDM should be conducted to identify what areas are susceptible to their impacts and what possible risk reduction strategies there may be for these hazards.

# 1.1.3 Risk Summary

In this section the results of the risk assessment conducted within the ANDM are summarised.

The table below provides a district-wide view of which hazards were found to be most prevalent within the district, influencing the majority of local municipalities.

Natural Hazards				
Hydro Meteorological Hazards				
Drought	Hail storms			
Erosion	Severe storms			
Fire	Violent wind			
Flood	Snow			
Lightning	Loss of Biodiversity			
Extreme Temperatures	Oceanographic (tsunami, storm surge)			
Biologica	l Hazards			
Human Diseases: Swine Flu, Measles, Rabies, TB, HIV/AIDS, Flu	Animal Diseases: Rabies (Animals), Foot and Mouth			
Plant Diseases	Infestations			
Geological Hazards				
Earthquake	Subsidence			
Landslides	Rockfalls			
Technologi	cal Hazards			
Sewerage and drainage Infrastructure failure	Structural failure (bridges, dams, building)			
Road accidents	Service Delivery Failure (electrical, IT, sanitation, transport, water)			
Illegal Dumping				
Hazardous material by road (spillage, explosions)				
Industrial accidents				
Environmental hazards				
Air pollution	Water pollution			
Land Pollution (Soil contamination)				
Social hazards				
Civil Unrest	Major Events (religious, cultural, political)			

# **Table 1: ANDM Common Hazards**

Review findings									
The present DM Plan review included a process of identifying the priority hazards and disaster risks and the									
findings ar	e set out below:								
IDENTIFIE	IDENTIFIED HAZARDS								
The list of	Hazards identified below in an ac	cumulation fi	rom both the	Scientific as well	as the Commu	nity-Based			
Survey components.									
Number Hazards Mbizana Matatiele Umzimvubu Ntabankulu District									
		•	•	•					

1	Wildfires (Veld/Forest)	Х	P=2	Х	P=1	Х	P=2	Х	P=4	Х	P=1
2	Structural Fires (Formal/Informal)	Structural Fires X (Formal/Informal)		Х		Х		Х		Х	
3	Floods: river	Х		Х		Х		Х		Х	
4	Extreme weather; Hail, high winds	Х		Х	P=4	Х	P=1	Х	P=1	Х	P=3
5	Snow	Х		Х						Х	
6	Soil erosion	Х				Х		Х			
7	Drought	Х		Х		Х					
8	Motor vehicle accidents	Х	P=1	Х	P=3	Х	P=3	Х		Х	P=2
9	Bad roads	Х		Х							
10	Mist	Х									
11	Stray Animals on roads	Х		Х						Х	
12	Meat poisoning	Х				Х					
13	Wild pigs damage crops	Х								Х	
14	Air pollution	Х									
15	Human diseases	Х	P=4	Х	P=2	Х		Х		Х	
16	Stock theft	Х	P=3	Х	P= 3	Х	P=4	Х	P=3	Х	
17	Ground water pollution	Х								Х	
18	Drug abuse	Х	P=5	Х							
19	Domestic violence	c violence X									
20	Male circumcision	Х				Х		Х	P= 5	Х	P=4
21	Teenage pregnancy	eenage pregnancy X		Х		Х	P=5				
22	Sexual assault: rape	Х		Х							
23	Herbal intoxication	Х		Х	P=5						
24	Suicidal attempts (tank pill)	Х									
25	Drought leading to starvation	Х		Х							
26	High unemployment	Х		Х							
27	Mist	Х									
28	Assaults	Х									
29	Alien plant infestation	Х								Х	
30	Shortage of nurses and doctors	Х									
31	Abortions	Х									
32	Spillages	Х								Х	
33	Child abuse	Х									
34	Animal diseases			Х							
35	Xenophobia			Х							
36	Illegal border crossings			Х		Х				Х	P=5
37	Violent protests					Х		Х		Х	
38	Deforestation					Х				Х	
39	Sewerage spillage					Х					
40	Lack of clean water					Х		Х	P=2		
41	Mud flows/road falls									Х	
P = Priorit	у										
Summary	of findings										
The hazard	ds classified as high identified acro	oss	the AND	∕I:							
	2020			20	14						

1.	2016	Veld/forest fires
2	Severe weather patterns	Extreme weather;
	Urought Human diseases (Covid-19, HIV, TB etc)	Hail, High winds etc.
3.	Motor vehicle accident	Motor vehicle accidents
4.	Veld fires	Stock theft
5.		numan diseases. 16, niv, cholera
Propos	ed action or changes	
2014 K	Voldt (forest fires	
•		
•	Extreme weather;	
•	Motor vehicle accident.	
•	Stock theft	
•	Human disease: TB; HIV; Cholera	
2016 Ri	isk Assessment/Risk Profile	
٠	Drought	
•	Veldt/forest fires	
•	Extreme weather;	
•	Motor vehicle accident	
•	Human disease: TB; HIV; Cholera	
2020 Ri	isk Assessment/Risk Profile	
•	Wildfires (Veldt/Forest)	
•	Flooding (Flash Floods/Riverine)	
•	Severe Weather (Strong Winds/Lightning)	
•	Motor Vehicle Accidents	
•	Human Diseases (TB; HIV; Cholera; Covid-19)	
•	Drought	
It is root	opponded that ANDM force on the Contract to be-	rde develop rick reduction plans integrate into IDD-

The recent declaration of drought in the ANDM as a disaster, and the 2015 council resolution adopted by the municipality necessitated the revision of the risk profiles. The below table depict the top 5 hazards in the area, and drought has moved from number 7 to number 2, replacing stock theft in the top 5.

#### SEVERE WEATHER

- Severe storms occurring in the Eastern Cape are compound; storms produce various combinations of hail, snow, wind, tornado, thunderstorms/lightning and flash flooding, thereby increasing the threat to and impact on people.
- Landslides and mudslides: These are either "dry" or "wet" types of rapid (up to 80km/h) downhill mass wasting which may be caused by ground destabilisation or other trigger and can vary in mass and velocity. Depending on the location of the landslide or mudslide, it may impact on the safety of communities below and may also have an impact on especially on roadways and traffic flow. Areas on the mountain slopes previously burnt where vegetation normally stabilises the ground are most at risk of landslides or mudslides, especially after extended periods of heavy rainfall.
- **Coastal storm surges** (Mbizana Local Municipality only): A storm surge is an offshore rise of water associated with a low-pressure weather system. A storm surge is caused primarily by high winds pushing on the ocean's surface. The wind causes the water to pile up higher than the ordinary sea level. Low pressure at the centre of a weather system also has a small secondary effect, as can the bathymetry of the body of water.

# **GENERAL IMPACTS:**

**ECONOMIC:** Causes electricity disruption; Damage to infrastructure. i.e. blow away roofs from poorly built RDP houses; Loss of tourisms due to closing of vital routes; Increase in maintenance and recovery costs prices; Disruption transport services; Bent, snapped or collapsed light poles or traffic lights, or downed power lines; Heavy snowfall or hailstorms can give rise to traffic chaos if people fail to adapt their driving to the road conditions; Road closures due to hailstorms; To reduce the chances of such an event, farmers purchase foodstuff for their animals, which could be a financial burden; Extreme winter cold often causes poorly insulated water pipelines and mains to freeze and sometimes burst. Even some poorly protected indoor plumbing ruptures as water expands within them, causing much damage to property and costly insurance claims; Demand for electrical power and fuel rises dramatically during such times.

**ENVIRONMENTAL:** In summer, strong winds promote fire and contribute to erosion particularly where it moves over the escarpment and removes the natural vegetation; Increases waves and resultant damage; Crop damage, cave-ins, mud slides, debris flows and sink holes; Erosion which leads to land degradation. This could lead to a decline in the number of species available and an increase in the risk of species endemism; It can cause death and injury to livestock and wildlife.

**SOCIAL:** Loss of livelihood; Increase in poverty; Increase in respiratory disease outbreaks (human); Increase in crime; Possible injuries and loss of life; Exposure to extreme and especially unexpected cold can lead to hypothermia a frostbite, which require medical attention due to the risks of tissue damage and organ failure; Exposure to cold mandates greater calorie intake for all animals, including humans, and if a cold wave is accompanied by heavy and persistent snow, grazing animals may be unable to reach needed food and die of hypothermia or starvation; Psychological trauma.

Municipality		EVAL	UTION		
	IMPACT	LIKELIHOOD	RISK INDEX	RANKING	Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate
Alfred Nzo District (Overall)	4	4	16	1	<ul> <li>change affects more than just a change in the weather; it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. Because so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water, and health risks. Recent climate modelling results indicate that extreme weather events may become more common. Rising average temperatures produce a more variable climate system.</li> <li>Localised events could include:         <ul> <li>Windstorms and heavy winds</li> <li>Heat waves, droughts</li> <li>Storms with extreme rain or snow</li> <li>Severe thunderstorm and hail storm</li> <li>Extreme high and low temperatures</li> </ul> </li> </ul>

**General Impacts:** 

DROUGHT

**ECONOMIC:** Destruction of holiday/weekend resorts; Loss of pastures requiring expensive replacement by buying fodder; Loss of fencing; Loss of farming equipment; Loss of livestock; Closure of roads leading to disruption of tourist routes and tourism activities; Interruption of power supplies on main Eskom line; Job losses; Increased insurance claims; Special arrangements for high risk periods (temporary staff, aerial fire-fighting); and High cost of fire prevention and awareness programmes.

**ENVIRONMENTAL:** Changes to biodiversity if vegetation is burnt too regularly or if fires burn vegetation completely; Specie loss or habitat loss if untimed or extreme; Damage to soil structure; Loss of water catchment areas; Air pollution; Spread of fire-adapted alien invasive plant species; and Vegetation fires can create elevated levels of gases and particle air pollution over a long period of time through the release of CO<sup>2</sup>.

**SOCIAL:** Loss of and damage to residential property. Areas that are repeatedly affected may lose access to insurance coverage. Some residents may also be uninsured for various reasons; Loss of livelihood/income; Increase in poverty; Increase in crime; Smoke inhalation; Damage to infrastructure; Disruption of road traffic and reduced visibility; and Injury/death of people and livestock.

Municipality		EVAL	UTION		
	IMPACT	LIKELIHOOD	RISK INDEX	RANKING	Drought conditions often provide too little water to support food crops, through either natural
Alfred Nzo District (Overall)	3	2	6	5	precipitation or irrigation using reserve water supplies. The same problem affects grass and grain used to feed livestock and poultry. When drought destroys food sources, people go hungry. Faced with other impacts of drought, many people will flee a drought-stricken area in search of a new home with a better supply of water, enough food, and without the disease. Drought often creates a lack of clean water for drinking, public sanitation and personal hygiene, which can lead to a wide range of life-threatening diseases. All living things must have water to survive; people can live for weeks without food, but only a few days without water. The low moisture and precipitation that often characterize droughts can quickly create hazardous conditions in forests and across rangeland, setting the stage for wildfires that may cause injuries or deaths as well as extensive damage to property and already shrinking food supplies.

**General Impacts:** 

FLOOD

• Flash floods can be caused by very localized, almost stationary thunderstorms, where an exceptionally deep layer of unusually humid air is present, and where the amount of potential precipitable water in the clouds is very high. Intense rainfall occurs over a relatively small area leading to a sudden influx of water into a drainage basin. This water in turn fills the streams and rivers in the basin and the water races downstream in a high peak discharge, with little or no advance warning. Factors affecting the speed of onset of a flash flood include the intensity and duration of the rain, the topography, soil conditions and ground cover. In arid regions where watercourses are often dry, sudden episodic flooding can lead to potentially high levels of damage and loss of life.

In remote rural areas the threat of flash flooding is high, where advance early warning systems are poorly developed or even absent.

- **RIVERINE (OR FLUVIAL) FLOODS** rainfall over an extended period and an extended area can cause major rivers to overflow their banks. Downstream areas may be affected, even when they didn't receive much rain themselves. Riverine floods are influenced by the hydrology of water courses, the size and topography of the catchment, the intensity and location of rainfall, and how the built environment has been designed. Riverine floods can result in floods that take days (or even weeks) to subside, but effective warnings can help to minimise the loss of lives. Buildings and critical infrastructure can be damaged or destroyed and it can become extremely difficult for affected areas to function for a prolonged period; economic losses can be vast. Chemicals and other hazardous substances (such as sewage) can contaminate the water bodies and people's homes
- URBAN OR PLUVIAL FLOODS can be caused by flash floods, coastal floods, or river floods, but there is also a specific flood type that is called urban flooding. Urban flooding (stormwater) is specific in the fact that the cause is a lack of drainage in an urban area. Flooding usually results when the storm-water runoff exceeds the capacity of drainage systems (natural and constructed) or when ground water flows into structures or when water accumulates in depressions (ponding). In respect of Informal Structures, they will be rated as being flooded: if they are situated in areas of extensive ponding of water which has resulted in a substantial amount of water covering floors and areas around dwellings for an extended period of time (more than 48 hours).

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**Severe storms, linked to cold front and low-pressure systems** - The impact of storms is particularly severe on impoverished and vulnerable rural populations in the eastern parts of the province, where there is an urgent need for building capacity in disaster risk management. Severe storms in the Eastern Cape are a more frequent and severe phenomenon than has been reported in the past, and pose a significant risk for various geographic populations in terms of loss of life, injury and impact on livelihoods.

frontal system or an inland cut-off low pressure system may have a surface wind gusting up to 100kph or higher and may cause structural damage – roofs are blown off and trees uprooted. These storm systems are also intense rainfall producers and flooding - rivers burst their banks and widespread urban and seepage flooding can occur. Cold, including snow on the higher mountains, may also occur. Those living in low-cost Human Settlements or informal settlements are the most vulnerable.

- Wildfires dramatically change landscape and ground conditions, which can lead to increased risk of flooding during heavy rains because the burned ground is unable to absorb the falling rain, producing runoff conditions much like a parking lot. Because of this, even modest rainstorms over a burned area can result in flash flooding downstream. These floods are typically much larger for a given sized storm than they were before the wildfire, so flooding is likely to be much more extensive following wildfire, endangering properties previously considered safe from flooding. These floodwaters typically transport surface debris such as downed trees, boulders, and gravel.
- Hail storms may also occur when cumulonimbus clouds are present Agriculture, gardens, buildings and even people, animals and birds may also be affected as a result.

**ECONOMIC:** After flooding, government resources are used for aiding or reconstruction, e.g., police force, fire control, aid workers, etc. This leads to greater financial loss to society; National departments and parastatals (state owned enterprises) typically affected by a flood events are the DWA, South Africa National Parks (SANParks), SANRAL, Transnet, and Telkom. Provincial government departments most affected by flooding are Agriculture, Education, CapeNature, Housing, Provincial Roads, Public Works and Emergency Services; and Flooding exerts stress on sewerage and stormwater systems and it is costly to restore the damage to critical infrastructure such as water purification systems and sewerage systems; Loss to recreational/tourism industry; Loss to industries directly dependent on marine business; Damage to commercial forestry plantations; Damage to crops; Rerouting of traffic on routes which are longer and add to cost of transport.

**ENVIRONMENTAL:** Poor agricultural practices (draining of wetlands) have impacted on wetlands, reducing their ability to act as sponges, attenuating floods and ensuring perennial flows. As a result, rivers remain dry for longer periods and flood damage is more extensive; Damage to the farmland: loss of boundary fences; loss of soil on permanent crop land; Damage to river banks, crops; soil erosion, inability to cultivate land due to water logging of soils; Disruption of critical municipal infrastructure; Increased demand for recovery and repair operations; Disruption of communication and electrical services; Increased risk to soil erosion and desertification; Damage and degradation of marine and wildlife habitat; Damage to irrigation channels and other infrastructure; Pollution.

**SOCIAL:** Food security problems; Flooding can lead to infectious diseases (through stagnant infected water): diarrhoea, cholera, waterborne diseases; Drinking water quality problems; Increase in lower respiratory infections; Damage to cultural or heritage sites; Loss of memorabilia; Uninsured losses; Depression, nervousness and anxiety in flood survivors; Adverse effects on quality of surface and groundwater; Contamination of water supply; Drowning; Overcrowded hospitals; and Injuries.

Municipality		EVAL	UTION		
	IMPACT	LIKELIHOOD	RISK INDEX	RANKING	The combination of increased temperatures and changes in rainfall distribution, it is likely that
Alfred Nzo District (Overall)	3	2	6	5	flooding and storm events will increase and will impact on human settlements, infrastructure, human health and place a greater burden on particularly impoverished communities. Increased temperatures will also lead to increased sea surface temperatures which could possibly lead to greater storm surges, destroying infrastructure, affecting human life and marine ecosystems. The Eastern Cape Province is projected to experience an increase in severe extreme weather events such as flooding and storms. Poor communities concentrated in high-risk areas will be especially vulnerable as they tend to have limited adaptive capacities, and a higher dependence on climate-sensitive resource. Increased frequency of extreme weather events such as hail, wind and heavy rain will increase the risk of crop failure. Such changes will have significant impacts on soil erosion and fertility, crops, livestock, and grazing land which will threaten the province's agricultural sector, and subsequently the financial sustainability of existing commercial and subsistence farming operations. This will impact on the livelihoods of rural communities, as well as food security in the region.

**General Impacts:** 

WILDFIRE

**ECONOMIC:** Destruction of holiday/weekend resorts; Loss of pastures requiring expensive replacement by buying fodder; Loss of fencing; Loss of farming equipment; Loss of livestock; Closure of roads leading to disruption of tourist routes and tourism activities; Interruption of power supplies on main Eskom line; Job losses; Increased insurance claims; Special arrangements for high risk periods (temporary staff, aerial fire-fighting); and High cost of fire prevention and awareness programmes.

**ENVIRONMENTAL:** Changes to biodiversity if vegetation is burnt too regularly or if fires burn vegetation completely; Specie loss or habitat loss if untimed or extreme; Damage to soil structure; Loss of water catchment areas; Air pollution; Spread of fire-adapted alien invasive plant species; and Vegetation fires can create elevated levels of gases and particle air pollution over a long period of time through the release of CO<sup>2</sup>.

**SOCIAL:** Loss of and damage to residential property. Areas that are repeatedly affected may lose access to insurance coverage. Some residents may also be uninsured for various reasons; Loss of livelihood/income; Increase in poverty; Increase in crime; Smoke inhalation; Damage to infrastructure; Disruption of road traffic and reduced visibility; and Injury/death of people and livestock.

Municipality		EVAL	UTION		
	IMPACT	LIKELIHOOD	RISK INDEX	RANKING	These days with climate variability, climatic conditions do not always follow the same pattern
Alfred Nzo District (Overall)	3	2	6	5	<ul> <li>and as such can result in fires flaring up any time during the year. Most fires recorded in the area are in summer and autumn, and the relative prevalence of summer fires has increased in recent times. There are a few factors associated with the risks of veld fires such as:</li> <li>Climate, vegetation and fires are linked as any changes will influence fire spread and intensity and it will result in differences in the prevailing fire regime, this include unmanaged alien vegetation that produces high fuel-loads;</li> <li>The prevalence of wind and wind speed, coupled with the last rain event during the fire season influences fire ignition and the spread of fire. In this regard berg-winds pose a high threat in the high situated locations in the area;</li> <li>The age of the veldt (when last burned) is also an important factor, the older the higher the risk.</li> </ul>

#### MOTOR VEHICLE ACCIDENTS

The rail network in the district is limited to the Matatiele and Cedarville towns where the rail runs through these towns in a north east to west direction connecting these towns to the KwaZulu-Natal Province. The main roads in the Alfred Nzo District include (COGTA, 2020):

- The N2 This is a national road which runs in a north-south direction linking the Eastern Cape and KwaZulu-Natal provinces.
- The R56 This is a regional road which runs along the northern and western boundaries linking Matatiele with Kokstad to the east and Mt Fletcher to the south respectively.
- The R61- This is a regional road linking Mbizana and Port Edward

Other roads include (COGTA, 2020):

- Three gravel roads from N2 to R56 (ending at Cedarville and Ematolweni, the (405)
- Gravel back road from Mount Ayliff to Mount Frere passing through Sphambukeni and Cancele junctions
- R626 from N2 (Phakade junction) to R61 (Kubha junction), and on to Flagstaff
- Matatiele to Qacha's Nek (Lesotho)
- Matatiele to Queen's Mercy, Malekgonyane (Ongeluksnek) and Thaba Chicha.

**ECONOMIC:** Destruction of holiday/weekend resorts; Loss of pastures requiring expensive replacement by buying fodder; Loss of fencing; Loss of farming equipment; Loss of livestock; Closure of roads leading to disruption of tourist routes and tourism activities; Interruption of power supplies on main Eskom line; Job losses; Increased insurance claims; Special arrangements for high risk periods (temporary staff, aerial fire-fighting); and High cost of fire prevention and awareness programmes.

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invasive plant species; and Vegetation fires can create elevated levels of gases and particle air pollution over a long period of time through the release of CO<sup>2</sup>.

**SOCIAL:** Loss of and damage to residential property. Areas that are repeatedly affected may lose access to insurance coverage. Some residents may also be uninsured for various reasons; Loss of livelihood/income; Increase in poverty; Increase in crime; Smoke inhalation; Damage to infrastructure; Disruption of road traffic and reduced visibility; and Injury/death of people and livestock.

Municipality		EVAL	UTION		
	ІМРАСТ	LIKELIHOOD	RISK INDEX	RANKING	<ul> <li>Because of the national road running through the district, the N2 has a strong impact on</li> </ul>
Alfred Nzo District (Overall)	3	2	6	5	<ul> <li>the travel patterns and traffic composition in the district. Large volumes of heavy vehicles dictate the travel speed on the N2 and are also the cause of much of the congestion in towns such as Mt Frere.</li> <li>Alfred Nzo DM is one of the labour-sending areas to various mines around the country. Every Sunday buses and taxis leave or pass through the DM using the N2 route to various provinces (Malila, 2018).</li> <li>The typical socio-economic factors influence the operational methods of the taxi industry as follows: a) The widely scattered distribution of villages b) The low level of income in villages c) The low level of employment in the Eastern Cape Province, with specific reference to villages.</li> <li>The freight vehicle has taken over nearly all kerbside parking in Mt Frere and to a lesser extent Mt Ayliff. The lack of law and order allow the freight operations to conduct the loading and off-loading by double parking and take long to complete the process. This reduces the available roadway capacity. All this results in that the N2 is lacking continuity in the traffic flow and it increases the chances for accidents.</li> </ul>

#### **REPORTABLE HUMAN DISEASES**

In 2018, 103 000 people in the Alfred Nzo District Municipality were infected with HIV. This reflects an increase at an average annual rate of 1.58% since 2008, and in 2018 represented 11.83% of the district municipality's total population. The Eastern Cape Province had an average annual growth rate of 1.87% from 2008 to 2018 in the number of people infected with HIV, which is higher than that of the Alfred Nzo District Municipality. The Alfred Nzo District Municipality has 72 clinics, 8 hospitals and 2 community health centers (COGTA, 2020).

There is a total of 10 assessed and approved quarantine facilities in the District with a total bed capacity of 165 and one facility has been activated which has 53 beds. Out of the 10 facilities, five are in the Matatiele local municipality, 3 in the Umzimvubu local municipality, 1 in the Mbizana local municipality and 1 in the Ntabankulu Municipality (COGTA, 2020).

Certain health-related events may be rare or only occur after a series of unrelated factors all happen at the same time. This will include the introduction of a life-threatening disease hitherto unknown in the area or an outbreak of a disease that causes severe quarantine measures to be introduced. Even though the chance may not be great, when such an event happens, the ripple effects can seriously jeopardize survival, food production and movement of people or the economic stability of the area.

**Generally human health hazards are referred to as "low probability - high consequence" events.** Throughout history though nothing has killed more human beings globally than infectious disease. Furthermore, for all the advances we've made against infectious disease, our very growth has made us more vulnerable, not less, to microbes that evolve 40 million times faster than humans do. Covid-19 demonstrates exactly how vulnerable we remain – our interconnected global economy both helps spread new infectious diseases – and, with its long supply chains, is uniquely vulnerable to the disruption that they can cause. Viruses constantly change through mutation, and so the emergence of new variants is an expected occurrence and not in itself a cause for concern; SARS-CoV-2 is no exception. A diversification of SARS-CoV-2 due to evolution and adaptation processes has been observed globally. While most emerging mutations will not have a significant impact on the spread of the virus, some mutations or combinations of mutations may provide the virus with a selective advantage, such as increased transmissibility or the ability to evade the host immune response. In such cases, these variants could increase the risk to human health and are considered to be variants of concern.

Such events require particular co-operation between public and private organizations to cope with the domino effects of the consequences. Usually individuals and organizations do not take preventative action unless there are incentives to do so and thus the co-ordination to deal with such events is of crucial importance. In areas where there is an increased vulnerability of sections of the community due to poverty, which in turn is linked to disease, malnutrition and contaminated food and water and they all form part of a vicious cycle that also requires additional interventions. Different human diseases affect different parts of the region which can have a local to provincial impact.

ECONOMIC: Absenteeism; and Additional pressure on limited health care services.

**ENVIRONMENTAL:** Spread of disease.

**SOCIAL:** Illness; absenteeism; and death which could potentially lead to child headed families with comes with further socio-economic problems.

Municipality		EVALU	JTION			
	IMPACT	LIKELIHOOD	RISK INDEX	RANKING	•	Alfred Nzo District is currently considered a National Hotspot (COGTA, 2020). Because
Alfred Nzo District (Overall)	3	2	6	5	•	Alfred Nzo is a labour sending and impoverished area with limited access to basic services it displays high vulnerability to COVID-19. The areas around Mount Ayliff display pafrticularly extreme vulnerability. Whilst the villages around Matatiele (near Masimangweni) and Umzimvubu (near Kwa Dungu), also show high vulnerability. The district has the most improvised health facilities with problems such as severe staff shortages, lax security measures, leaking roofs, "unreliable" ablution facilities, dilapidated infrastructure, poor filing system and inconsistent delivery of medication, among others (COGTA, 2020).

I.D	RISK EVENT	IMPAC T	LIKELIHO OD	RISK INDE X	RANKIN G	ΜΟΤΙVΑΤΙΟΝ
A	DROUGHT	5	3	15	2	<ul> <li>Likelihood is medium since drought has hit South Africa recently and climate is changing.</li> <li>Extreme consequences such as loss of grassland, crops and arable land</li> <li>Scarcity of water</li> <li>A major disaster in terms of total economic loss and a significant number of the overall population of 804,500 people affected since 94% of the population reside in rural areas and rely heavily on farming especially those who are illiterate. Agriculture the principal private sector, the 3<sup>rd</sup> highest contributor to the district's economy, forestry and livestock farming are all key to its economy.</li> <li>In January 2016, SABC reported that R9million was set aside for Eastern Cape drought relief for farmers in the province.</li> <li>Later in February, according to News24, the Premier reported R129million set to help Eastern Cape farmers affected by the drought.</li> <li>Impact is huge both financially and non- financially if the risk materialises.</li> </ul>
В	BIOLOGICAL HAZARDS	3	3	9	3	<ul> <li>Health and safety risks, mortality and increased incidence of infectious diseases and respiratory diseases due to increased surface temperature.</li> <li>Increased incidence of skin cancer, eye diseases due to exposure to higher ultraviolet radiation levels from changes in temperature.</li> <li>Water quality deterioration may cause diseases like cholera.</li> <li>Impact is reduced by the municipal health services unit under the community development services department which is responsible for water and quality monitoring, food control over business and other activities, monitoring and giving support to local municipalities in managing waste disposal and ensure prevention of surveillance of communicable diseases within the district.</li> </ul>
С	VELD FIRES	3	2	6	5	Low moisture and precipitation that often characterise droughts can quickly create hazardous conditions in forests and across rangeland, setting a stage for wildfires, that may cause injuries or deaths as well as extensive damage to property and already shrinking food supplies.

			EVALUA	TION			
I.D	RISK EVENT	IMPAC T	LIKELIHO OD	RISK INDE X	RANKIN G	ΜΟΤΙVΑΤΙΟΝ	
						<ul> <li>Impact results in loss of grazing land, danger to human life, livestock and buildings.</li> <li>To reduce this impact, there is a fire and rescue services unit under community and development services department responsible for planning, coordination and regulation of Veld Mountains, structural fire services in order to strengthen community safety and save lives.</li> </ul>	
D	MOTOR VEHICLE ACCIDENTS	2	4	8	4	<ul> <li>Extreme rain and snowstorm will cause flooding, damage to roads and bridges, which leads to accidents.</li> <li>5 bus accident victims at Maluti Civic Centre in Matatiele on 27 February 2014 which left 36 passengers seriously injured.</li> <li>A total of 48 people lost their lives through horrific accidents on the 29 August and 3 September 2015 which the provincial government declared a provincial disaster (3 of the people were from an accident at Mount Ayliff near Ndzongiseni village).</li> <li>Accidents have a high probability of occurring but in most cases with no material impact on Alfred Nzo District Municipality's objectives.</li> </ul>	

SEVERE WEATHER PATTERNS

#### **General Impacts:**

The following events could arise from severe weather systems:

- Flooding;
- In respect of informal structures, they will be rated as being flooded if they are situated in areas of extensive ponding of water which has resulted in a substantial amount of water covering floors and areas around dwellings for an extended period of time (more than 48 hours)
- Storm damage (due to heavy rain and strong winds) Minor or major damage to property or infrastructure incurred during periods of strong/gale force wind and heavy rain which puts the safety of the community at risk, may have longer term health effects and will have economic implications. There is also a very small chance of a tornado-like phenomenon occurrence during times of extreme rain storm weather.
- Landslides and mudslides These are either "dry" or "wet" types of rapid (up to 80km/h) downhill mass wasting which may be caused by ground destabilisation or other trigger and can vary in mass and velocity. Depending on the location of the landslide or mudslide, it may impact on the safety of communities below and may also have an impact on especially on roadways and traffic flow. Areas on the mountain slopes previously burnt where vegetation normally stabilises the ground are most at risk of landslides or mudslides, especially after extended periods of heavy rainfall.
- **Coastal storm surges** (Mbizana Local Municipality only)- A storm surge is an offshore rise of water associated with a lowpressure weather system. A storm surge is caused primarily by high winds pushing on the ocean's surface. The wind causes the water to pile up higher than the ordinary sea level. Low pressure at the centre of a weather system also has a small secondary effect, as can the bathymetry of the body of water. It is this combined effect of low pressure and persistent wind over a shallow water body which is the most common cause of storm surge flooding problems. The term "storm surge" in casual (non-scientific) use is storm tide; that is, it refers to the rise of water associated with the storm, plus tide, wave run-up,

			EVALUA	TION						
I.D	RISK EVENT	IMPAC T	LIKELIHO OD	RISK INDE X	RANKIN G	ı	MOTIVATION			
and poi • In a wh sto	d freshwater flooding. Wh nt. areas where there is a sig en they occur at the tim rm surge since it requires	en referen nificant di ne of a hig weather fo	cing storm su ifference betw gh tide. In the precasts to be	rge heigł ween low ese cases, accurate	nt, it is imp t <b>ide and l</b> this incre to within a	bor hig ease a fe	tant to clarify the usage, as well as the reference <b>of tide, storm surges are particularly damaging</b> es the difficulty of predicting the magnitude of a w hours.			
	CONOLUS		EN // DATE							
<ul> <li>Cau</li> <li>Dan blow built</li> <li>Loss vital</li> <li>Incr recc</li> <li>Disr</li> <li>Ben pole pow</li> <li>Hea give fail road</li> <li>Roa</li> <li>To r even food coul</li> <li>Extr poo and som poo plur expa mud cost</li> <li>Den fuel such</li> </ul>	ses electricity disruption; hage to infrastructure. v away roofs from poor t RDP houses; s of tourisms due to closing routes; ease in maintenance a overy costs prices; uption transport services; t, snapped or collapsed lights or traffic lights, or down ver lines; vy snowfall or hailstorms of to adapt their driving to to adapt their driving to the conditions. d closures due to hailstorm educe the chances of such that, farmers purch dstuff for their animals, whild be a financial burden. eme winter cold often cau rly insulated water pipeling mains to freeze a netimes burst. Even so rly protected indo mbing ruptures as wa ands within them, caus th damage to property a rises dramatically dur n times.	i.e. prly a of and and and and and ase ich an ase ich ases and ase ase and ase an ase an ase an ase an ase an ase an ase an an ase an ase an an ase an an ase an an ase an an ase an an ase an an ase an an ase an an ase an an ase an an an ase an an ase an an ase an an an an ase an an ase an an ase an an a an a	In summer, promote fire a erosion partii moves over and remove vegetation; Increases wav damage; Crop damage; Crop damage; slides, debris holes; Erosion which degradation. This could lea the numbe available and a risk of species It can cause de livestock and	strong and contr cularly w the esca es the res and r e, cave-ir flows a n leads d to a de r of an increas e endemis eath and i wildlife.	winds ibute to /here it arpment natural esultant as, mud nd sink to land ecline in species se in the m. injury to	•	Loss of livelihood; Increase in poverty; Increase in respiratory disease outbreaks (human); Increase in crime; Possible injuries and loss of life; Exposure to extreme and especially unexpected cold can lead to hypothermia a frostbite, which require medical attention due to the risks of tissue damage and organ failure; Exposure to cold mandates greater calorie intake for all animals, including humans, and if a cold wave is accompanied by heavy and persistent snow, grazing animals may be unable to reach needed food and die of hypothermia or starvation; Psychological trauma.			

			EVALUA	TION		
I.D	RISK EVENT			RISK		MOTIVATION
		IMPAC	LIKELIHO	INDE	RANKIN	MOTIVATION
		т	OD	Х	G	
E		4	4	16	1	<ul> <li>Recent climate modelling results indicate that extreme weather events may become more common.</li> <li>South Africa is located in the region that is most susceptible and vulnerable to climate change. Temperatures have increased and rainfall patterns have changed and frequency of extreme weather events has increased.</li> <li>Impact of such changes is on the economy such as agriculture, fishing, tourism and human health. Effects on Alfred Nzo the smallest and one of the poorest among the 7 districts in the Eastern Cape will be devastating.</li> <li>Climate change will reduce the availability of natural resources, availability and use of water, affect agricultural production and cause health risks for the locals. Lack of stamina to adapt will result in people suffering more yet 40% of the people of the district already live below the poverty line and a total of 314,489 people, that is, about 36% of the population in the district are dependent on social grant.</li> <li>Water scarcity causing disruptions on water services.</li> <li>Loss of life and livestock</li> <li>Damage to infrastructure</li> <li>Quarterly publication from the executive mayor states that 3 residents were lost due to devastating storms that hit the district repeatedly, and that the extreme weather conditions have left more than 150 homes completely destroyed leaving hundreds homeless and about 700 homes severely damaged.</li> </ul>

# 1.2 Climate Change

The climate of the world varies from one decade to another, and a changing climate is natural and expected. The climate goes through warm and cold periods, taking hundreds of years to complete one cycle. Changes in temperature also influence the rainfall, but the biosphere is able to adapt to a changing climate if these changes take place over centuries. Unfortunately, human intervention is currently causing the climate to change too fast. (Climate models predict that the mean air temperature over South Africa will increase by an estimated 2°C over the next century.) Plants and animals may not be able to adapt as quickly to this rapid climate change as humans can, and therefore the whole ecosystem is in danger.

Given the major effects that climate change will have on our environment and the way that these changes will affect people, climate change research in South Africa is now no longer seen purely as an environmental problem, but also a developmental problem.

To understand why climate change is a developmental problem think about the impacts from increasing temperatures, increased flooding, changes in rainy seasons and changes in winds on many aspects of broader socioeconomic development, such as water availability, food security, housing and infrastructure. South Africa's per capita emissions are high relative to other countries in Africa, and even globally.

Critically, the extension of basic services to people in rural areas – safe, clean and reliable energy, water, sanitation, and transport, as well as safe and well-designed settlements and dwellings – will go a long way towards addressing the drivers of socio-economic vulnerability generally.

Enhancing livelihoods through job creation and local economic development will achieve the same ends, in combination with integrated infrastructure development and planning that considers both the natural environment and the wellbeing of society. Healthy, safe, and resilient communities are better able to adapt to shocks and stresses of any kind, including climate change. Thus effective service delivery is one of the primary tasks to be undertaken in building a climate responsive and resilient ANDM.

Alfred Nzo is one of the seven districts of the Eastern Cape Province of South Africa, and it is the smallest and one of the poorest districts in the province. The Alfred Nzo district has a small formal economy compared to the rest of the province. Agriculture is the principal private sector and provides 12% of formal employment. Forestry is the best formal agricultural sector with wide-spread plantations around Maluti. There is also livestock farming, which includes cattle, sheep and goats. Rural households tend to rely heavily on climate-sensitive resources such as local water supplies and agricultural land; climate sensitive activities such as arable farming and livestock husbandry and natural resources such as fuel wood. Climate change can reduce the availability of these local natural resources, limiting the options for rural households that depend on natural resources for consumption or trade. Land may become less fertile may be. Shifts in climate will bring changes in Alfred Nzo region; some areas may see greater natural resources because of increased rainfall, for example. But on balance, the poorest regions are most likely to suffer because they are least able to adjust to new conditions.

Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate change affects more than just a change in the weather; it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. Because so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water, and health risks. For example, a change in the usual timing of rains or temperatures can affect when plants bloom and set fruit, when insects hatch or when streams are their fullest. This can affect h pollination of crops, food for migrating birds, spawning of fish, water supplies for drinking and irrigation, forest health, and more. Some short-term climate variation is normal, but longer-term trends now indicate a changing climate. A year or two of an extreme change in temperature or other condition doesn't mean a climate change trend has been "erased." Alfred Nzo District is an area that exceeds 1000m above sea above level; rainfall is very high and can be very cold and snowy in winter season. Climate change is causing more severe and more frequent storms resulting in changes in timing and amount of rainfall that damage agricultural production. Agriculture is the mainstay in this district; because most people in the district are illiterate so they depend on agriculture. Understanding changes in agriculture already taking place, or likely to take place in the near future, in response to climate change is therefore of utmost importance Added to other environmental degradation such as deforestation, erosion and desertification these changes have significant impacts on the health and livelihoods of people.

#### ANDM CLIMATE CHANGE CHALLENGES :

The above incidents has resulted to district state of disaster being declared as follows(only reflecting in the previous three years);

Year	Brief description of disaster	Impact
2014	Heavy rains & floods: District state of disaster	Damage to houses , infrastructure and agricultural products
2014	Veld & forest fires: District state of disaster	Damage to agricultural products, grazing land ,houses and loss of life
2014	Heavy rains : Local Municipality state of disaster (Matatiele LM)	Damage to infrastructure including houses
2015	Heavy rains & floods: District state of disaster	Damage to houses , infrastructure and agricultural products
2016	Heavy rains & floods: District state of disaster	Damage to houses , infrastructure and agricultural products and loss of life
2016	Drought : district state of disaster	Loss of water

# **CLIMATE CHANGE IMPACTS**

Climate change is the most alarming cause of environmental degradation. Changes in our climate may have significant effects on agriculture, fisheries and forest of Alfred Nzo District and the economy. Most rural household of Alfred Nzo District earn less then R1000 a month and others they depend in welfare grants therefore agriculture is the main source of livelihood for most of the rural people of this area. The South African study identified the following; health sector, maize production, plant and animal biodiversity, water resources and rangelands as areas most vulnerable to climate change. More recent climate change models may lead to modifications of the anticipated effects, but the summaries below offer the latest available information on the impacts of climate change.

Health Sector	The potential impact of climate change on health of the South African population has been modeled as it has in other countries. Indirect health effects anticipated to occur locally include the following:						
	• Mortality and increased incidence of infectious diseases and respiratory diseases due to increased surface temperature. The likely occurrence of epidemics of infectious diseases are related to changes in the distribution of diseases carriers and to reduce cellular immunity in humans as the result of ultraviolet						
	• Increased incidence of skin cancer , eye diseases due to exposure to higher ultraviolet radiation levels						
	Water quality deterioration may cause water related diseases like cholera						
	• Indirect effects of global climate change on human welfare are related to the potential						
	impacts on biodiversity and ecosystems and on the availability of agricultural land and						
	water for irrigation. The potential for crowding, malnutrition and starvation, allergic						
	diseases, and suffering due to weather extremes has also been noted.						
Water scarcity	Water scarcity is a National problem not only limited to the Alfred Nzo District. Even without						
	climate change it is predicted that within a few decades South Africa will be using up most of						
	its surface water resources. The most significant impacts of climate change on water resources						
	are the potential changes in the intensity and seasonality of rainfall. While some regions may						
	receive more surface water flow, future problems are likely to include water scarcity, increased						
	demand for water, and water quality deterioration. Climate change may also alter the						
	magnitude, timing and distribution of storms that produce flood events.						

Rangelands	Previous climate change scenarios predicted that rangelands will generally become drier bringing both direct and indirect effects. With current predictions of wetting in the eastern parts of South Africa, rangelands here may not be affected directly. Nevertheless, lower rainfall and higher air temperatures will affect fodder production and affect the marginal costs of ranching. In addition, climate change could affect the frequency and spatial extent of livestock disease outbreaks, such as foot and mouth disease. Increased grass fuel load is predicted to increase fire intensities by about 20% by the coming years.
Forestry	Africa including Alfred Nzo District is suitable for tree crops and the forestry sector is affected by factors such as land availability, water demand and socio-economic conditions. General
	aridification in some areas due to lower rainfall and higher air temperatures could affect the
	with planting in sub-optimal areas. Shifts in the optimum tree growing areas could affect the
	profitability of fixed capital investments such as sawmills and pulp mills. Lower production
	tolerant cultivars among the current tree species being planted could be selected for
	cultivation but it is probable that more lucrative uses for the land such as sub-tropical fruits
	will compete for the land currently taken up by tree plantations.
Biodiversity	Biodiversity is important for South Africa because it maintains ecosystem functioning and has
	of climate change, rising human population, and increasing per capita consumption will result
	in major changes to biodiversity. Climate change scenario modelling indicates that the area
	covered by the current biomes will decrease; of the 179 species of animals examined, 143
	indicated range contractions and 4 are predicted to become extinct. A concern is the
	predicted expansion of insect pests, such as the brown locust, to areas that were previously
	cooler. Climate change and the resulting loss of biodiversity has the potential to harm the
	tourism sector which currently contributes R100 billion each year to our economy and it is
	change it could cost the country about 1.5% of gross domestic product by 2050. Alfred Nzo
	District is mostly dependent on natural resources to increase the economy of this district for
	example tourism and therefore it is vital that protection measures are put into place.
Extreme	Recent climate modelling results indicate that extreme weather events may become more
weather events	common. Rising average temperatures produce a more variable climate system.
	Localised events could include:
	Windstorms and heavy winds
	Heat waves, droughts
	Storms with extreme rain or snow
	Severe thunderstorm and hall storm     Evtrome high and low temperatures
1	<ul> <li>Extreme night and low temperatures</li> </ul>

Drought conditions often provide too little water to support food crops, through either natural precipitation or irrigation using reserve water supplies. The same problem affects grass and grain used to feed livestock and poultry. When drought destroys food sources, people go hungry. Faced with other impacts of drought, many people will flee a drought-stricken area in search of a new home with a better supply of water, enough food, and without the disease. Drought often creates a lack of clean water for drinking, public sanitation and personal hygiene, which can lead to a wide range of life-threatening diseases. All living things must have water to survive; people can live for weeks without food, but only a few days without water. The low moisture and precipitation that often characterize droughts can quickly create hazardous conditions in forests and across rangeland, setting the stage for wildfires that may cause injuries or deaths as well as extensive damage to property and already shrinking food supplies. Extreme rain and snowstorm they will cause damage to buildings, flooding, washing away of roads, siltation in dams and damage to crop. Because of these heavy rains the ground water will not be able to recharge and this will result in shortage of water.

#### Extreme weather events likely to happen in Alfred Nzo District their impacts and mitigation measures

EVENTS	IMPACTS	MITIGATION

Possible increase in frequency, of severe tornadoes and heavy winds	Damage in houses, buildings, crops, soil erosion, inability to cultivate land due to water logging of soil	Identify areas prone to these natural disasters and limit further development
Possible increase in frequency of thunderstorm and hail	Flooding washing away of roads and bridges, siltation in dams and damage of crop	Wetlands must be protected and enhanced Roads and bridges are properly engineered
Possible increase in frequency of veld fires	Loss of grazing land, danger to human, livestock and buildings	Manage burning and range land management
Possible in frequency of snow and extreme temperature	Loss of life and livestock Damage to infrastructure	Proper disaster management Awareness about this we
Possible increased in land degradation	Current eroded areas will become worse	Proper disaster management Donga repair and clearing the wattle
Possible increased frequency of drought	Land degradation and soil erosion, lower yields from crop damage and failure, increase in livestock deaths and risk wildfire, loss of arable land. Loss of grassland, crops and scarcity of water	More protection for existing water resources (wetlands, dams, springs and rivers)
Possible frequency in floods	Reducing storage of dams and destroying wetlands. Damage of sewer systems	Quality of sewage systems for sewer lines in the floodplain, fasten and seal manhole covers to prevent floodwater infiltration Flood resistance, resilience measures specific to the potential for ground water flooding. Management surfaces run-off. Maintenance, improvement of water courses, culvert, drains and sewerage network reduce associated flood risk

# 1.3 CLIMATE CHANGE RISK ANALYSES

# Table 2: Summary of direct temperature related risks. Opportunities are italicised.(CSA, 2015)

	CLIM	ATE CHANGE RISKS RELATED TO TEMPERATURE INCREASES IN THE ANDM			
Relevance	for	Stimulate more frequent veld fire			
people		Increase energy demand for cooling			
		• Increase risk of heat related mortality, especially for vulnerable groups such as the			
		elderly			
		Reduce quality of life for people without appropriate housing			
		Reduce productivity of livestock			
		Reduce productivity of agricultural workers and others working outdoors			
		Promote invasion of woody alien vegetation as number of frost days decreases			
		• Increase water stress (for growing crops and for water) as evapotranspiration increases			

Municipality	<ul> <li>Increased magnitude and intensity of storm events, also as result of increased evaporation</li> <li>Desiccate exposed soils</li> <li>Increase water demand</li> <li>Stimulate a longer tourism season; winters may be more moderate in the interior Some crops will be more resilient under hotter temperatures such as Sorghum Devise new work hours for labourers to accommodate extreme weather</li> </ul>			
	/ledium- erm	erm	Risk for the medium (2040-2059) and longer (2081 – 2100) term was assigned based on the relative magnitude and rate of temperature change in the ANDM. The risk categories were	
Alfred Nzo District (Overall)	High	High	based on the natural breaks in the national average temperature projections data. ANDM projected temperature changes were then evaluated by comparing the local projected temperature changes with the national projections.	
Matatiele	High	Very High	In the medium term, an increase of up to 1.6°C was categorised as <b>Moderate</b> , while 1.7-2.0°C was categorized as a <b>High-risk</b> increase. Anything higher than that was categorised as a <b>Very- High</b> risk increase.	
Mbizana	Moderate	High	As longer time periods give more time to adapt, we used a different set of criteria for the longer term. Here, a change of less than 3.5° was categorised as <b>Moderate</b> change, 3.5-4° as High risk, and anything higher than 4° as a <b>Very-High</b> risk	
Ntabankulu	High	High	increase. No current risk was assigned as current temperatures are the status quo, not presenting any specific risk. The ANDM is currently quite temperate, and while temperature increases	
Umzimvubu	High	High	could affect number of frost days, even large increases will still leave average annual temperatures in the District fairly moderate.	

# Rainfall

# Table 3: Summary of direct rainfall change related risk. Opportunities are italicised.(CSA, 2015)

	CLII	MATE CHANGE RISKS RELATED TO RAINFALL CHANGES IN THE ANDM
Relevance people	for	Possible increase in extreme events related to high volume rainfall Possible unpredictability in timing of rainfall, important for planning and planting crops Increase in water demand tied to temperature increases and broader water access Potential increase in difficulty of capturing water for storage – runoff from high rainfall events can be difficult to store
		Potential increase in water available for storage from storm events Unlikely that the total amount of water available will change much – opportunities for sound management of water supply infrastructure and for water demand management and water efficiency to ensure that water services reach as many people as possible

Municipality	7		Risk Description and Basis for Assessment:		
	Medium-Term	Long-Term	Predicted rainfall change for the District in both the medium and longer term is largely within the range of current natural levels of variability. The ANDM appears to be one of the "better off" places in South Africa in terms of rainfall change. Aggregated changes are		
Alfred Nzo District (Overall)	Moderate	Moderate	often in the single digits. This is a very small change given that the District receives almost 700mm of rainfall per year on average at the moment. We have therefore classified the direct rainfall change related risk as <b>Moderate</b> in both the short and long term.		
Matatiele	Moderate	Moderate	Overall precipitation shows little change in either seasonal pattern or total quantity. There may be important changes in the variability of rainfall between years, and increases in short term variability are also likely. If similar patterns occur in the ANDM to the rest of the eastern portions of the country, it is likely that the number and intensity of		
Mbizana	Moderate	Moderate	major rainfall events is increased (CSA, 2015). These risks, related to extreme rainfall events, are examined in more detail in the summary tables related to water processes and health.		
Ntabankulu	Moderate	Moderate	No current risk was assigned as current rainfall is the status quo, not presenting any specific risk.		
Umzimvubu	Moderate	Moderate			

# WATER SUPPLY AND INFRASTRUCTURE

# Table 4: Summary of climate related surface water runoff risks. Opportunities are italicised (CSA, 2015)

	Clim	ate Change Risks Related To Changes In Surface Water Runoff In The ANDM
Relevance people	for	<ul> <li>Negative impacts on water related ecological infrastructure through, for example the expansion of alien vegetation such as wattles, increases in forestry plantations, urban expansion into wetlands, or unsustainable stocking rates in catchments, could rapidly increases risks associated with runoff – flooding, soil moisture and ground water loss, evaporation, and erosion</li> <li>Where water supply systems are not robust and consist of stand-alone systems with less integrated and limited alternative water supply options, as in most of the ANDM, significant risk could exist due to local short-term variability in water availability during</li> </ul>
		<ul> <li>dry periods (DEA, 2015)</li> <li>High runoff years come with a range of potential impacts, including flooding, soil erosion, and infrastructure damage. These related impacts are dealt with in separate sections.</li> </ul>
		Water availability for household, agricultural, and industrial use is unlikely to change much in total volumes, a big plus
		Conservation, restoration and maintenance of water related ecological infrastructure, such as groundwater resources, rivers and streams, and wetlands, will ensure adequate water supply in the future and protect built infrastructure from damages

Municipality	2	-	Risk Description and Basis for Assessment:
	/ledium-Term	ong-Term	Medium term trends in surface water catchment runoff show that the median impact of unconstrained climate change is an increase in annual catchment runoff of 5-15%, mostly due to increased rates of runoff due to more intense rainfall events (DEA 2015).
Alfred Nzo District (Overall)	Moderate	Moderate	As average runoff is likely to be maintained, or even potentially slightly increased, overall surface water catchment runoff risk has been classed as Moderate.
Matatiele	Moderate	Moderate	This means that the overall risk to bulk water supply and the availability of sufficient clean water in the future is manageable. Broad-scale and extended disruption to water supplies appears to be unlikely from a climate change perspective (DEA, 2015).
Mbizana	Moderate	Moderate	However, the studies suggest that runoff will vary significantly. Most noticeably, maximum values indicate a potential doubling of annual runoff events in high runoff years (Figure 11), which may lead to flooding. This comes with a range of potential impacts, including flooding, erosion, and infrastructure damage which are dealt with separate sections.
Ntabankulu	Moderate	Moderate	In summary, compared to much of SA which has a runoff disaster, ANDM has a spectacular underutilized resource which is unlikely to be impacted and may even improve. Extreme events may, however, be an issue.
Umzimvubu	Moderate	Moderate	

# Table 5: Summary of Flooding Related Risk. Opportunities are Italicised (CSA, 2015)

Clim	nate Cha	nge Risk	s Relat	ted to Changes in Surface Water Runoff in the ANDM						
Clim Relevance for people	<ul> <li>Flooding of houses</li> <li>Damage to assets and infrastructure and loss of life</li> <li>Damage to access roads – disrupted transport routes and isolation of rural communitie if roads are washed away</li> <li>Soil erosion and siltation of water supply dams and water courses</li> <li>Pollution of water with solid waste and sewerage</li> <li>Spread of waterborne communication diseases</li> <li>Houses that are poorly built, are poorly located, or lack flood protection, efficier drainage systems or damp-proofing are particularly vulnerable. Also, informal housin (shacks) and traditional building, widespread in ANDM.</li> </ul>									
	• O • O pl	<ul> <li>Opportunity to harvest high volumes of water for storage</li> <li>Opportunity to gradually reduce this risk over time in a low-cost way through careful planning and avoiding high risk areas</li> </ul>								
Municipality	Current	Medium-Term	Long-Term	<b>Risk Description And Basis For Assessment:</b> Current flood risk to buildings and infrastructure was evaluated on the basis of the percentage of dwellings that are located either within 250m of a larger river (Figure 11) or within 100m of a major wetland.						

Alfred Nzo District (Overall)	Modera	High	High	Risk categories used were <b>Low</b> Risk = under 1%, <b>Moderate</b> Risk > 1-2%, <b>High</b> Risk > 2-5%, and <b>Very High</b> Risk > 5%.
	Ite			Data for long term change in flood risk was derived from the ratio of change from the base scenario in the 1 in 10-year flood peak
Matatiele	High	Very High	Very High	estimated by James Cullis (DEA, 2015). Using the average change in flood peak across 3 models for each quaternary catchment, we identified high risk areas.
Mbizana	High	Moderate	Moderate	We then assessed each house in the <b>high</b> -risk areas and evaluated their future flood risk status according to the following categories: <b>Low</b> risk = flood peak predicted to reduce or stay the same, <b>Moderate</b> risk = flood peak increasing by $<0 - 10\%$ , <b>High</b> risk = flood peak increasing by $<10 - 25\%$ . <b>Very-High</b> risk = flood peak
Ntabankulu	Moderat	Moderat	Moderat	increasing by >25%. This was used to assess whether flood risk to dwellings was increasing or decreasing.
Umzimvubu	e Moderate	e High	e High	used then that risk category was assigned to the municipality for the medium- and long-term future. For example, in Matatiele almost all at risk houses are in a Very High-risk category, whereas in Mbizana almost all at risk houses were in a Low Risk category in future. Following the one category down only rule, Mbizana's future flood risk is described as Moderate.
				Where there was an equal balance between houses at increased risk and houses with reduced risk (Ntabankulu – Moderate risk), then the current flood risk status was retained.
				The same value was used for medium- and long-term change as flood models were only completed for the long-term time period, and we have not modelled where people will live in the future.

	Cli	mate c	hange	risks related to surface water runoff in the ANDM			
Relevance for people	•	Siltation of water supply dams Damage to access roads and pipelines Loss of topsoil for growing crops; damage to crop fields Instability of soil surface for construction Damage to assets Reduced livestock carrying capacity Isolation of rural communities if roads are eroded away Lots of opportunities for labour intensive land care projects that can reduce erosion and improve socio economic development and offer an opportunity to tap into national					
Municipality	Current	Funds       Risk Description and Basis for Assessment:         Figure 1       Figure 2         Figure 2       Figure 2					
Alfred Nzo District (Overall)	Moderate	High	Very High	erosion can place infrastructure, such as roads and pipelines, at risk and can result in the rapid sedimentation of water supply dams (Le Roux et 2008).			

Matatiele	Moderate	High	Very High	
Mbizana	Low	Moderate	High	۱۱ ۲ ۲
Ntabankulu	Moderate	High	Very High	e c i
Umzimvubu	High	Very High	Very High	r c a c

Importantly, the climate change impacts associated with intensification of storm events, desiccation of soils, and the structural change from grasslands to savanna predicted for much of the District, as well as secondary impacts associated with agricultural systems being under pressure, all suggest that soil erosion impacts are likely to both be significantly underestimated in the ANDM and are likely to increase significantly as with changing climate.

The Eastern Cape has several hotspot zones for sediment and soil erosion which have the potential to be further exacerbated by climatic changes (DEA, 2015).

Current risk was assessed by identifying the portion of each municipality in high risk areas for gully formation (Marakanye and Le Roux 2012) – within 250m of an existing gully. Risk categories were assessed based on natural breaks in the data. Based on the anticipated increasing intensity of rainfall and widespread structural impacts on grassland areas, we have assumed a gradual increase in soil erosion risk by one category above current risk in the shorter term and an additional category above current risk in the longer term.

Biodiversity

			(CSA, 2015)				
C	limate	Chang	ge Risks Related to Changes in Biome Stability in the ANDM				
Relevance for people	<ul> <li>Biome shifts are unlikely to be neat, and will include the expansion of invasive alien and indigenous woody species into grasslands</li> <li>Disruptive system changes such as animal or plant population declines and extinctions</li> <li>Structural disruption of the grassland biome particularly</li> <li>Changes in rangeland productivity through changes in animal diets, biomass produced, and nutrient availability</li> <li>Potential for improved availability of wood as a fuel source</li> <li>Implementation of sustainable agriculture and restoration and management of grassland ecosystems will create jobs and secure ecosystem services</li> </ul>						
Municipality	Medium       Fisk Description and Basis for Assessment:         We examined biome stability projections for the medium (2 longer term (2081-2100) for the ANDM.         Risk for the medium (2040 -2059) and longer (2081-2100) to						
Alfred Nzo District (Overall)	Moderate	stability was assigned based on the likelihood that an area will retain its biome. A score was given for each site based on the number of model predicted that the current biome would be stable. These scores were are across each municipality and the district. Values were then cate					

# Table 7: : Biome stability and associated risks. Opportunities are italicised.



separately for the medium and longer term based on natural breaks in the distribution of values.

Clear spatial and temporal patterns emerge. Matatiele experiences very little biome level change in the medium term (Moderate risk), but in the longer term most grassland areas are likely to change (Very-High risk). In contrast, although Mbizana experiences high levels of medium-term impact as its grasslands are the first to be invaded by savanna (High risk), in the longer term it retains much of its coastal belt biome and the associated Pondoland centre of Endemism. Hence it does not experience significant additional structural biome change impacts, or additional associated risk, retaining the High-risk classification in the long term.

No current risk was assigned as current temperatures are the status quo, not presenting any specific risk.

# Table 8: Climate change related ecological infrastructure risks. Opportunities are italicised. (CSA, 2015)

Climate change risks related to impacts on ecological infrastructure in the ANDM									
Relevance for people	•	<ul> <li>Exacerbate and risks related to runoff, flooding, and soil erosion – see relevant tables</li> <li>Conservation, restoration and maintenance of water related ecological infrastructure, such as groundwater resources, rivers and streams, and wetlands, secures water flows and improves water quality for clean water</li> <li>Conservation, restoration and maintenance of water related ecological infrastructure, such as groundwater resources, rivers and streams, and wetlands, acts as a buffer, reducing soil erosion and flood damage</li> </ul>							
Municipality	Current	Risk description and basis for assessment: Ferrit Ferrit Ecological Infrastructure refers to the functioning ecosystems that deliver valuable ecosystem services to people. It includes wetlands, rive buffers and key catchment areas.							
Alfred Nzo District (Overall)	High	Very High	Very High	Current risk is based on an assessment of portions of important and additional Ecological Infrastructure that are currently either degraded or have been completely lost. Risk was classified as Low if under 20 has been lost, Moderate if 20 – 40% has been lost, High if 40-60% has been lost and Very High if over 60% had been lost.					
Matatiele	Moderate	Moderate	Very High	Changes to risk in the medium- and long-term values were based on the risk of biome change. Where the biome stability risk was assessed as Low (Table 12), the risk to ecological infrastructure was kept the same. Where					

Mbizana	Very High	Very High	Very High
Ntabankulu	High	Very High	Very High
Umzimvubu	Moderate	High	Very High

the biome stability risk was Moderate, the risk to ecological infrastructure was increased by one category. Where the biome stability risk was High, by two categories, and where it was Very High, by up to three categories.

A 'high water mark' approach was used, with risk values not dropping below the values for the previous period. With appropriate management of existing intact Ecological Infrastructure and rehabilitation of degraded and transformed Ecological Infrastructure, it is possible that this risk can be significantly reduced.

## Table 9: Climate change related habitat loss risks. Opportunities are italicised. (CSA, 2015)

		Clima	te Char	ge Risks Related to Habitat Loss in the ANDM						
Relevance for	•	Exacerbate risks related to runoff, flooding, and soil erosion – see relevant tables								
people	•	Loss of ecosystem services and particularly grassland habitats, which may impact								
		livesto	ck-base	d livelihoods						
	•	Loss of	special	lised tourism opportunities						
	•	Potent	ial loss	or gain of natural resources for energy or building materials						
	•	Consei	vation,	restoration and maintenance of water related ecological infrastructure,						
		such a	s grour	ndwater resources, rivers and streams, and wetlands, secures water flows						
		and in	proves	water quality for clean water						
	•	Consei	vation,	restoration and maintenance of water related ecological infrastructure,						
		such a	s grou	ndwater resources, rivers and streams, and wetlands, acts as a buffer,						
		reduci	ng soil e	erosion and flood damage						
	•	Oppor	tunities	for protection of important habitats for conservation and tourism						
Municipality	2	Ξ	5	Risk Description and Basis for Assessment:						
	urrent	ActionOgImage: Image:								
Alfred Nzo	7		<	heavily impacted landscapes and the ecosystem threat status of habitats.						
District (Overall)	Noderate	High	'ery High	Ecosystem threat status was calculated on the basis of an integrated habitat map (terrestrial, wetland, river, estuary) that reflected the most threatened habitat type at a site. Threat values were allocated as Critically						
Matatiele	Low	Low	Very High	Endangered=10, Endangered=8, Vulnerable =4, and Least Threatened=0 (data from NFEPA). Average scores per municipality were calculated.						

Mbizana	High	Very High	Very High
Ntabankulu	Moderate	High	Very High
Umzimvubu	Low	Moderate	Very High

Landscape impacts were calculated based on the % of land that was heavily impacted based on a composite landcover layer developed for the strategy including 2009 national landcover (SANBI 2009) as well as information on gullies (Marakanye and Le Roux 2012) and dams (Nel et al 2011). The combined scores were then split into categories using a quantile approach.

Medium- and long-term risk was assigned using the biome change data. If there was risk of short-term biome change, then the current risk was increased by a category. The same approach was taken for long term risk, except that a high-water mark approach was taken (i.e. risk was not seen to drop at a habitat level after attaining a higher risk status in a previous time period).

Habitat loss represents the best overall summary of impacts linked to ecosystems, the species they contain, and their ability to deliver ecosystem services. This issue is particularly important in the ANDM which contains the critical Pondoland Centre of Endemism and key grassland and wetland habitat types.

# Table 10: Climate change related species loss risks. Opportunities are italicised (CSA, 2015)

Climate change risks related to climate related species losses in the ANDM										
Relevance for	•	Loss of diversity, a critical contributor to system resilience								
people	•	Loss of threatened species in Mbizana, which may impact tourism								
	•	Loss of	<sup>:</sup> grassla	ind species, which may impact livestock-based livelihoods						
	•	Loss of	<sup>:</sup> heritag	je						
Municipality	0	3	5	Risk Description and Basis for Assessment:						
	urrent	ledium-Term	Kisk Description and basis for Assessment:         Image: State of the state o							
Alfred Nzo District (Overall)	Moderate	High	Very High	Current risk is based on an assessment of the current number of threatened species. Risk was classified as Low if no threatened species were found, Moderate if 1 – 15 species, High if 16-30 species and Very High if over 30 threatened species were found. Risk for the District was						
Matatiele	Low	Low	Very High	assessed based on an average value across the local municipalities. Medium- and long-term values were adjusted based on the risk of bior change. Where the biome stability risk was assessed as Low, the risk species loss was kept the same. Where the biome stability risk w						
Mbizana	Very High	Very High	Very High	Moderate, the risk to species loss was increased by one category. Where the biome stability risk was High, by two categories, and where it was Very High, by up to three categories.						
Ntabankulu	Low	Moderate	Very High	below the values for the previous period.						

Umzimvubu	Low	Moderate	Very High	Da atl Mi

Data from South African National Biodiversity Institute herbaria and atlasing projects, University of Cape Town Bolus Herbarium, and Albany Museum Schonland herbarium.

# Agriculture

# Table 11: Climate change related agriculture risks. Opportunities are italicised. (CSA, 2015)

	C	limate o	hange	risks related to impacts on agriculture in the ANDM							
Relevance for	•	Subsist	ence ag	gricultural systems may have limited ability to cope with climatic change							
people		and va	riability								
	•	Reduce	ed prod	uctivity of livestock							
	•	Increas	ed dem	hand for irrigation							
	•	Stimula	ated live	estock and crop pests and diseases							
	•	Increas	ing der	nand for water for livestock and crops may lead to an increased cost of							
		supplyi	ng wat	er							
	•	Dairy y	Dairy yields could decrease by up to 25%								
	•	Maize s	stover a	vailability per head of cattle may decrease due to water scarcity							
	•	Job cre	eation fe	or development of new crops and preserving indigenous seed							
	•	Increas	ed opp	ortunities for growing certain crops in new areas, such as sorghum							
	•	New o	r differ	ent crops may need to be considered, especially drought tolerant crops							
		that ca	<i>n deal</i> i	with variable rainfall							
	•	Oppor	tunities	for no-till agriculture which can be more productive and have lower							
		climate	e risk								
Municipality	5	Z	5	Risk Description and Basis for Assessment:							
	irrent	edium-Term	ng-Term	Current levels of risk are based on the proportions of households currently dependent on agriculture in each local municipality, which are larger than 50% in all local municipalities.							
Alfred Nzo District (Overall)	Moderat	High	Very Hig	The overall picture for maize production is that median yield and overall suitability of the area for maize production is unlikely to change much in the future.							
Base of the	ťe		Jh	Some spatial shifts in optimal growing regions are likely by mid-century							
Matatiele	Moderate	High	Very High	and natural rangeland grasses such as Eragrostis curvula and Kikuyu (Pennisetum clandestinum), and major commercial forestry trees such as eucalyptus, pine, and acacia species (DEA, 2013).							

Mbizana	High	High	Very High
Ntabankulu	High	High	Very High
Umzimvubu	Moderate	High	Very High

Increasing temperatures across the District are likely to reduce feed intake and thus the productivity of all forms of livestock. For each 1°C above 30, most livestock reduce their feed intake by as much as 5%. Both milk yields and conception rates are likely to be affected by heat stress. Impacts on rangeland productivity may also reduce the quality and quantity of forage available for livestock.

Risk is seen as **High** in the medium term and **Very High** in the longer term in all areas with a long-term biome shift. In addition, in any area where the maize yield is reduced in the medium and longer term, risk is assumed to increase.

Sea level rise and Storm Surge

Table 12: Climate change	related risks for storm s	urge and sea level rise	Opportunities are italicised.

	C	Climate	e chan	ge risks related to impacts on agriculture in the ANDM							
Relevance for	•	Increa	sed ri	sk of deaths and injuries by drowning in floods							
people	•	Loss of property and livelihoods									
	•	Withdrawal of risk coverage in vulnerable areas by private insurers									
	•	Inund	ation	of coastal land, wetlands, and estuaries							
	•	Perma	anent	erosion of land							
	High costs of coastal protection										
	•	High costs of land-use relocation and damage to natural infrastructure									
	•	Poten	tial re	quirement for the relocation of populations and infrastructure							
	•	Орро	ortunity	/ for sound planning in all coastal developments so that sensitive areas are							
		avoid	led								
	•	Prote	ction d	of coastal ecosystems could have tourism benefits							
Municipality		Ν		Risk Description and Basis for Assessment:							
	Current	Medium-Term	Long-Term	Risk description and basis for assessment Mbizana is the only coastal municipality in the District. As a result, it is the only one considered here. Risks from sea level rise and storm surge are minimal.							

Low	Moderate	Areas below 5.5 m of elevation, which is the upper bound of land potentially impacted by sea level rise, tidal fluctuations and increased storm surges by the end of the century, are at risk from sea level rise and storm surges. Risk is currently classified as Low, as only 5.78km2 of coastline, which represents 0.24% of Mbizana, and an even smaller proportion of buildings, are situated below the 5.5m elevation level (Figure 15). In addition, the coastal zone, including the critical dune cordon, is currently largely intact. However, other drivers of change in the region, such as mining the dune cordon or increasing development in the coastal zone, could place the ANDM at greater risk from storm surge and sea level rise.
		The medium- and longer-term risks have been classified as <b>Moderate</b> , as they are higher than currently experienced. Note though that risks in Mbizana are lower than most other coastal areas in the country. The risks are manageable through appropriate preparation and adaptation responses

# Human Health

Table 13: Climate change related	human health risks.	Opportunities are	e italicised.	(CSA, 2015)

	Climate Change Risks Related to Human Health in the ANDM	
Relevance for	• Spread of vector-borne diseases such as malaria into new areas	
people	<ul> <li>Spread of communicable water-borne diarrheal diseases such as cholera</li> </ul>	
	<ul> <li>Increase in non-communicable diseases such as respiratory infections</li> </ul>	
	• Direct impacts to persons and property from extreme weather, storms hail and high wind	ds,
	floods, drought, fire, extreme heat, and air pollution.	
	Deleterious effects on mental health	
	<ul> <li>Deleterious effects on occupational health for people who work outdoors</li> </ul>	
	<ul> <li>Exacerbate existing food insecurity, hunger, and malnutrition</li> </ul>	
	• Opportunity to develop new integrated health system and more mobile clinics to support	ort
	communities	

Opportunities to significantly improve the quality of health care for ANDM residents
 Opportunity to leverage special climate change funds to safe and healthy energy sources

Municipality	Access to reliable supplies of clean drinking water	Access to adequate sanitation	Dwellings that can withstand extreme events	Access to safe and healthy energy sources for cooking
Alfred Nzo District (Overall)	High	High	High	High
Matatiele	Moderate	High	Moderate	High
Mbizana	Very High	High	High	High
Ntabankulu	High	High	Very High	Very High
Umzimvubu	High	High	High	High

Risk description and basis for assessment

Socio-economic vulnerability is affected by access to reliable supplies of clean drinking water, sufficient sanitation, dwellings that are safe in extreme weather, and safe and healthy energy sources for cooking. As future changes in these things depend on ANDM service delivery and development decisions more than climatic changes, only the current risk status is assessed here. Compared to national, the ANDM is in a state of emergency regards service delivery. Relative to the national data, all metrics for all municipalities are in the worst quartile. Most of them are in the worst 5 or 10%. The whole table should read Very High risk. However, here we have used natural breaks in the data to highlight which local municipalities in the ANDM are worst off relative to each other.

Access to clean drinking water: the proportion of households at the local municipality scale sourcing water directly from the environment or dependent on delivery (Table 20).

Access to sanitation: the proportion of households at the local municipality scale using a pit toilet without ventilation, a bucket toilet or no toilet (Table 21).

Adequate dwellings: the proportion of households at the local municipality scale living in traditional and informal dwellings as more vulnerable. Access to safe and healthy energy: the proportion of households at the local municipality scale using paraffin stoves and coal or wood fires for cooking.

Water supply and its links to health risks.

	Robust Water Supply	Water Supply Robust	Potentially	Major Water Supply Climate Change Risk						Total
	Regional/local water scheme (operated by municipality or other water services provider)	Borehole Rain water tank	Subtotal	Spring	Dam /pool / stagnant water	River/ stream	Water tanker or vendor	Other	Subtotal	
Matatiele	24115 (48.7%)	37981295(7.7%)(2.6%)	5093 ) (10.3%)	5441 (11%)	4154 (8.4%)	6383 (12.9%)	2353 (4.8%)	1986 (4%)	20317 (41%)	49527
Umzimvubu	14363 (30.6%)	33642381(7.2%)(5.1%)	5745 ) (12.3%)	5635 (12%)	2083 (4.4%)	15198 (32.4%)	2798 (6%)	1069 (2.3%)	26783 (57.1%)	46891
Mbizana	3401 (7%)	1103 2236 (2.3%) (4.6%	3339 (6.9%)	7662 (15.8%)	1355 (2.8%)	30345 (62.6%)	1514 (3.1%)	832 (1.7%)	41708 (86.1%)	48447
Ntabankulu	6036 (24.7%)	961 446 (3.9%) (1.8%	1407 (5.8%)	1980 (8.1%)	1063 (4.4%)	12889 (52.8%)	779 (3.2%)	242 (1%)	16953 (69.5%)	24397
Alfred Nzo District	47915 (28.3%)	9226 6358 (5.5%) (3.8%	15584 ) (9.2%)	20719 (12.2%)	8656 (5.1%)	64815 (38.3%)	7444 (4.4%)	4129 (2.4%)	105763 (62.5%)	169261

2	Sanitation u health risk	unlikely to	o pose a	If well man sufficient to risks unde conditions	aged, sanita o avoid signi er warmer	Major Sanit	Total					
	Flush toilet (connected to sewerage system)	Flush toilet (with septic tank)	Subtotal	Pit toilet with ventilation (VIP)	Chemical toilet	Subtotal	Pit toilet without ventilation	Bucket toilet	Other	None	Subtotal	
Matatiele	5135 (10.4%)	744 (1.5%)	5879 (11.9%)	11834 (23.9%)	2348 (4.7%)	14182 (28.6%)	20064 (40.5%)	161 (0.3%)	3052 (6.2%)	6187 (12.5%)	29464 (59.5%)	49527
Umzimvubu	2476 (5.3%)	717 (1.5%)	3193 (6.8%)	12763 (27.2%)	3867 (8.2%)	16630 (35.5%)	19903 (42.4%)	156 (0.3%)	1874 (4%)	5133 (10.9%)	27066 (57.7%)	46891
Mbizana	557 (1.1%)	504 (1%)	1061 (2.2%)	16081 (33.2%)	1914 (4%)	17995 (37.1%)	20009 (41.3%)	366 (0.8%)	2159 (4.5%)	6855 (14.1%)	29389 (60.7%)	48447
Ntabankulu	545 (2.2%)	572 (2.3%)	1117 (4.6%)	7063 (29%)	1055 (4.3%)	8118 (33.3%)	7009 (28.7%)	156 (0.6%)	1547 (6.3%)	6449 (26.4%)	15161 (62.1%)	24397
Alfred Nzo District	8713 (5.1%)	2538 (1.5%)	11251 (6.6%)	47743 (28.2%)	9184 (5.4%)	56927 (33.6%)	66986 (39.6%)	840 (0.5%)	8632 (5.1%)	24625 (14.5%)	101083 (59.7%)	169261

	Lower risk	or lower lo	ocal impact		Potential health risk or local environmental impact						Total
	Electricity	Gas	Solar	Subtotal	Paraffin	Wood	Coal	Animal dung	None or other	Subtotal	
Matatiele	15823 (31.9%)	3755 (7.6%)	87 (0.2%)	19665 (39.7%)	9963 (20.1%)	18493 (37.3%)	113 (0.2%)	1075 (2.2%)	218 (0.4%)	29862 (60.3%)	49527
Umzimvubu	13949 (29.7%)	4246 (9.1%)	55 (0.1%)	18250 (38.9%)	7954 (17%)	19660 (41.9%)	66 (0.1%)	762 (1.6%)	199 (0.4%)	28641 (61.1%)	46891
Mbizana	14980 (30.9%)	2465 (5.1%)	48 (0.1%)	17493 (36.1%)	2897 (6%)	27662 (57.1%)	109 (0.2%)	85 (0.2%)	202 (0.4%)	30955 (63.9%)	48447
Ntabankulu	3273 (13.4%)	1589 (6.5%)	12 (0%)	4874 (20%)	2496 (10.2%)	16050 (65.8%)	30 (0.1%)	784 (3.2%)	162 (0.7%)	19522 (80%)	24397
Alfred Nzo District	48024 (28.4%)	12054 (7.1%)	203 (0.1%)	60281 (35.6%)	23311 (13.8%)	81865 (48.4%)	318 (0.2%)	2705 (1.6%)	781 (0.5%)	108980 (64.4%)	169261

	Robust Water Supply	Wat Poten	ter Sup tially Ro	ply obust							
	Regional/ local water scheme (operated by municipal ity or other water services provider)	Boreh oles	Rai n Wat er Tan ks	Subt otal	Spri ng	Dam/pool/st agnant water	River/str eam	Wat er tank er or ven dor	Oth er		
Matatiel e	24115 (48.7%)	3798 (7.7%)	129 5 (2.6 %)	5093 (10.3 %)	5441 (11% )	4154 (8.4%)	6383 (12.9%)	235 3 (4.8 %)	198 6 (4% )	2031 7 (41% )	4952 7
Umzimv ubu	14363 (30.6%)	3364 (7.2%)	238 1 (5.1 %)	5745 (12.3 %)	5635 (12% )	2083 (4.4%)	15198 (32.4%)	279 8 (6%)	106 9 (2.3 %)	2678 3 (57.1 %)	4689 1
Mbizan a	3401 (7%)	1103 (2.3%)	223 6 (4.6 %)	3339 (6.9% )	7662 (15.8 )	1355 (2.8%)	30345 (62.6%)	151 4 (3.1 %)	832 (1.7 %)	4170 8 (86.1 %)	4844 7
Ntaban kulu	6036 (24.7%)	961 (3.9%)	446 (1.8 %)	1407 (5.8% )	1980 (8.1 %)	1063 (4.4%)	12889 (52.8%)	779 (3.2 %)	242 (1% )	1695 3 (69.5 %)	2439 7
Alfred Nzo District	47915 (28.3%)	9226 (5.5%)	635 8 (3.8 %)	1558 4 (9.2% )	2071 9 (12.2 %)	8656 (5.1%)	64815 (38.3%)	744 4 (4.4 %)	412 9 (2.4 %)	1057 63 (62.5 %)	1692 61

# 1.4 COVID-19

Transmission potential areas identify areas that prevent social distancing to be practiced and where limitations of practicing good basic hygiene. The health susceptibility index denotes areas where large number of people are potential more susceptible to being adversely affected by COVID-10 due to factors such as age and underlying health conditions. The Alfred Nzo vulnerability profile is presented below. The map shows low vulnerability areas (blue dotted areas) versus areas with higher vulnerability (red dotted areas).

Because Alfred Nzo is a labour sending and impoverished area with limited access to basic services it displays high vulnerability to COVID-19. The areas around Mount Ayliff display pafrticularly extreme vulnerability. Whilst the villages around Matatiele (near Masimangweni) and Umzimvubu (near Kwa Dungu), also show high vulnerability. Area specific I GIS vunerability maps are available curtosy of CSIR at:

https://pta-gis-2-web1.csir.co.za/portal2/apps/opsdashboard/#/390a74fb10844c7a85396e60555a866d