Alfred Nzo District Municipality

ALFRED NZO
DISTRICT MUNICIPALITY

Climate Change Adaptation Summary Report

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1 Executive Summary

The Alfred Nzo District Municipality recognises climate change as a threat to the environment, its residents, and to future development. Therefore, measures should be implemented to reduce or eliminate carbon emissions or enhance greenhouse gas sinks (mitigation) (Böckmann, M 2015). However, due to lag times in the climate and biophysical systems, the positive impacts of past and current mitigation will only be noticeable in the next 25 years (Jiri, O 2016). In the meanwhile, adaptation is regarded as inevitable and a necessary response to the changes that are projected to take place in the District.

The Alfred Nzo District Municipality have developed a Climate Change Response Strategy, which notes:

"Changes in temperature and rainfall are likely to have direct impacts people living in the ANDM [Alfred Nzo District Municipality] and on the ability of the District and its local municipalities to deliver sustainable basic infrastructure and services to all." (Conservation South Africa 2015)

The Alfred Nzo Climate Change Response Strategy also highlights the following strategic priorities for the district in terms of climate change response:

1. Build resilience through avoiding and reversing any loss of, and formally protecting, important ecological infrastructure, including wetlands, river buffers, and water catchment areas.
2. Transition to a low carbon economy by maximising energy efficiency and making the most of natural resources to deliver low-carbon development in the ANDM and avoid development.
3. Ensure universal access to safe and reliable energy, water, sanitation, and housing.
4. Ensure integrated land use planning, across sites and sectors, to build climate resilience, risk minimisation, and ecological infrastructure in a way that supports a green economy in the ANDM. Multi-sectoral integrated planning and implementation, along with internal and community capacity development, is critical.
5. Influence behaviour change through education and awareness and getting buy-in from all levels.
6. Enhance institutional capacity of the district through training and capacity development of officials on climate change and disaster preparedness including enhancing early warning systems and communications on disasters.

This Climate Change Summary Report is intended to provide stakeholders with key summary information on Climate Change in the District. The report content was drafted through stakeholder consultation and research with the aim to review and make recommendation on key climate change vulnerabilities and responses for the District. The report was developed through the Local Government Climate Change Support (LGCCS) program (http://www.letsrespondtoolkit.org/). The LGCCS is led by the Department of Environmental Affairs and is part of the International Climate Initiative (IKI) and is supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

Through this LGCCSP, priority climate change vulnerability indicators for the Alfred Nzo District Municipality were identified. These indicators demonstrate areas that maybe at considerable risk of climate change impacts.

A summary of the key vulnerability indicators is provided in the table below.

Table 1: Key Vulnerability indicators for Alfred Nzo District Municipality

No	Sector	Name Indicator Title	Exposure Answer	Sensitivity Answer	Adaptive Capacity Answer
12	Biodiversity and Environment	Loss of High Priority Biomes	Yes	High	Low
14	Biodiversity and Environment	Increased impacts on environment due to land-use change	Yes	High	Low
15	Biodiversity and Environment	Loss of Priority Wetlands and River ecosystems	Yes	High	Low
16	Coastal and Marine	Impacts on Marine and Benthic Ecosystems	Yes	High	Low
21	Human Health	Health impacts from increased storm events	Yes	High	Low
25	Human Health	Increased malnutrition and hunger as a result of food insecurity	Yes	High	Low
27	Human Health	Increased Occupational health problems	Yes	High	Low
29	Human Settlements, Infrastructure and Disaster Management	Increased impacts on strategic infrastructure	Yes	High	Low
30	Human Settlements, Infrastructure and Disaster Management	Increased impacts on traditional and informal dwellings	Yes	High	Low
31	Human Settlements, Infrastructure and Disaster Management	Increased isolation of rural communities	Yes	High	Low
32	Human Settlements, Infrastructure and Disaster Management	Increased migration to urban and peri-urban areas	Yes	High	Low
33	Human Settlements, Infrastructure and Disaster Management	Increased risk of wildfires	Yes	High	Low
36	Water	Decreased water quality in ecosystem due to floods and droughts	Yes	High	Low

Based on the key indicators identified in the table above, the following sub-projects and actions are prioritised as a response to each of the indicators.

1.1 Biodiversity and Environment

Climate change predictions include the shifting of biomes across South Africa. It is projected that under a medium risk climate scenario, the Savanna Biome in the Alfred Nzo District will expand westwards, roughly doubling its current range at the expense of the Grassland Biome. Additionally, the Indian Ocean Coast Belt Biome is predicted to expand marginally inland, replacing a bit of the Savanna Biome. Under a high risk climate scenario, it is forecast that the Savanna Biome will become the dominant biome in the Alfred Nzo District Municipality Area. the Savanna Biome is predicted to replace much of the area currently covered by the Grassland Biome and virtually all of the area currently covered by the Indian Ocean Coast Belt Biome.

The following key biodiversity indicator, sub-project and actions were identified:

Project	Sub-Project
Manage Loss of High Priority Biomes	Implement the guidelines of the Conservation SA resource handbook and the DEA's 'Lets respond' Toolkit
	Initiate awareness on programs on implementation of guidelines of the Conservation SA resource handbook and the DEA's "Let's respond" Toolkit by September 2018.
	Initiate an afforestation project in Ntabankulu and Bizana by June 2019.
Manage Increased impacts on environment due to land-use change	Enhance a programme of establishing nature reserves in the catchment areas by ECPTA.
	Promote EbA activities that maintain the biodiversity tourists come to see at all local municipalities.
	Upscale natural resources management programmes, including land user incentives.
	Avoid deforestation.
	Implement soil conservation.
	Implement conservation tillage.
	Zoning and land use planning to avoid ecological infrastructure and other important landscapes.
	Upscale natural resource management programmes, including land user incentives.
	Mainstream conservation planning into decision making.
Manage Loss of Priority Wetlands and River ecosystems	Adopt a local wetland protection by law that require vegetated buffers around all wetlands
	Control invasive wetland plants
	Encourage infrastructure and planning designs that minimize the number of wetland crossings
	Establish volunteer wetland monitoring and adoption programs

Project	Sub-Project
	Identify priority wetlands and River ecosystems to be conserved
	Restrict discharges of untreated wastewater and stormwater into natural wetlands
	Maintain natural vegetation buffers along river systems to support water yield and flood attenuation.

1.2 Coastal and Marine

In the Alfred Nzo District Municipality, changes in precipitation, sea-level rise, increased temperatures, and coastal storminess are expected to reduce the diversity and quantity of species in the benthic, marine, coastal and estuarine ecosystems. This could result in adverse impacts on subsistence fishing markets and community livelihoods in the District Municipal Area. Coastal livelihoods may also be negatively affected by predicted increases in the severity and frequency of storms and sea level rise. However, the Alfred Nzo District Municipality is considered to be at a low risk from sea level rise compared to other coastal district municipalities due to the limited size of low-lying areas in the District Municipal Area.

The following key coastal and marine indicators, sub-projects and actions were identified:

Project	Sub-Project
Manage impacts on Marine and Benthic Ecosystems	Commission research and improve understanding of climate change impacts on marine and benthic ecosystems.
	Develop a coastal management policy that will enable the management of the existing marine and benthic ecosystems in the face of the changing climate.
	Facilitate cooperation between the municipality and the relevant research institutions to jointly manage climate change impacts and provide environmental feedback to coastal communities.
	Identify and prioritise the conservation of marine and benthic Ecosystems that are rich in biodiversity.
	Implement continuous monitoring initiatives and management systems for marine and benthic Ecosystems.

1.3 Human Health

Climate change impacts affect the social and environmental determinants of health and will therefore affect human health in several ways in the Alfred Nzo District Municipality. Projected temperature increases due to climate change will negatively affect the young and elderly population of the district. People working in the informal sector usually work outdoors and are therefore exposed to all weather elements and are particularly vulnerable to temperature increases.

The following key human health indicators, sub-projects and actions were identified:

Project	Sub-Project
Manage health impacts from increased storm events.	Incorporate climate change issues into disaster plan with strong community awareness programmes and response units in Ntabankulu and Umzimvubu local Municipalities by the end of 2019. This is to be done by the Disaster Management Unit.
Manage increased malnutrition and hunger as a result of food insecurity.	Develop and implement a crop production change awareness programme by social needs cluster (Social development, health and agriculture departments) by 2018 in Umzimvubu and Ntabankulu Local Municipalities.
	Develop research unit within the District Municipality by June 2019.
Manage the increasing occupational health problems.	Educate communities and outdoor workers from all sectors on the risks of heat stress.
	Develop new work practices to accommodate temperature extremes.

1.4 Disaster Management, Infrastructure and Human Settlements

Climate change impacts will affect Disaster Management, Infrastructure and Human Settlements in several ways in Alfred Nzo District Municipality. Increases in the severity of storm events and increase in flooding will damage infrastructure which may result in a loss of industrial productivity and service delivery disruptions. The impacts of storm events will particularly affect communities located in informal settlements, on flood plains and where there is poor drainage infrastructure. In addition, communities in rural areas that depend on subsistence farming may be unable to grow crops that they have grown in the past due to the changing climate. It is predicted that there will therefore be an increase in rates of rural-urban migration. Rural communities may also become more physically isolated due to extreme events impacting on key infrastructure.

The following key human settlement indicators, sub-projects and actions were identified:

Project	Sub-Project
Manage potential increased impacts on strategic infrastructure.	Develop a road maintenance plan for each local municipality by 2018 with assistance from Department of Transport, Road and Public Works.
	Safe bridges for water crossings.
	Identify critical infrastructure at risk from climate change.
	Implementation of road maintenance plan.
	Facilitate the implementation of maintenance plans by through different departments such as Roads and Public Works, SANRAL, local municipalities, Water Affairs, and Department of Human Settlement by March 2018.
	Consider climate change impacts on surface water flows in the design specifications of any new dams, stormwater systems, culverts and bridges by ensuring that all the current projects have climate change responses.
	Consider ecological infrastructure in infrastructure planning by monitoring construction of new dams.

Project	Sub-Project
Manage increased impacts on traditional and informal dwellings	Commission a reliable early warning system (linked to radio stations, community leaders and social media) to alert communities and industries on the possible occurrences of storm events.
	Conduct a climate change risk assessment on informal dwellings.
	Conduct regular assessments of informal dwellings in order to identify priority areas for interventions to reduce climate change risk.
	Implement informal settlement upgrades.
	Update community emergency plans that will assist with responding to climate change related impacts/risks.
Manage potential increased isolation of rural communities.	Mobilise tourism as part of a livelihoods diversification strategy for agricultural communities by encouraging maintenance in roads that lead to tourism sites. To be done by April 2018.
Manage potential increase migration to urban and peri-urban areas.	Assess drivers and dynamics of migration.
	Develop and implement rural development programs to create economic opportunities.
	Identify alternative basic service provision options for rural areas, such as water tanks, new sanitation services, etc.
	Promote behavioural change within communities that will contribute towards the building of economic nodes within rural areas and consequently reduce the need for migration.
Manage potential increased risk of wildfires	Plan appropriately and develop capacity for fire management in settlements by capacitating the available fire and rescue units.
	Improve fire management for sustainable grasslands by establishing fire safety bylaws and traditional leader awareness to ensure fire safety bylaws are enforced.

1.5 Water

Water resources are the primary medium through which climate change impacts will be felt by South Africans (Schulze et al., 2014). Climate change will affect Alfred Nzo District Municipality's water accessibility, quantity, and quality (Parikh, J 2007). Drought, reduced runoff, increased evaporation, and an increase in flood events will impact on both water quality and quantity.

The following key water indicators, sub-projects and actions were identified:

Project	Sub-Project
Manage decreased water quality in ecosystem.	Catchment management that conserves natural resources.
	Develop investment opportunities in ecosystem goods and services.

1.6 Cross-Cutting

A cross-cutting co-ordinated approach is required to adapt to climate change. Alfred Nzo District Municipality requires coordination across different departments, as well as the integration of climate change into different sectors and strategic plans. In particular all sectors have a role to play in disaster risk reduction and the early warning systems.

The following key cross-cutting objectives and projects were identified:

Objective	Project	Priority
Coordinate climate change response in the Municipality	Include all sectors in early warning systems and disaster risk reduction.	
	Develop enhanced EWS and disaster risk reduction approaches.	
Build human capacity to respond to climate change	Build institutional capacity to be flexible in the face of changing conditions.	
Generate knowledge and disseminate information on climate change	Develop early warning systems, as well as risk management and decisions support tools for farmers.	

2 Introduction

This document outlines key climate change vulnerabilities and responses to address these vulnerabilities for Alfred Nzo District Municipality. The Climate Change Vulnerability Assessment and Response Plan were developed through the Local Government Climate Change Support Program (LGCCSP), an initiative of the National Department of Environmental Affairs and the International Climate Initiative (IKI) and is supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

The three primary objectives of the LGCCSP are to:

- Perform a desktop analysis of the municipality to provide context on change vulnerabilities and responses;
- Undertake district municipal specific engagements to draft climate change vulnerabilities and responses;
- Facilitate capacity building and knowledge-transfer throughout the program to enhance implementation of prioritised climate change adaptation options.

For more details on the LGCCSP please visit the website: http://www.letsrespondtoolkit.org/.

Through the LGCCSP, a Climate Change Vulnerability Assessment Toolkit was developed to assist municipalities to identify and prioritise climate change indicators to facilitate the assessment of adaptive capacity. Indicators are a range of potential impacts which have been developed using the Long Term Adaptation Scenario (LTAS) reports (Department of Environmental Affairs 2013g). Indicators are grouped into the following themes:

- Agriculture
- Biodiversity and Environment
- Coastal and Marine
- Human Health
- Disaster Management, Infrastructure and Human Settlements
- Water

The LGCCS Toolkit was applied to the Alfred Nzo District Municipality to assist with the development of its Climate Change Response Plan.

2.1 Climate Change Introduction

2.1.1 Climate change defined

Climate change is a natural phenomenon that takes place over geological time. However, over the past few decades the rate of climate change has been more rapid and the magnitude of global warming has increased dramatically (Warburton, M.L and Schulze, R 2006; Warburton, M.L 2012). This change has been attributed to increased anthropogenic greenhouse gas emissions (Koske, J and Ochieng, M.A 2013). For example, the burning of coal to generate electricity, the burning of petrol in cars, some chemical processes in industries, and many farming activities all contribute to the increased concentration of greenhouse gasses in the atmosphere.

Climate change is not just an increase in average global temperatures but changes in regional climate characteristics such as rainfall, relative humidity and severe weather extremes (Davis, C.L 2011). Climate change can manifest as a shock or a stress (Ziervogel, G and Calder, R 2003). Shocks are defined as discrete, extreme events (rapid onset) such as floods, while gradual change (slow

onset) such as long-term climate variability is classified as a stress (Ziervogel, G and Calder, R 2003). The negative impacts of climate change "are already felt in many areas, including in relation to, *inter alia*, agriculture, and food security; biodiversity and ecosystems; water resources; human health; human settlements and migration patterns; and energy, transport and industry" (United Nations WomenWatch 2009, 1).

2.1.2 Climate Change Policy Context in South Africa

Climate change is a relatively new area of policy development in South Africa. As policies and structures are developed, it is necessary to ensure that they are evidence-based, coordinated and coherent. This section introduces international and national climate change policies and structures, which are listed below:

- The United Nations Framework Convention on Climate Change (UNFCCC). This international treaty provides guidance on setting agreements pertaining to the reduction of greenhouse gas emissions.

- The Paris Agreement, came into effect on 4 November 2016. This is the first agreement all countries have committed to and stipulates that all countries must reduce carbon emissions to limit global temperature increase to 1.5 degrees Celsius above pre-industrial levels.

- South Africa's Nationally Determined Contributions, came into effect after the Paris Agreement was signed. South Africa is therefore required to report on mitigation and adaptation efforts. Concerning mitigation, South Africa is to reduce emissions by a range between 398 and 614 million metric tons of carbon equivalent by 2025 and 2030. There are several instruments to ensure reduction in carbon emissions including car tax and company carbon budgets among other instruments. With reference to adaptation a National Adaptation Plan is currently being developed, and climate change is to be incorporated in all policy frameworks, institutional capacity is to be enhanced, vulnerability and adaptation monitoring systems are to be in place, vulnerability assessment and adaptation needs framework are to be developed and there needs to be communication of past investments in adaptation for education and awareness.

- The National Climate Change Response White Paper (NCCRWP) was adopted in 2011 and presents the South African Government's vision for an effective climate change response in the long-term, to transition to a climate-resilient and lower-carbon economy and society.

- The National Development Plan, focuses on eliminating poverty and reducing inequality by 2030 and creating an environmentally sustainable country through mitigation and adaptation efforts.

- Long Term Mitigation Scenarios, outline different scenarios of mitigation action for South Africa.

- Long Term Adaptation Scenarios, consist of two phases. Phase one, was the identification of climate change trends and projections as well as impacts and responses for the main

sectors. Phase two focussed on integrating issues such as climate information and early warning systems, disaster risk reduction, human settlements and food security.

2.1.3 Climate Change Impacts in South Africa

South Africa's temperature is expected to increase to 1.2° C by 2020, 2.4° C by 2050 and 4.2° C by 2080 (Kruger, A.C and Shongwe, S 2004). Contrary to the global increase in rainfall, South Africa's rainfall is expected to decrease by 5.4% by 2020, 6.3% by 2050 and 9.5% by 2080 (Kruger, A.C and Shongwe, S 2004). The frequency and intensity of climate extremes, *inter alia,* droughts, floods, storms and wild fires will increase (Davis, C.L 2011; Böckmann, M 2015). Climate change evidence indicates the changes in frequency and intensity of flood and prolonged drought events at small scales (Meyiwa, T et al. 2014). Furthermore, the sea level will continue rising and ocean acidification will get worse (Böckmann, M 2015).

There are however uncertainties associated with climate projections because they are based on the potential rates of resource use in the future, and associated greenhouse gas emissions (Nicholson-Cole, S.A 2005).

To assist with assessing the potential impacts from climate change, the country has been divided into six hydrological zones (Figure 1 below). These hydrological zones not only reflect water management areas but have been grouped according to common climatic and hydrological characteristics (Department of Environmental Affairs 2013a). Based on a range of data and projections, four possible climate scenarios have been identified for South Africa:

- Warmer/wetter (with greater frequency in extreme rainfall events),
- Warmer/drier (with an increase in frequency of drought and somewhat increased frequency of extreme rainfall events),
- Hotter/wetter (with substantially greater frequency of extreme rainfall events), and,
- Hotter/drier (with a substantial increase in the frequency of drought events and greater frequency of extreme rainfall events).

Projections on rainfall have also been developed for each of the hydrological zones (Department of Environmental Affairs 2013a). The following four climate change scenarios have been described for the Mzimvubu-Tsitsikama Hydrological Zone (the dominant zone in the Eastern Cape) in the Department of Environmental Affairs' Long Term Adaptation Scenarios Reports. These are:

- Warmer wetter scenario - Increased rain in all seasons
- Hotter wetter scenario - Strongly increased rain in all seasons
- Hotter drier scenario - Decreased rain in all seasons & strongly decreased in summer & autumn
- Warmer drier scenario - Decreased rain in all seasons & strongly decreased in summer & autumn

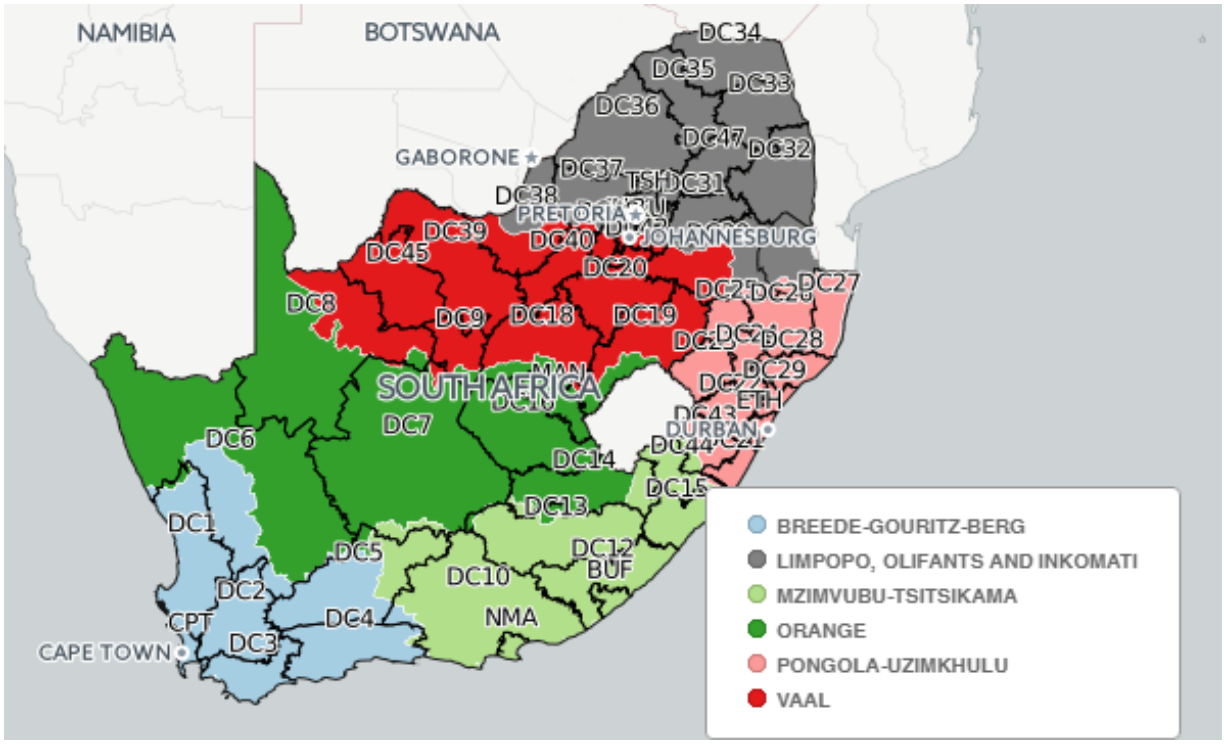

Figure 1: Hydrological Zones of South Africa

2.1.4 Provincial Climate Change Context

In 2010, the Eastern Cape Provincial Department of Economic Development and Environmental Affairs (DEDEA) initiated the development of the Eastern Cape Climate Change Response Strategy (ECCCRS) (Coastal & Environmental Services 2011). The response strategy notes that, in the Eastern Cape, increased dry spell duration has already been experienced, while the wet spell duration has decreased for the 1910-2004 period (Department of Environmental Affairs 2013a). Annual mean temperatures are expected to increase by at least 1.5 degrees Celsius and at most 2.5 degree Celsius (Coastal & Environmental Services 2011). Projections show that the Province's precipitation will be stable or slightly higher than present precipitation but with greater intensity (Coastal & Environmental Services 2011). In addition, the duration of droughts is expected to increase (Coastal & Environmental Services 2011). The strategy also notes that climate change threatens the economic, social, environmental and political systems of the province (Coastal & Environmental Services 2011).

The table below is a summary of the key climate change issues in the province as outlined in the Eastern Cape Climate Change Response Strategy.

Table 2: Key climate change issues in Eastern Cape

Climate Change Manifestation	2nd Order Impact	3nd Order Impact	Systems/sectors/ Infrastructure
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme, coupled with berg-wind conditions	Risk of major loss of livestock, grazing, crops and infrastructure. Threats to financial sustainability of existing commercial and subsistence farming operation and rural livelihoods; Reduced food security.	Agriculture Sector
Increased storm severity/ Extreme weather events	Increased inundation and loss of coastal land, wetlands and estuaries	Increased damage to/loss of coastal property and infrastructure and increased insurance premiums	Coastal and Marine Systems
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme, coupled with berg-wind conditions	Risk of major and widespread loss of standing stocks and threats to financial sustainability of existing operations.	Forestry Sector
More hot days and heat waves	Increased morbidity and mortality among elderly and infirm (e.g. HIV/AIDS patients)	Increased strain on health services	Social & Economic Systems
Higher mean temperatures	Coupled with increased rainfall, spread in range of diseases and vectors, including cholera, malaria and bilharzia.	General increase in occurrence of disease; exacerbation of effects on people with HIV/AIDS, the elderly and the poor.	Social & Economic Systems
Increased storm severity/ Extreme weather events.	Increased storm surges coupled with sea level rise and flooding from both climate change causes and catchment hardening.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Social & Economic Systems

Climate Change Manifestation	2nd Order Impact	3nd Order Impact	Systems/sectors/ Infrastructure
Increased storm severity/ Extreme weather events.	Coupled with more intense rain, catchment hardening due to urban development, and reduced integrity of water catchments: increased risk of flooding or flash floods	Direct threat to infrastructure within flood-prone areas; Direct threat to human life.	Social & Economic Systems
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme	Increased fire frequency increases direct threat to human life; threats to livelihood and infrastructure.	Social & Economic Systems
More hot days and heat waves	Increased morbidity and mortality among elderly and infirm (e.g. HIV/AIDS patients)	Direct threat to livelihoods and social services	Social & Economic Systems
Higher mean temperatures	Increased evaporation, reduced soil moisture, reduced runoff and river base flow.	Compounded by reduced MAP, systemic water shortages will limit economic growth potential to the south-west.	Social & Economic Systems
Sea level rise	Coupled with storm surges and flood events exacerbated by catchment hardening, inundation and wave damage to coastal low lying areas.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Social & Economic Systems
Increased storm severity/ Extreme weather events.	Crop damage from hail and wind and heavy rain	Increased risk of crop failure; threats to commercial and subsistence agriculture, rural livelihoods and food security.	Social & Economic Systems
Longer dry spells and increased likelihood/ severity of droughts	Increased risk/frequency of dry land crop-failure; Increased mortality and reduced productivity among livestock.	Threats to commercial and subsistence agriculture, rural livelihoods and food security.	Social & Economic Systems

Climate Change Manifestation	2nd Order Impact	3nd Order Impact	Systems/sectors/ Infrastructure
More hot days and heat waves	Heat waves coupled with dry conditions may increase the risk of uncontrollable shack fires in informal settlements	Threat to human life. Threats to urban livelihoods and increased strain on urban disaster Management systems.	Social & Economic Systems
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Reduced safety of personnel and increased frequency of injury or loss of life	Transport infrastructure

3 Methodology

This climate change response plan was developed through a combination of desktop research and stakeholder engagement activities. Initially, desktop research was conducted on the climate change status quo for each of the key sectors in the district. This research was used for the basis of the stakeholder engagement activities.

The workshop methodologies were based on the active-based learning theory approach. Action learning is an approach used to train and to encourage stakeholders to solve real life problems. The workshop methodologies ensured there was a focus on knowledge exchange and capacity building at the workshops.

There were three stakeholder engagement occurrences. These were:

- Provincial level workshop, where key stakeholders were introduced to the core concepts of climate change and the LGCCSP program. The exposure component of the vulnerability assessment was also undertaken by various stakeholders at this workshop, including government officials and other key community members. The workshop therefore involved presentations, participatory exercises and associated discussions.
- A District Municipality Level workshop, where the focus was specifically on the identification and review of key climate change vulnerabilities for the area. A more detailed vulnerability assessment was undertaken by the participants. The process included the identification of context specific climate change indicators, assessing exposure, sensitivity and adaptive capacity. Participants also developed priority climate change responses.
- A final Provincial Level workshop, where key stakeholders were invited to present their municipal climate change plans.

These workshops aimed to provide the necessary tools, build capacity and provide support to stakeholders to develop and review existing Climate Change Vulnerability Assessments and response plans.

3.1 What is a Vulnerability Assessment?

According to the IPCC (Parry et al. 2007) "vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change". A vulnerability assessment therefore is a multifaceted assessment of an area's vulnerability to climate change. Nelitz et al. further define a climate change vulnerability assessment as "a process for assessing, measuring, and/or characterizing the exposure, sensitivity, and adaptive capacity of a natural or human system to disturbance"(Nelitz, M, Boardley, S, and Smith, R 2013). The methodology used in assessing climate change vulnerability for the District used the three assessment criteria, namely: exposure, sensitivity and adaptive capacity.

- **Exposure** refers to the magnitude and extent, to which a municipal area is exposed to climate change impacts (Amos, E, Akpan, U, and Ogunjobi, K 2015) and is a function of one's location and environment.
- **Sensitivity** on the other hand refers to the extent to which a municipal area is affected by the climate change impacts
- The IPCC (Parry et al. 2007) formally defines **adaptive capacity** as: "The ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences".

Exposure and sensitivity increases one's vulnerability to climate change, while adaptive capacity decreases vulnerability. The above-mentioned components allow for more detailed characterizations of climate change vulnerability.

3.2 Steps involved in a Vulnerability Assessment

Four steps were followed when conducting a vulnerability assessment, they are:

- Step 1: Identify indicators of potential impacts.
- Step 2: Assess whether the impact will take place (exposure).
- Step 3: Assess how important the risk is (sensitivity).
- Step 4: Assess if you can respond to the risk (adaptive capacity).

Figure 2 below illustrates how the components of a Climate Change Vulnerability Assessment link to each other.

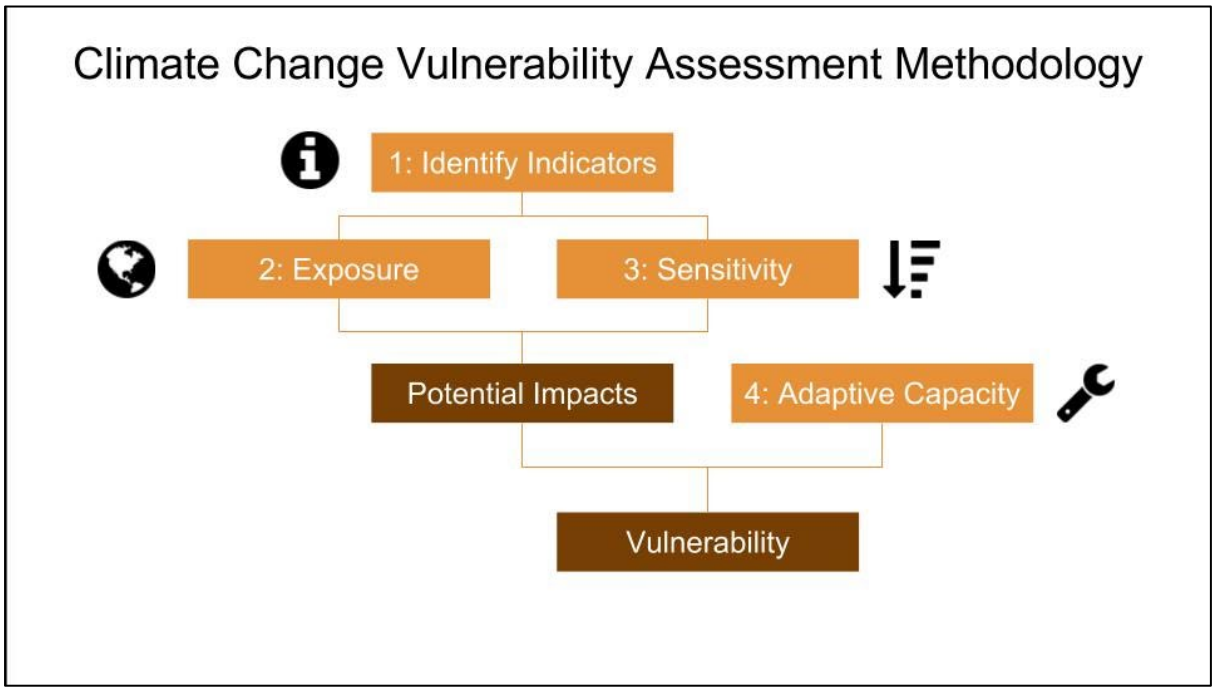

Figure 2: Vulnerability Assessment Methodology

3.3 Step 1: Develop Climate Change Indicators

As mentioned above, the first step in a Climate Change Vulnerability Assessment is the identification of context specific indicators. Essentially, indicators are potential climate change induced impacts in a specific area. The LGCCSP Vulnerability Assessment Toolkit developed a draft of several indicators using the Long Term Adaptation Scenario Reports (Department of Environmental Affairs 2013g). The indicators are grouped into six sectors (agriculture; biodiversity and environment; coastal and marine; human health; disaster management, infrastructure and human settlements; and water).

3.4 Step 2: Assessing Exposure

The assessment of exposure followed the identification of indicators. Exposure assessment aimed to ascertain whether the identified indicators are relevant in the District Municipality. If the District Municipality was exposed to a particular indicator, stakeholders scored that indicator a 'yes'.

3.5 Step 3: Assessing Sensitivity

The third step of the Climate Change Vulnerability Assessment 'asks' the question, "if you are exposed, how important is the potential impact?" This is termed "sensitivity" and is assessed using a graded scale (High, Medium, Low). If an indicator scored a "yes" in the exposure assessment, the sensitivity of the Municipality to that indicator was than analysed using the graded scale.

3.6 Step 4: Assessing Adaptive Capacity

Once exposure and sensitivity were determined, the next step was the assessment of adaptive capacity. The question directed at stakeholders during the workshop was "If there are going to be significant impacts due to climate change, do you have the necessary systems (policy, resources, social capital) in place to respond to the change?"

The indicators that scored "yes" for the exposure questions and "high" or "medium" for the sensitivity questions, were then assessed in terms of adaptive capacity. For the purpose of the LGCCS Vulnerability Assessment Toolkit, the guiding question was "Do you have high, medium or low adaptive capacity (policy, institutional, social and finance) to respond to the change?" The adaptive capacity answers were scored using a graded scale (high, medium or low).

Those that scored a "low" or "medium" were recorded as indicators with potential adaptive capacity constraints in Alfred Nzo District Municipality.

3.7 Step 5: Develop Response Plans for Priority Indicators

Upon completion of the exposure, sensitivity and adaptive capacity assessments, priority indicators were identified using the criteria below:

- Exposure - Yes
- Sensitivity - High
- Adaptive Capacity - Low

Priority indicators are perceived to be the ones the district is most vulnerable to. A response plan was then developed to address climate change vulnerabilities and inform resource allocation for climate change adaptation. To facilitate the development of a response plan, stakeholders were given a LGCCS generic response plan template for each sector, which was used as a starting point to develop sector specific response plans for Alfred Nzo District Municipality.

3.8 Desired Adaptation Outcomes

The Department of Environmental Affairs (DEA) has developed (ongoing process) a set of Desired Adaptation Outcomes (DAOs). The DAOs provide evidence of climate change impacts and of responses to climate change in South Africa. DAOs identify desired states that, individually and in combination, will contribute to climate resilience in the short to medium-term (i.e. over the next five to 20 years). They aim to provide clear insights into climate change adaptation in South Africa and help capture the country's unique circumstances to aid reporting on adaptation at national and international levels. They also provide a means of assessing the capacity of 'at risk' sectors and their stakeholders to adapt to climate change and whether the measures being taken are appropriate, efficient and effective.

The current set of DAOs are provided below:

- G1 - Robust/integrated plans, policies and actions for effective delivery of climate change adaptation, together with monitoring, evaluation and review over the short, medium and longer-term.

- G2 - Appropriate resources (including current and past financial investments), capacity and processes (human, legal and regulatory) and support mechanisms (institutional and governance structures) to facilitate climate change adaptation.
- G3 - Accurate climate information (e.g. historical trend data, seasonal predictions, future projections, and early warning of extreme weather and other climate-related events) provided by existing and new monitoring and forecasting facilities/networks (including their maintenance and enhancement) to inform adaptation planning and disaster risk reduction.
- G4 - Capacity development, education and awareness programmes (formal and informal) for climate change adaptation (e.g. informed by adaptation research and with tools to utilise data/outputs).
- G5 - New and adapted technologies/knowledge and other cost-effective measures (e.g. nature-based solutions) used in climate change adaptation.
- G6 - Climate change risks, impacts and vulnerabilities identified and addressed.
- G7 - Systems, infrastructure, communities and sectors less vulnerable to climate change impacts (e.g. through effectiveness of adaptation interventions/response measures).
- G8 - Non-climate pressures and threats to human and natural systems reduced (particularly where these compound climate change impacts).
- G9 - Secure food, water and energy supplies for all citizens (within the context of sustainable development).

The activities in the Sector Response Plans below have a column to allocate to the DAOs. This will assist the DEA to monitor and evaluate the implementation of climate change adaptation throughout the country.

4 District Snapshot Alfred Nzo District Municipality

Alfred Nzo District Municipality is one of six district municipalities within the Eastern Cape Province. The district is in the north-eastern corner of the province and comprises of the following four local municipalities: Matatiele, Mbizana, Ntabankulu and Umzimvubu local municipality. The District municipal area has a total population of 801 344 more than 10% of the province's total population (Statistics South Africa 2011). Mbizana local municipality is home to a great proportion of the district's population while Ntabankulu local municipality is home to the minority of the district's population. The district is predominantly rural (Department of Cooperative Governance and Traditional Affairs n.d.; Alfred Nzo District Municipality 2016a) and 94% of the population reside in rural areas (Alfred Nzo District Municipality 2016a). Among the priority disaster risks in the district's disaster management plan are extreme weather conditions (storms, hail, high winds), forest and veld fires (Conservation South Africa 2015; Alfred Nzo District Municipality 2016a).

Responding to climate change has been identified as a key issue for the Alfred Nzo District Municipality (Alfred Nzo District Municipality 2016b). In response to identifying this need, the Alfred Nzo District Municipality undertook a study on the vulnerability and resilience of the Alfred Nzo District Municipal Area to the predicted impacts of climate change (Alfred Nzo District Municipality 2016b). Furthermore, the Alfred Nzo District Municipality has budgeted money, over a period of three years, for the development of a climate change adaptation strategy (Alfred Nzo District Municipality 2016b).

4.1 Key District Indicators

The table below provides a summary of the key indicators for the District. The table lists the national indicators for comparison purposes. Many of these indicators are used in the climate change vulnerability assessment process below.

Table 3: Key District Municipal Indicators for Alfred Nzo DM compared to the National Average

General Information	Alfred Nzo District Municipality	South Africa
Code	DC44	
Province	Eastern Cape	
Seat	Mount Ayliff	
Area (km²)	6859	1219740
Census Statistics		
Criteria	**Alfred Nzo District Municipality**	**South Africa**
Population	**801344**	**51770553**
Age Structure		
Population under 15	40.89%	29.17%
Population 15 to 39	37.19%	44.30%
Population 40 to 64	15.74%	21.19%
Population over 65	6.18%	5.34%
Dependency Ratio		

People in age group 0-14 & 65+, supported by age group 15-64	88.9%	52.7%
Employment (between 15 and 64)		
Employed	16.20%	38.87%
Not economically active	61.67%	39.21%
Unemployed	12.45%	16.50%
Discouraged work-seeker	9.68%	5.41%
Education (aged 20 +)		
Post School Qualification	4.62%	9.94%
Grade 12/Matric	12.53%	27.83%
High School	34.98%	32.16%
Less than High School	32.21%	16.43%
Other	15.68%	13.64%
Vulnerability Indicators		
Criteria	**Alfred Nzo District Municipality**	**South Africa**
Household Dynamics		
Households	169257	14450151
Average household size	4.73	3.58
Percentage households involved in agricultural activities	58.83%	20.56%
Dwelling Type		
Percentage Households that are Informal Dwelling	1.19%	13.58%
Percentage Households that are Traditional Dwelling	55.31%	7.89%
Combined Percentage Households that are Traditional and Informal Dwelling	56.50%	21.47%
Sources of Water		
Percentage of Population that sources water from Boreholes	4.99%	1.76%
Percentage of Population that do not source water from piped water schemes	74.34%	21.82%
Percentage of Population that source water from Service Providers (e.g. Municipalities)	25.66%	78.18%
Percentage of Population that sources water from Water Tanks	3.09%	2.67%
Electricity Usage		
Percentage of households that use alternatives to electricity for cooking	71.63%	26.12%
Percentage of households that use alternatives to electricity for cooking, heating or lighting	53.07%	17.77%

Sanitation		
Percentage Population with flush toilets	4.64%	56.51%
Percentage Population using pit latrines	68.30%	30.73%
Percentage of Population with no toilet facilities	15.37%	5.34%
Percentage of Population with other toilet facilities	11.69%	7.42%
Refuse		
Percentage of Households with no rubbish disposal	17.37%	5.97%
Percentage of households with refuse removed by local authority/private company	5.03%	59.40%
Health		
Percentage of young (<5yrs) and elderly (>64yrs)	20.12%	16.32%
Percentage workforce employed in the informal Sector	19.89%	12.20%
Vulnerability Tool Indicators		

Criteria	Alfred Nzo District Municipality	South Africa
Percentage households involved in agricultural activities	58.83%	20.56%
Percentage Population with flush toilets	4.64%	56.51%
Percentage of young (<5yrs) and elderly (>64yrs)	20.12%	16.32%
Percentage Households that are Traditional and Informal Dwelling	56.50%	21.47%
Percentage of Households with no rubbish disposal	17.37%	5.97%

4.2 Alfred Nzo DM Agriculture Sector Summary

Agriculture is the largest land use in the Alfred Nzo District Municipal Area (Conservation South Africa 2015). Within the agriculture sector, the majority of agricultural activities are subsistence based, particularly in the rural areas (Alfred Nzo District Municipality 2016b). There are also several commercial farms in the northeast of the Alfred Nzo District Municipal Area, particularly around Cedarville (Alfred Nzo District Municipality 2016b).

Agricultural activities in the Alfred Nzo District Municipal Area are made up of livestock and crop farming as well as some commercial forestry (Alfred Nzo District Municipality 2016b). Crop farming consists of mainly dryland farming, but some irrigated crop farming does also occur (Alfred Nzo District Municipality 2016b). Livestock farming in the District Municipal Area includes goat, sheep, beef and dairy farming (Alfred Nzo District Municipality 2016b).

These agricultural activities are an important source of food security for subsistence farmers in the Alfred Nzo District Municipal Area (Alfred Nzo District Municipality 2016b). Additionally, the South African National Census of 2011, estimated that 58.83 % of households in the Alfred Nzo District Municipal Area are involved in agricultural activities (Figure 3) (Statistics South Africa 2011). In the map (Figure 3) the darker areas indicate higher percentages of households involved in the agriculture sector (Statistics South Africa 2011).

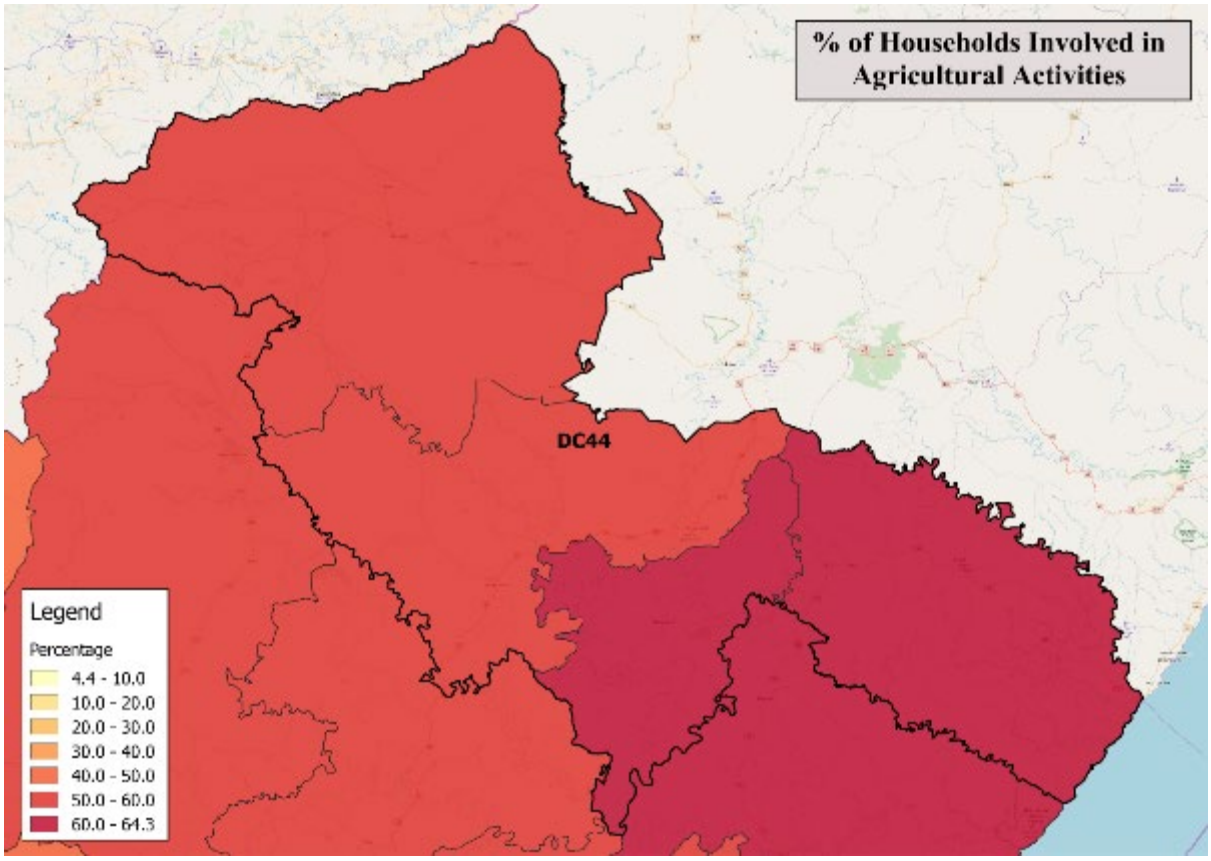

Figure 3: Percentage of households involved in agricultural activities across the District Municipal Area (Statistics South Africa 2011)

Additionally, commercial agriculture is an important source of employment in the District Municipal Area (Alfred Nzo District Municipality 2016b). Specifically, the agriculture sector accounts for approximately 12 % of the total employment in the Alfred Nzo District Municipal Area, making it the third largest employer in the District Municipal Area (Alfred Nzo District Municipality 2016b). However, even though the agriculture sector is an important job creator, it contributes little towards the Alfred Nzo District Municipal Area's economy.

In 2016, the agriculture sector contributed 1 % to the overall Gross Value Added of the Alfred Nzo District Municipal Area (Alfred Nzo District Municipality 2016b, 2017). The Gross Value Added refers to the economic performance of a sector, industry or area in terms of the value of the products and services produced (Statistics South Africa 2005). It includes subsidies and excludes taxes paid on products (Statistics South Africa 2005). The agriculture sector's contribution to the Gross Value Added is so low because most of the population take part in subsistence agriculture, which does not contribute to the Gross Value Added of the District Municipal Area (Alfred Nzo District Municipality 2017). Hence, the 1 % contribution to the overall Gross Value Added only consists of formalised commercial agriculture (Alfred Nzo District Municipality 2017).

Despite the low Gross Value Added contribution, the agriculture sector remains an important sector in the Alfred Nzo District Municipal Area in terms of food security and employment (Alfred Nzo District Municipality 2017). There is also some potential to expand the yields of certain crops in the Alfred Nzo District Municipal Area. In the Alfred Nzo District Municipality's 2016/2017 *Integrated Development Plan*, potential for the following vegetables and fruit was identified: maize, sorghum, sunflowers, beans, hemp, wheat, cabbages, potatoes, butternut, spinach, green peppers as well as peaches and apples (Alfred Nzo District Municipality 2016b).

The potential for maize yields in the District Municipal Area, ranges from 2 to 7 tons per hectare (t/ha), and could be gown across nearly the whole District Municipal Area (Figure 4). The map (in Figure 4) is divided into 'mesozones'. Mesozones are areas (spatial zones) of approximately the same size that are split by geographic as well as social boundaries such as rivers and areas of varying human activity (stepSA 2016). Each mesozone is roughly 50 square kilometres in size and allows for more accurate representations of activities or features (stepSA 2016).

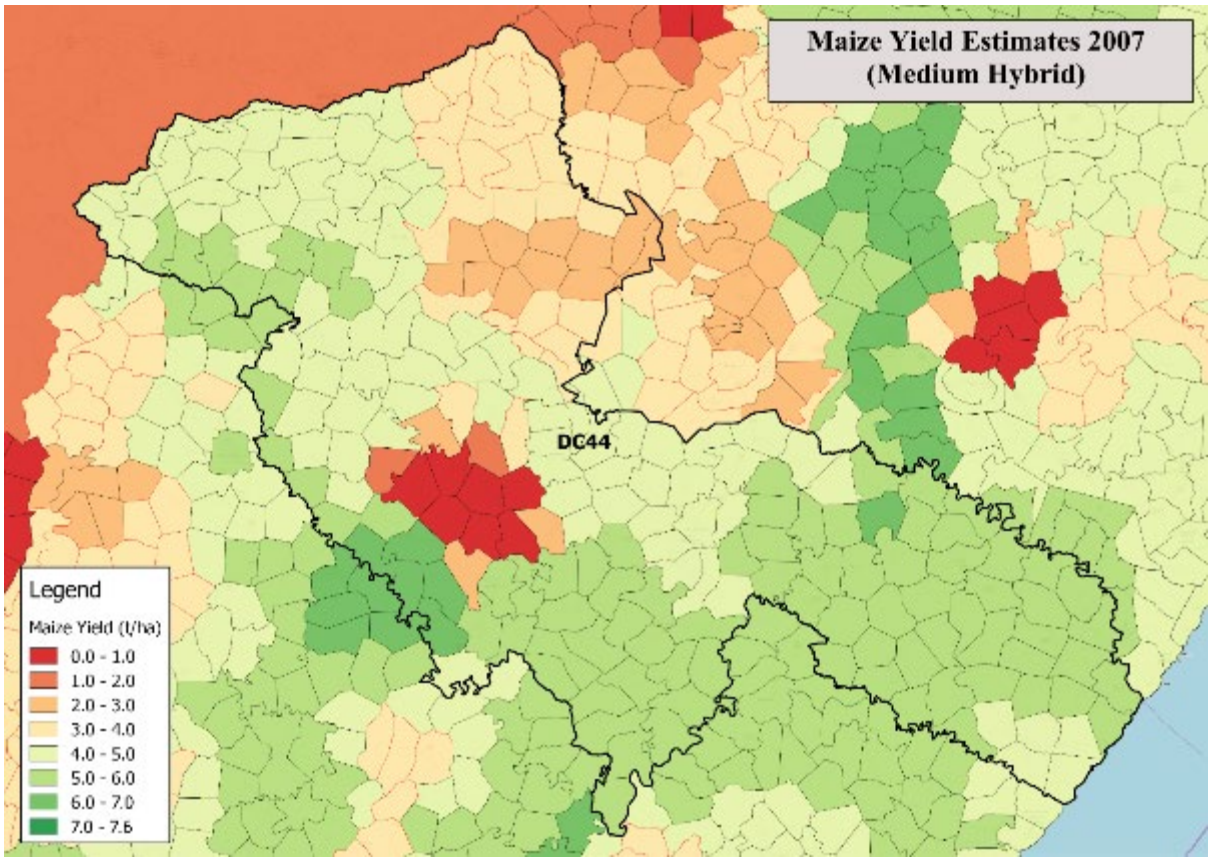

Figure 4: Maize (medium hybrid) yield estimates per mesozone across the District Municipal Area (Schulze and Walker 2007b)

In addition to maize, there is potential for sorghum and soybean production in the Alfred Nzo District Municipal Area. Potential for sorghum is spread across most of the District Municipal Area with possible yields in some areas as high as 6 t/ha (Figure 5) (Schulze and Walker 2007c). Soybean production (Figure 6) has less potential (ranging from 0 to 3 t/ha) but could be grown across nearly all of the Alfred Nzo District Municipal Area (Schulze and Walker 2007d).

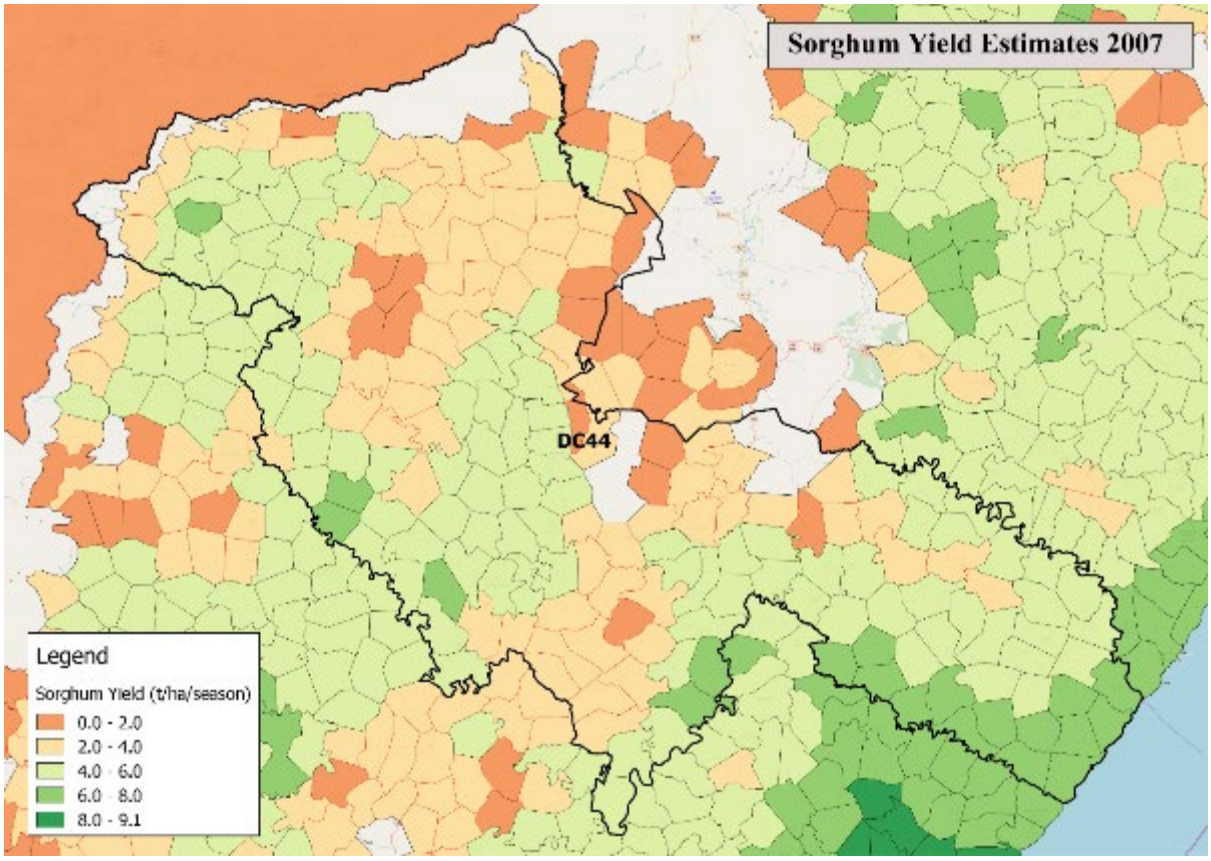

Figure 5: Sorghum yield estimates per mesozone across the District Municipal Area (Schulze and Walker 2007c)

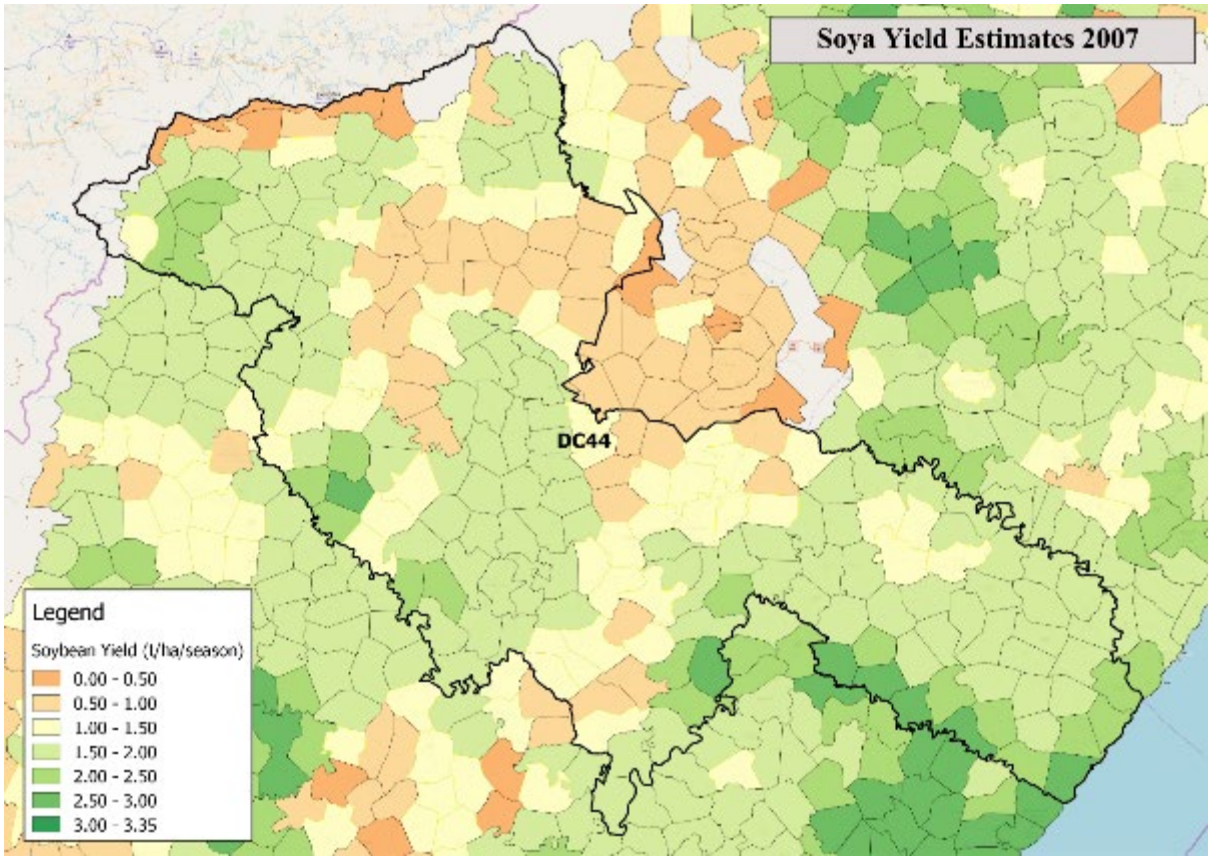

Figure 6: Soybean yield estimates per mesozone across the District Municipal Area (Schulze and Walker 2007d)

There is also potential for dryland (non-irrigated) sugar cane production throughout the entire Alfred Nzo District Municipal Area (Figure 7), with potential yields in many areas as high as 60 to 70 t/ha (Schulze and Walker 2007e).

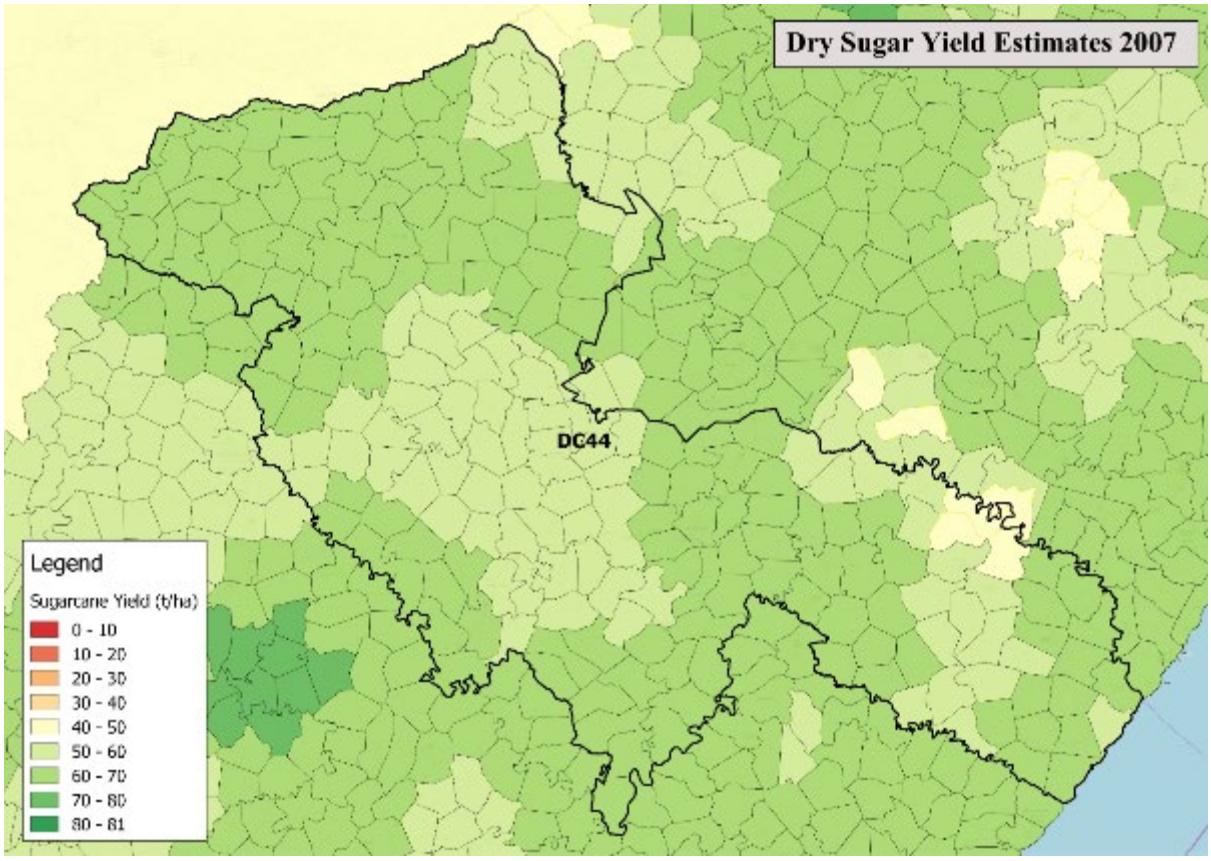

Figure 7: Dryland sugar yield estimates per mesozone across the District Municipal Area (Schulze and Walker 2007e)

Furthermore, there is potential to grow groundnuts in much of the Alfred Nzo District Municipal Area, with potential yields in some of the coastal areas as high as 4 t/ha (Figure 8) (Schulze and Walker 2007a).

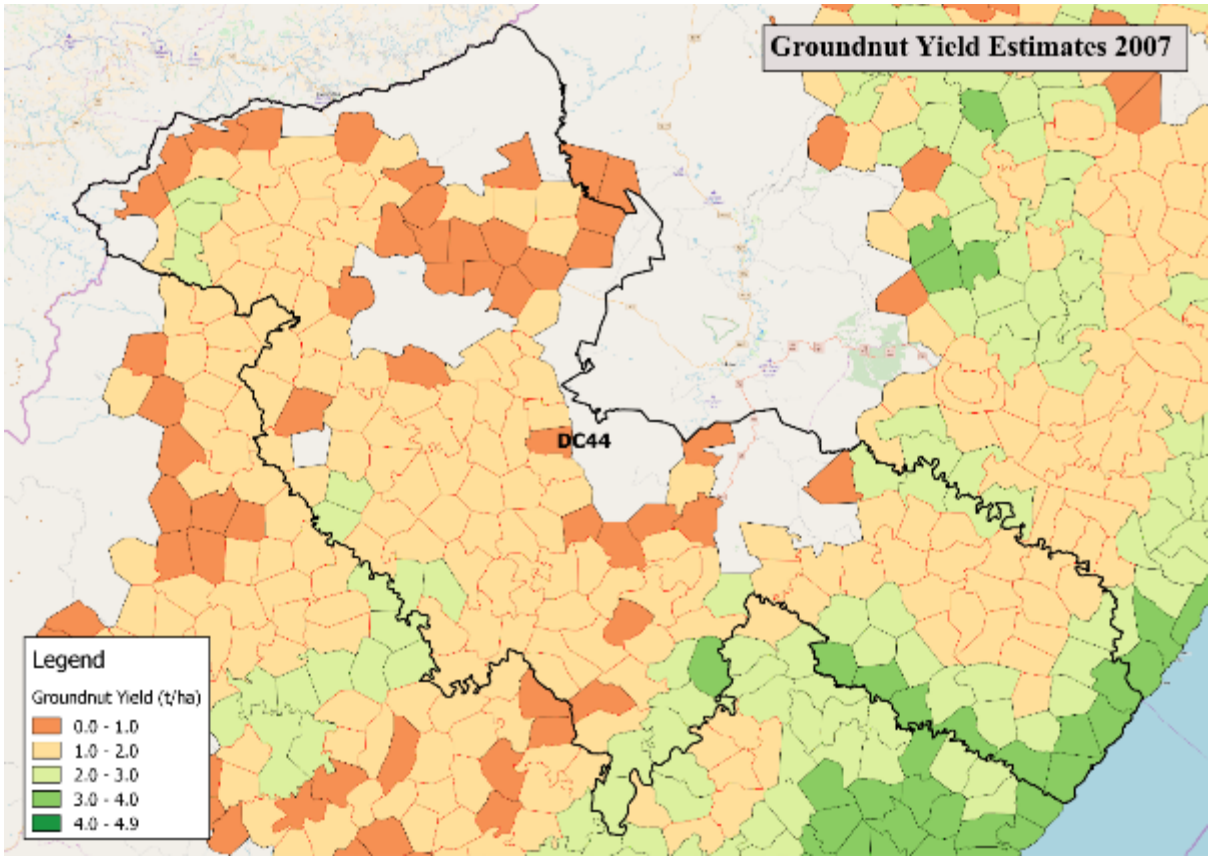

Figure 8: Groundnuts yield estimates per mesozone across the District Municipal Area (Schulze and Walker 2007a)

Additionally, commercial forestry currently covers approximately 20,000 hectares in the Alfred Nzo District Municipal Area, mainly in the Ntabankulu Local Municipality (Alfred Nzo District Municipality 2017) Commercial forests (consisting of *Pinus*, *Eucalyptus* and *Acacia* species) are scattered throughout the District Municipal Area (Figure 9) (De Lange 2013). Some processing of the wood does occur in the District Municipal Area as there are also several small-scale saw mills in the Alfred Nzo District Municipal Area (Alfred Nzo District Municipality 2017).

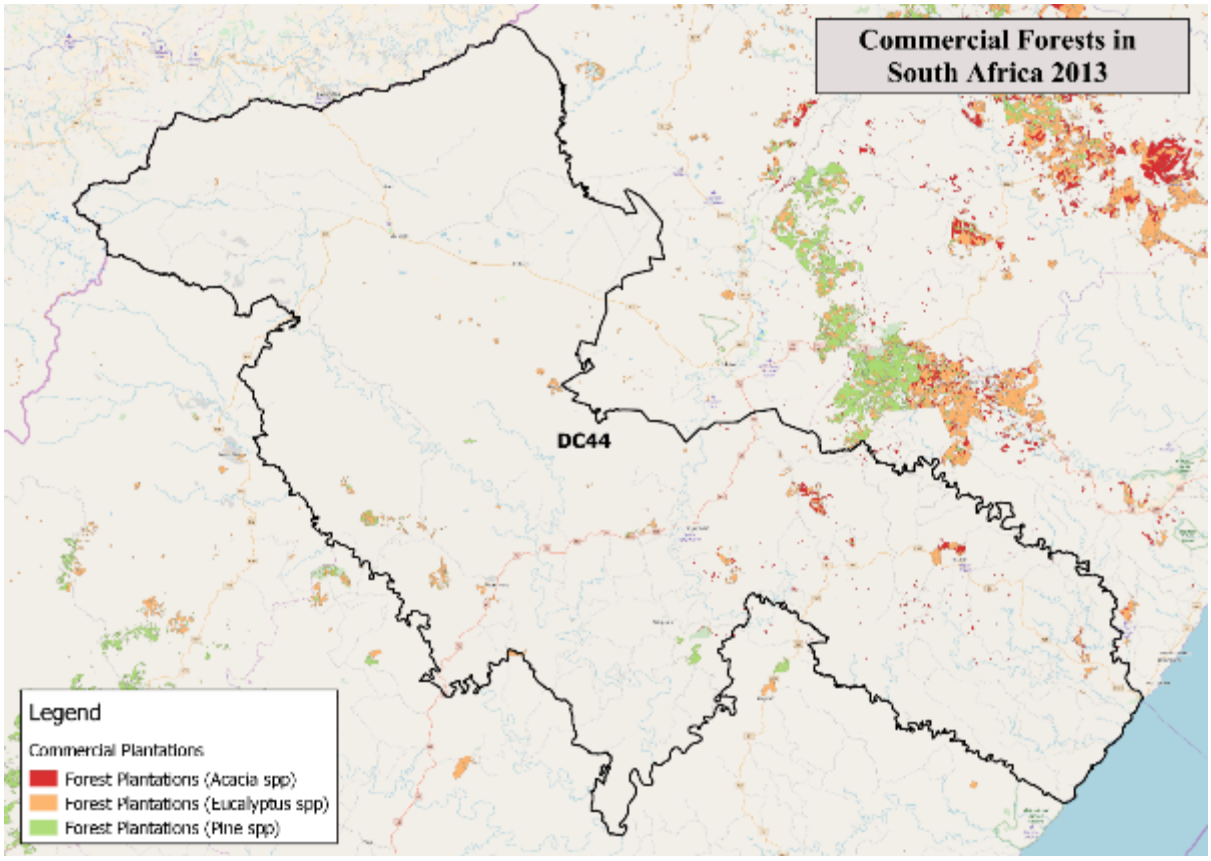

Figure 9: Commercial Forestry distribution across the District Municipal Area (De Lange 2013)

Despite the potential for expanding agricultural production in the Alfred Nzo District Municipal Area, it is predicted that climate change will affect the agriculture sector both positively and negatively. The Long Term Adaptation Scenarios Flagship Research Programme (LTAS) forecasts that in the future, parts of eastern South Africa will become more suitable for grain production (Department of Environmental Affairs 2013c). The LTAS has also forecast that the production of sugarcane and fruit (such as apples and pears) will be increasingly vulnerable to damage from a predicted expansion of the areas affected by agricultural pests (Department of Environmental Affairs 2013c).

Furthermore, climate change is predicted to increase the total average rainfall in the Alfred Nzo District Municipal Area (Department of Environmental Affairs 2013c). This could increase the agricultural output of maize, soybean and sugar cane as well as that of commercial forestry plantations (Department of Environmental Affairs 2013c). However, climate change is also predicted to increase rainfall variability and decrease water security in South Africa, which will negatively affect agricultural production in the District Municipal Area (Department of Environmental Affairs 2013c).

Given the high level of subsistence agriculture, food security is a big issue in the Alfred Nzo District Municipal Area (Conservation South Africa 2015). There is concern for small-scale and subsistence farmers regarding the predicted effects of climate change on food security (Conservation South Africa 2015). Subsistence farmers tend to lack access to information and the necessary resources to adapt to these predicted climatic changes (Conservation South Africa 2015). Furthermore, climate change could also decrease commercial agricultural yields and profitability in the Alfred Nzo District Municipal Area (Conservation South Africa 2015). However, commercial and large-scale farmers in the District Municipal Area are thought to have some capacity to adapt to these predicted climatic changes.

Moreover, these predicted changes are not only future-related considerations. Impacts to the agricultural sector, which have been attributed to climate variability (e.g. the recent droughts that resulted in poor harvests in 2015/2016) have already been observed in the of the Alfred Nzo District Municipal Area (Alfred Nzo District Municipality 2016b). In addition, floods could also damage crops and have a major impact on food security and agricultural livelihoods in the Alfred Nzo District Municipal Area (Conservation South Africa 2015).

4.3 Alfred Nzo DM Biodiversity Summary

The Alfred Nzo District Municipality is predominantly covered by the Grassland Biome (Figure 10). Additionally, the south and east of the Alfred Nzo District Municipal Area are partially covered by the Savanna Biome and in the south-east, the coastal part of the Alfred Nzo District Municipal Area, is covered by the Indian Ocean Coast Belt Biome. The Grassland Biome is characterised by a single layer of grass with varying degrees of land-cover depending on rainfall and grazing practices. The Grassland Biome is essential for agriculture in South Africa and has the second highest level of biodiversity after the Fynbos Biome (Mucina and Rutherford 2006). The Savanna Biome is the largest biome in South Africa and is characterised by shrubveld and bushveld (and where wet enough woodland) vegetation (Mucina and Rutherford 2006). The Indian Ocean Coast Belt Biome contains a mix of subtropical forests and grasslands and at most reaches about 35 kilometres inland from the Indian Ocean (Mucina and Rutherford 2006).

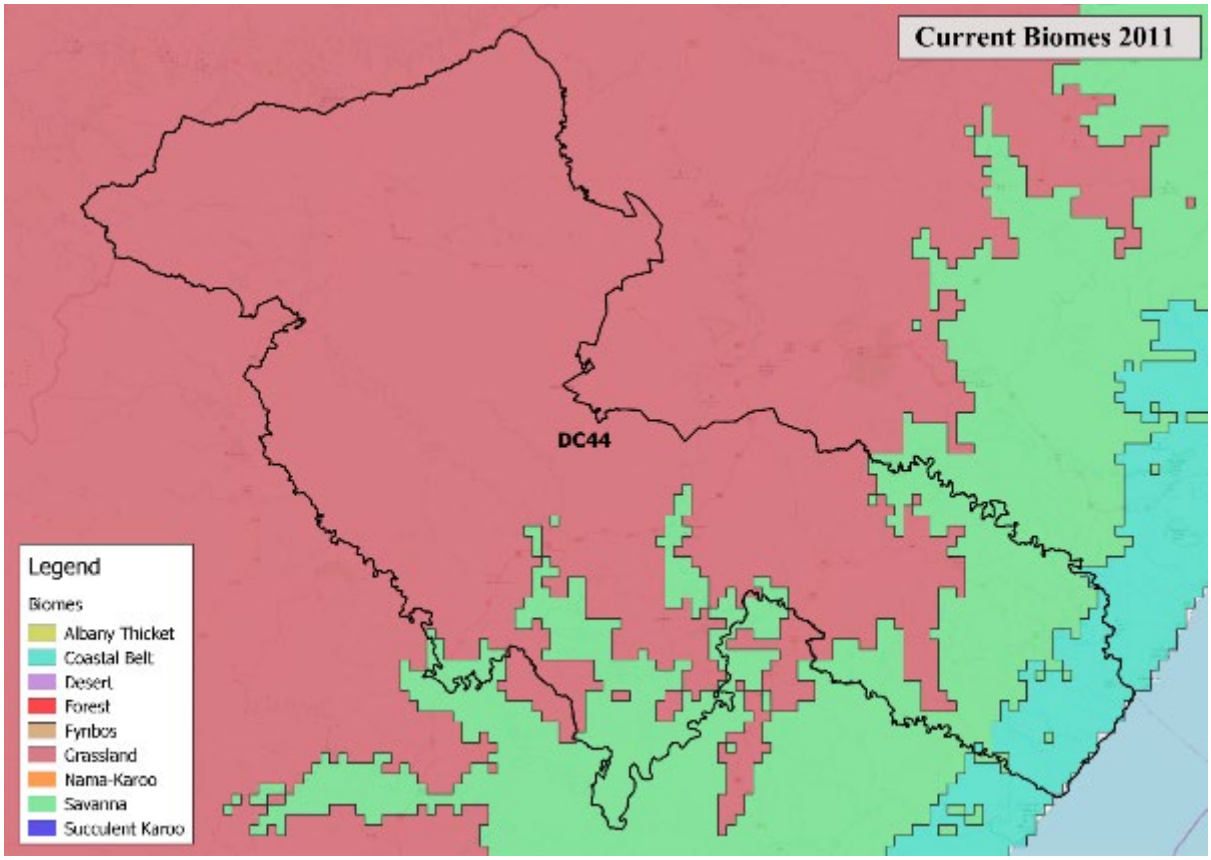

Figure 10: Current biome delineation in the District Municipal Area (South African National Parks 2011a)

Climate change is predicted to shift the biomes in South Africa, resulting in a change to the ecosystems and vegetation found in the Alfred Nzo District Municipal Area. The Long Term Adaptation Scenarios Report on biodiversity highlights the following biomes as the most vulnerable and "in need of strong protection, restoration and/or research" (Department of Environmental Affairs 2013b).

- Highest priority for action: Grassland and Indian Ocean Coastal Belt.
- High priority for action: Fynbos and Forest.
- Medium priority for action: Nama Karoo and Succulent Karoo.

The maps below (Figure 11 and Figure 12) show the shift in biomes in the Alfred Nzo District Municipal Area given different climate scenarios modelled by the South African National Biodiversity

Institute (SANBI) in 2011. It is forecast that under a medium risk climate scenario, the Savanna Biome will expand westwards, roughly doubling its current range at the expense of the Grassland Biome. Additionally, the Indian Ocean Coast Belt Biome is predicted to expand marginally inland, replacing a bit of the Savanna Biome. Under a high risk climate scenario, it is forecast that the Savanna Biome will become the dominant biome in the Alfred Nzo District Municipality Area. the Savanna Biome is predicted to replace much of the area currently covered by the Grassland Biome and virtually all of the area currently covered by the Indian Ocean Coast Belt Biome.

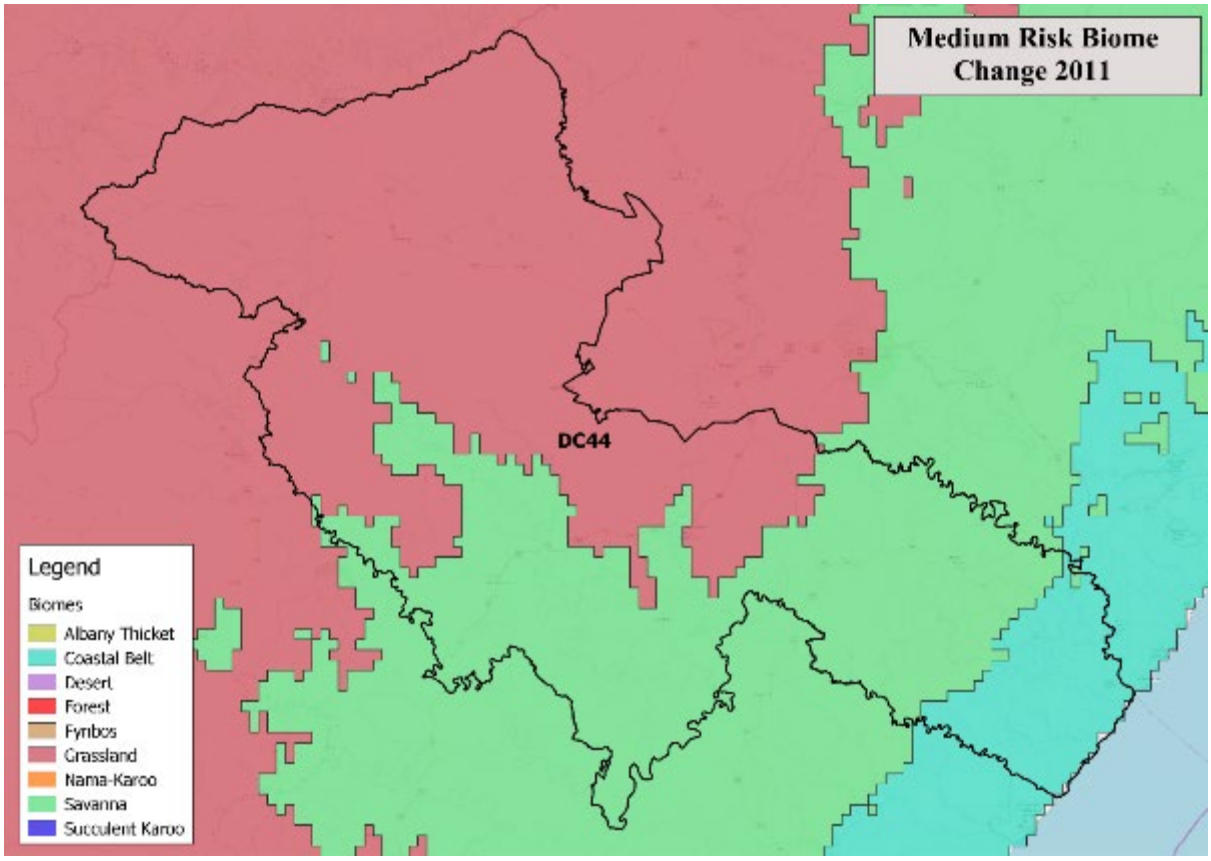

Figure 11: Predicted shift in biomes in the District Municipal Area using a medium risk scenario (South African National Parks 2011c)

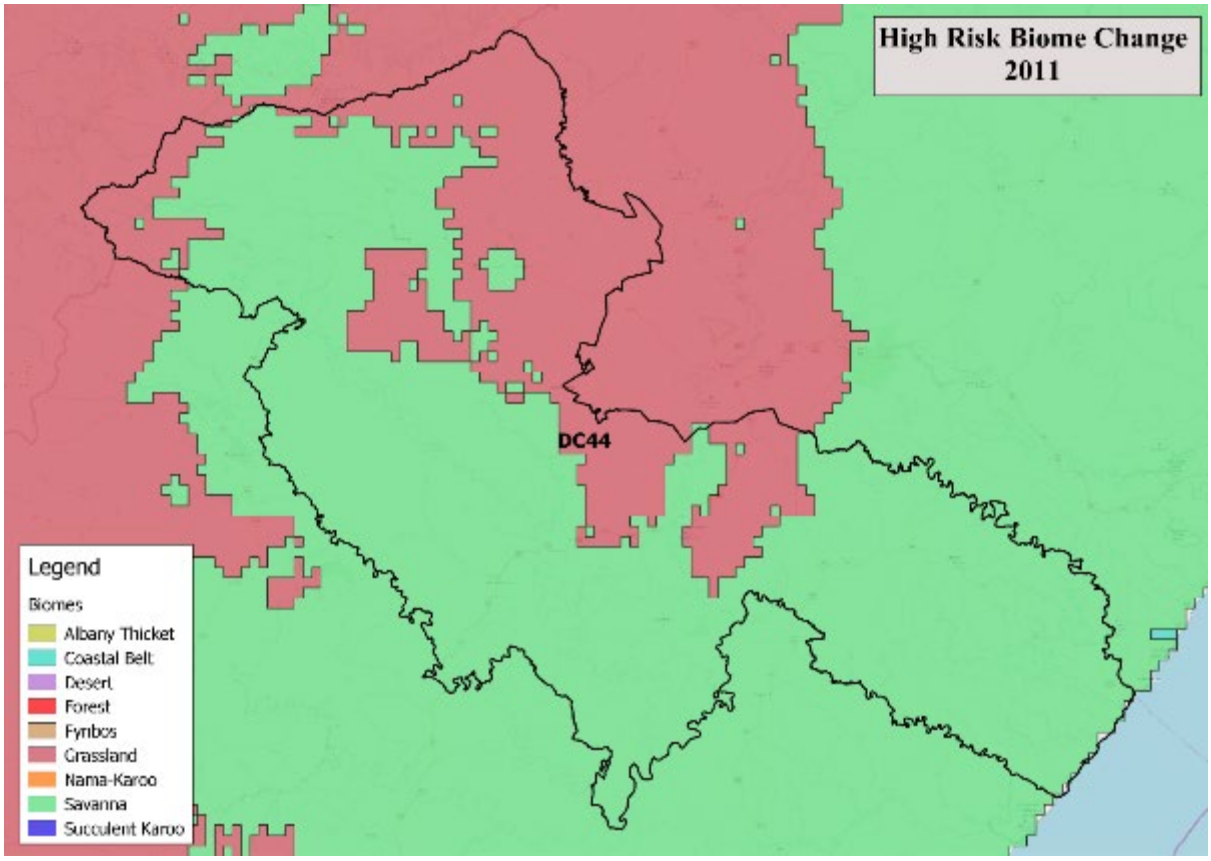

Figure 12: Predicted shift in biomes in the District Municipal Area using a high risk scenario (South African National Parks 2011b)

Within the Biomes found in the Alfred Nzo District Municipal Area, there are numerous threatened ecosystems types (Figure 13). All the threatened ecosystems types found in the Alfred Nzo District Municipal Area are categorised as vulnerable. Currently no critically endangered or endangered ecosystem types are found within the Alfred Nzo District Municipal Area (South African National Biodiversity Institute 2011b).

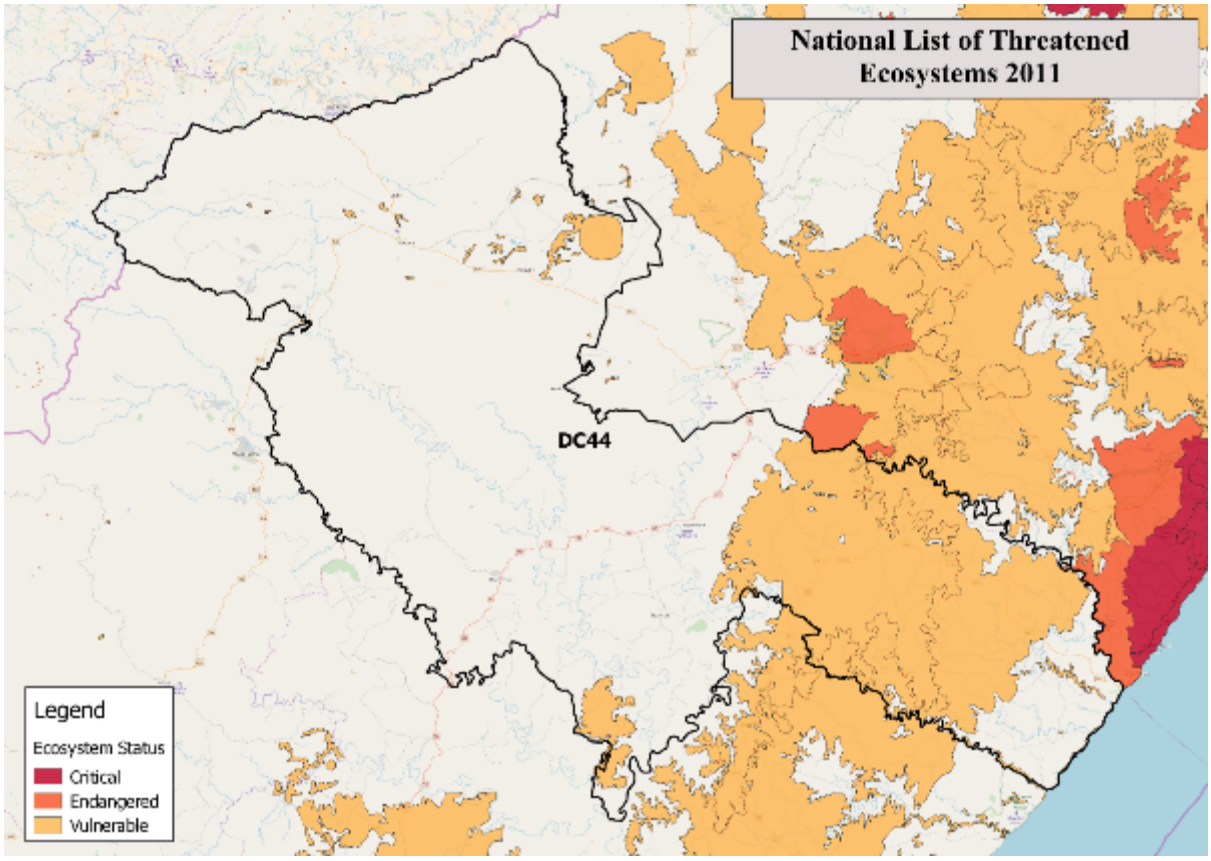

Figure 13: Threatened ecosystem types in the District Municipal Area (South African National Biodiversity Institute 2011b)

In South Africa, a 'protected area' is defined as areas of land (e.g. a national park) or ocean (e.g. a marine protected area) that is legally protected and managed for the conservation of biodiversity, as per the National Environmental Management: Protected Areas Act (No. 57 of 2003) (Department of Environmental Affairs 2009). Internationally, the International Union for Conservation of Nature's (IUCN) definition of protected area includes areas that are not legally protected, which the Department of Environmental Affairs refers to as 'conservation areas' (Department of Environmental Affairs 2009). Within the Alfred Nzo District Municipal Area there are five protected areas (Figure 14).

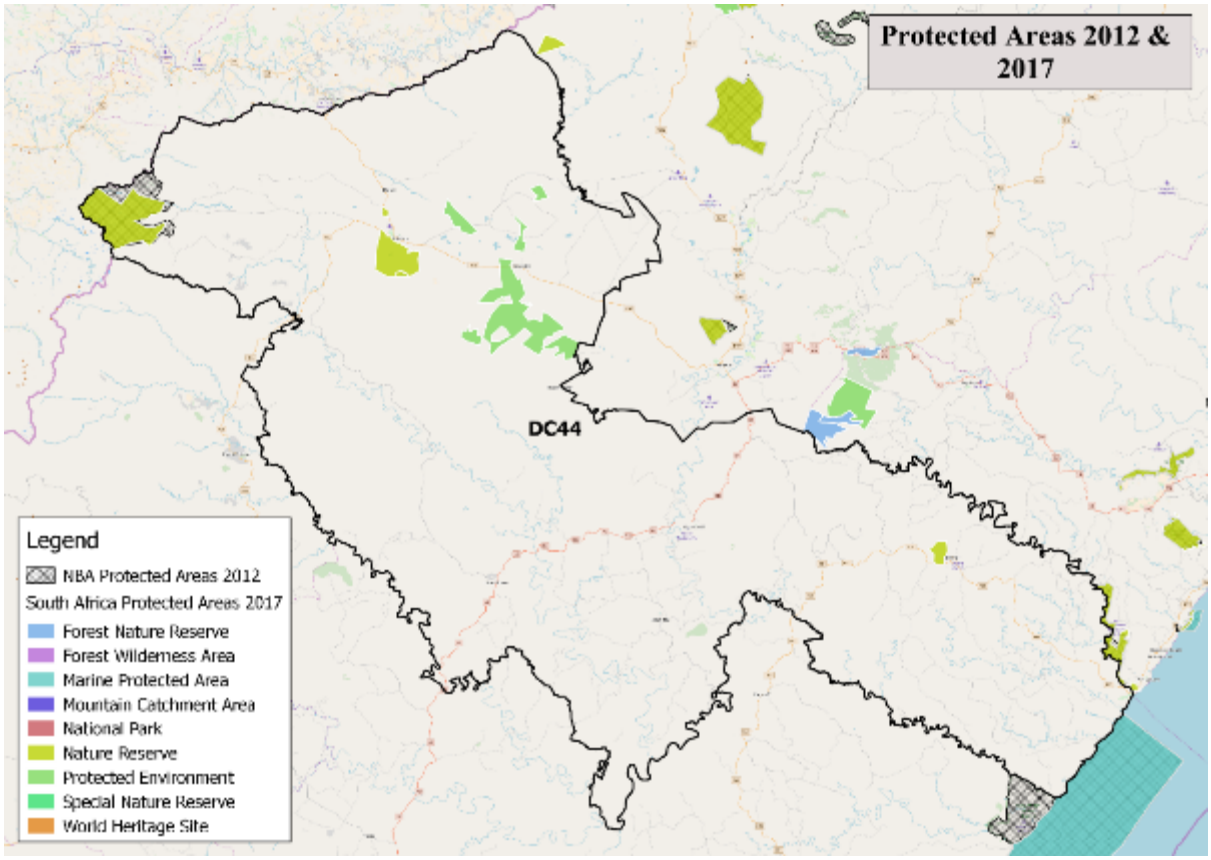

Figure 14: Protected areas in the District Municipal Area (South African National Parks / South African National Biodiversity Institute 2011; Department of Environmental Affairs 2017)

In South Africa, 65% of wetlands are threatened, of which 48% are critically endangered, 12% are endangered and 5% are vulnerable (Driver, A. et al. 2012). Wetland degradation is caused by inter alia: poor land management practises, spatial developments near urban areas, the spread of invasive alien plants; agricultural practises, pollution and the building of dams (Driver, A. et al. 2012).

In the Alfred Nzo District Municipal Area (Figure 15), there is a roughly equal split between wetlands classified as 'moderately modified' (between 25% and 75% of the wetland land cover is natural), 'mostly natural or good' (more than 75% of the wetland land cover is natural) and 'heavily to critically modified' (less than 25% of the wetland land cover is natural) (Council for Scientific and Industrial Research 2011). Wetlands classified as 'mostly natural or good' or 'moderately modified' tend to occur more in the northwest, while those classified as 'heavily to critically modified' tend to occur more in the southeast of the Alfred Nzo District Municipal Area.

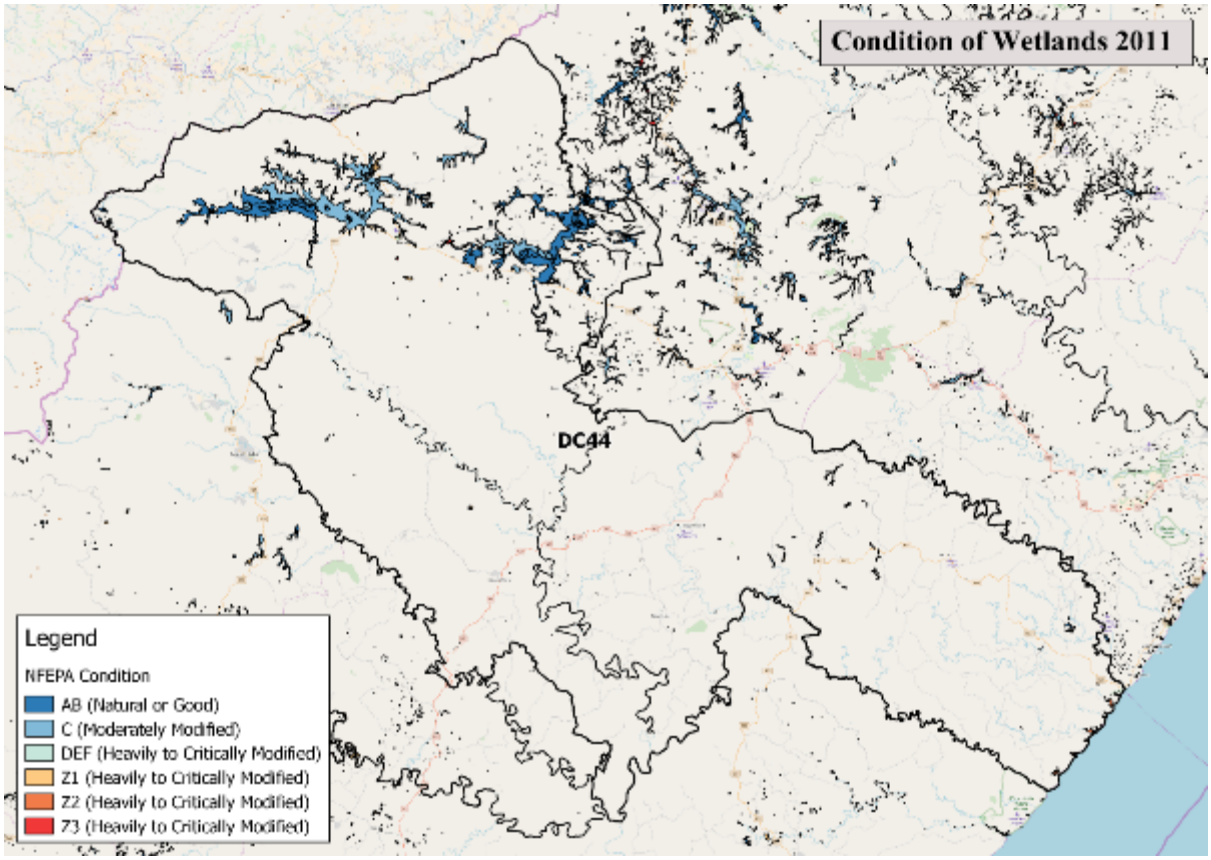

Figure 15: Condition of wetlands in the District Municipal Area (Council for Scientific and Industrial Research 2011)

Land use in the Alfred Nzo District Municipal Area is mostly split between rural settlements and agriculture and to a lesser degree forestry (plantations) (Alfred Nzo District Municipality 2017, 2016b). There are also several, relatively small urban areas, conservation areas and mining areas. Notably, some arable land in the Alfred Nzo District Municipal Area has been left fallow possibly due to lack of resources, land degradation and/or a loss of ecosystem services that has reduced the productive potential of the land (Alfred Nzo District Municipality 2017, 2016b). These land uses have had varying effects on the biodiversity of the Alfred Nzo District Municipal Area.

Biodiversity in the Alfred Nzo District Municipal Area has been positively influenced by the conservation areas. It has been negatively influenced by: land degradation (mainly due to overgrazing and poor land management practises), soil erosion, the spread of invasive alien species, unsustainable harvesting of natural resources, mining, increased pollution, poor waste management, population growth, spatial development (such as the expansion of agricultural and urban areas), a recent drought and climate change (Alfred Nzo District Municipality 2016b, 2017).

According to the Millennium Ecosystem Assessment (2005) ecosystem services are “the benefits that people obtain from ecosystems”, which can be divided into four categories: provisioning (e.g. timber), supporting (e.g. nutrient recycling), regulating (e.g. water purification), cultural (e.g. recreational activities) (Millennium Ecosystem Assessment 2005). The existing challenges that negatively affect the biodiversity in the Alfred Nzo District Municipal Area (discussed above) have also reduced ecosystem services (particularly provisioning services and regulating services) in the Alfred Nzo District Municipal Area and will continue to do so, if these impacts are not reduced.

If the biodiversity and related ecosystem services in the Alfred Nzo District Municipal Area are badly reduced, it could have direct negative consequences for the economy and social structures in the

Alfred Nzo District Municipality. These consequences could have a detrimental effect on efforts to reduce poverty, inequity and unemployment in the Alfred Nzo District Municipal Area. Furthermore, it is predicted that climate change will exacerbate these challenges and their effects on the biodiversity and related ecosystem in South Africa.

4.4 Alfred Nzo DM Marine and Coastal Sector Summary

The coastal zone in South Africa includes the inshore, offshore and estuarine ecosystems. It is a continually changing area where land and ocean meet, and includes beaches, rocky shores, estuaries, wetlands and the ocean near the coast (Nelson 2013; Provincial Government of the Western Cape 2005). A coastal zone extends seaward up to the boundary of the exclusive economic zone, which is 200 nautical miles (roughly 370 km) out to sea, and inland up to one kilometre after the high-water mark (Republic of South Africa 2014).

Climate change is predicted to result in several changes to South Africa's coastal zone (Department of Environmental Affairs 2013e, 2012). It is forecast that climate change will include:

- increase impacts on marine and benthic ecosystems
- increase impacts on estuary ecosystems
- increase impacts on coastal livelihoods, and
- increase impacts on infrastructure and property due to sea level rise.

These impacts are expected to affect all coastal district municipalities in South Africa (Department of Environmental Affairs 2013e).

In assessing benthic and marine ecosystems, it is worth considering the threat status of the coastal zone. There are several threatened ecosystem types in the coastal zone of the Alfred Nzo District Municipal Area (Figure 16). The 'Natal Inshore Reef' is categorised as an endangered ecosystem type (South African National Biodiversity Institute 2011a). Furthermore, the 'Natal Sandy Shelf', 'Natal Sandy Inshore', 'Natal Mixed Shore', 'Natal Shelf Reef' and 'Natal-Delagoa Intermediate Sandy Coast' are all categorised as vulnerable ecosystem types (South African National Biodiversity Institute 2011a). Some of these threatened ecosystems are partially being conserved in marine protected areas such as the Pondoland Marine Protected Area. Most of the Alfred Nzo District Municipality's coastline forms part of the Pondoland Marine Protected Area (Department of Environmental Affairs 2017).

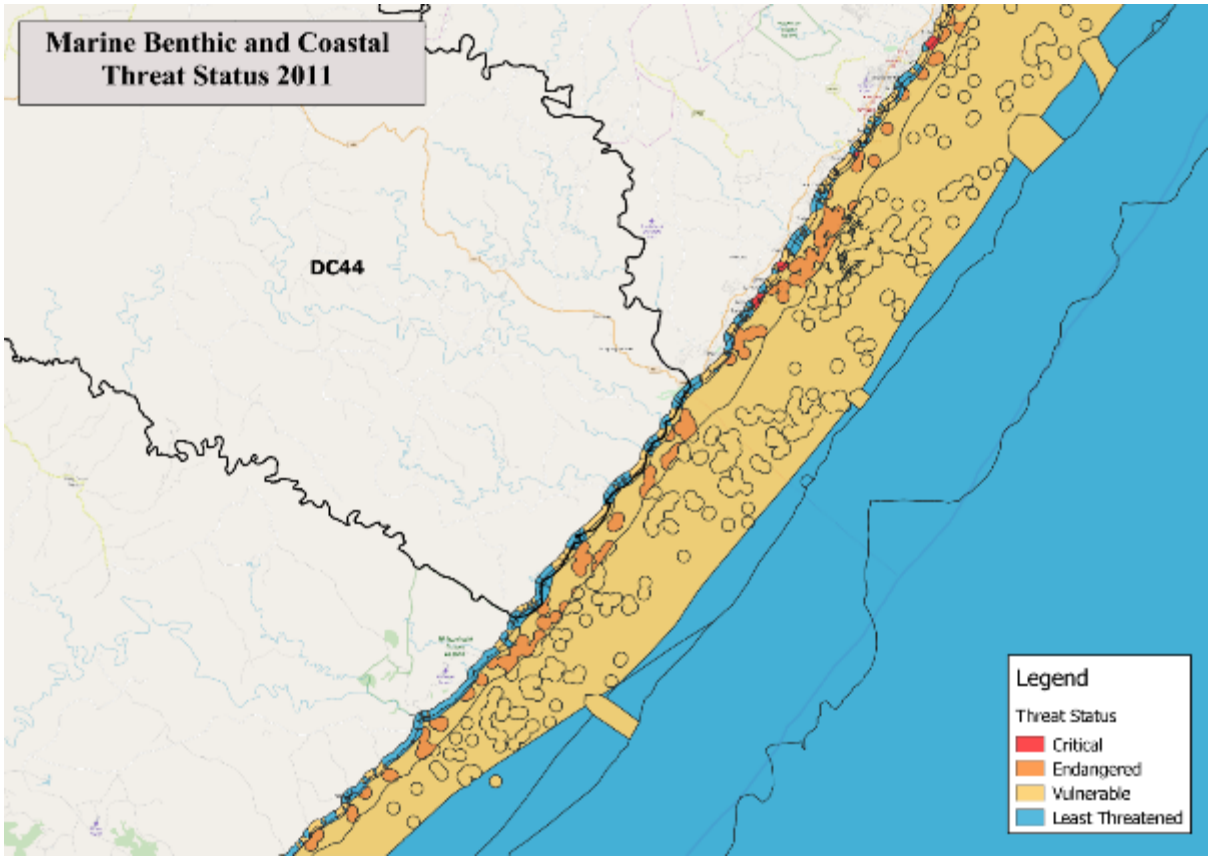

Figure 16: Threatened marine, benthic and coastal ecosystems in the District Municipal Area's coastal zone (South African National Biodiversity Institute 2011a)

There are eight estuarian systems wholly in the Alfred Nzo District Municipal Area (Figure 17) and two (the Mtamvuna and Mtentu estuaries) that mark the borders of the Alfred Nzo District Municipal Area (South African National Biodiversity Institute and CSIR 2012). The health condition of these estuaries is mostly good. The Mzamba, Mpahlane, Mnyameni, Kwanyana, Sikombe and Mtentu estuaries are classified as 'unmodified, natural', while the Mtentwana, Mpahlanyana and Mtolane estuaries are classified as 'largely natural with few modifications' (South African National Biodiversity Institute and CSIR 2012). Although the Mtamvuna estuary is classified as 'moderately modified', the Alfred Nzo District Municipal Area contains no estuaries classified as 'largely modified', 'seriously modified' or 'critically/extremely modified' (South African National Biodiversity Institute and CSIR 2012).

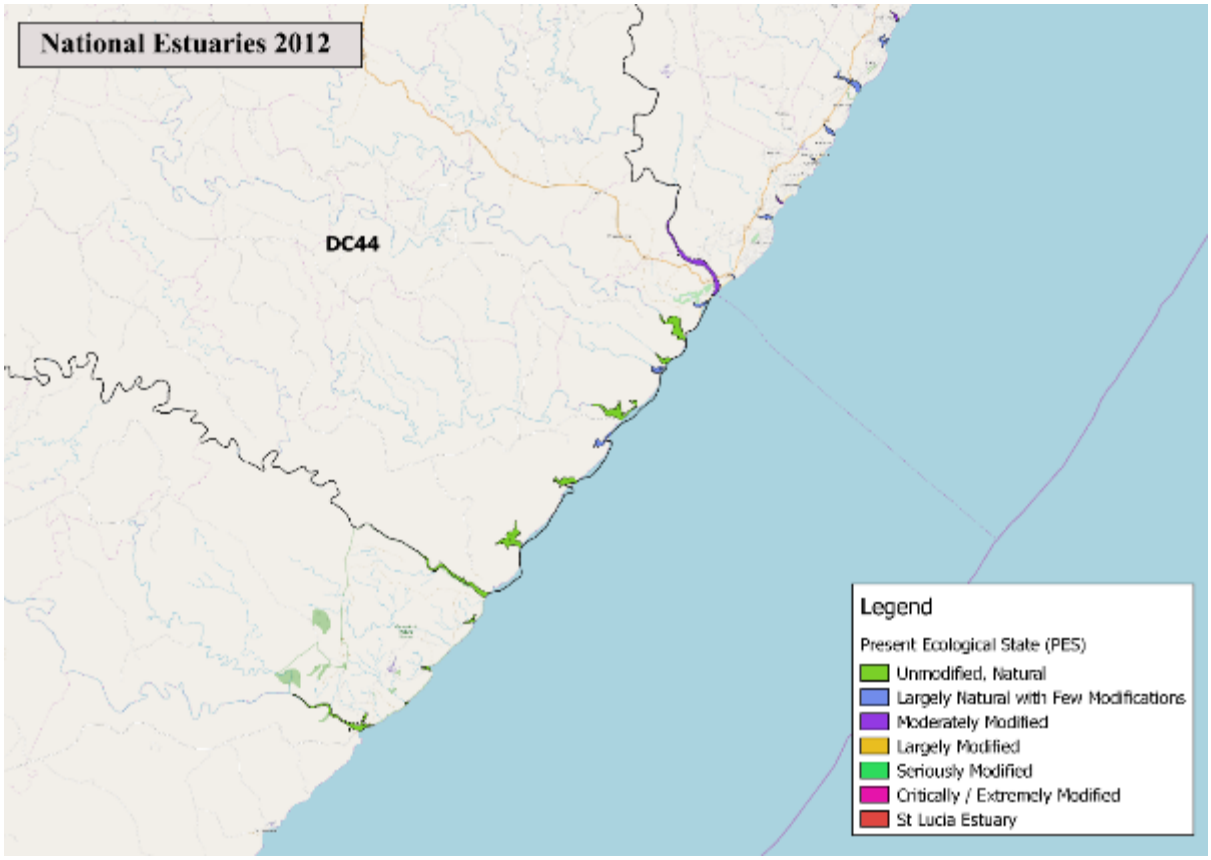

Figure 17: Estuaries in the District Municipal Area (South African National Biodiversity Institute and CSIR 2012)

In South Africa, 43 % of estuary ecosystems are threatened (Department of Environmental Affairs 2012). Estuary ecosystems are experiencing increasing pressure from human related activities that are decreasing the quantity and quality of available estuarian ecosystem services (Department of Environmental Affairs 2012). These pressures are caused by: the activities that happen in and around the estuary; changes to the quantity and quality of fresh water entering the estuary; and, poor land use practises and degradation higher up in the catchment (Department of Environmental Affairs 2012). Estuary ecosystems are also impacted by: artificially breaching the mouths of estuaries; pollution; and the expected impacts of climate change, especially escalating sea level rise, coastal erosion, and increased coastal storm frequency and intensity (Palmer, van der Elst, and Parak 2011; Department of Environmental Affairs 2013e).

Climate change is expected to reduce the diversity and quantity of fishes and other biota in estuarine ecosystems (as well as inshore and offshore ecosystems) through changes to: land and sea surface temperatures; frequency and distribution of precipitation; water runoff patterns; increased coastal storm frequency and intensity; oxygen levels; and wind (Department of Environmental Affairs 2013e). Sea level rise may also cause salt water intrusions into estuarine and agricultural lands which can lead to a reduction in their ecosystem services (Atkinson and Clark 2005).

Climate change may also have a negative effect on coastal livelihoods (Department of Environmental Affairs 2013e). Predicted increases in the severity and frequency of storms and sea level rise may reduce the number of feasible fishing days and cause damage to shore-based infrastructure (e.g. harbours and launch sites) and fishing boats (Department of Environmental Affairs 2013e).

With regards to impacts from sea level rise, the *Long-Term Adaptation Scenarios* specifically considers all land under 5.5 metres (m) above the current mean sea level to be part of the coastal

zone (Department of Environmental Affairs 2013f). The reason for this is that 5.5 m is the maximum estimated height of land that could be affected by the predicted increases in storm surges, sea level rise and tidal fluctuations by the year 2100 (Department of Environmental Affairs 2013f).

Within the Alfred Nzo District Municipal Area (Figure 18), six square kilometres (km^2), all in the Mbizana Local Municipality, are estimated to be below a 5.5 m elevation (Department of Environmental Affairs 2013f). The coastal zone of the Alfred Nzo District Municipal Area is considered to be at a low risk from climate change-linked sea level rise and storm surges compared to other coastal district municipalities in South Africa (Conservation South Africa 2015). The reasons for this are: relatively little coastal zone with less than a 5.5 m elevation, scant development in the coastal zone and a dune cordon that is mostly intact (Conservation South Africa 2015). However, these climate change-linked risks could increase if developments or dune mining occur in the coastal zone of the Alfred Nzo District Municipal Area (Conservation South Africa 2015).

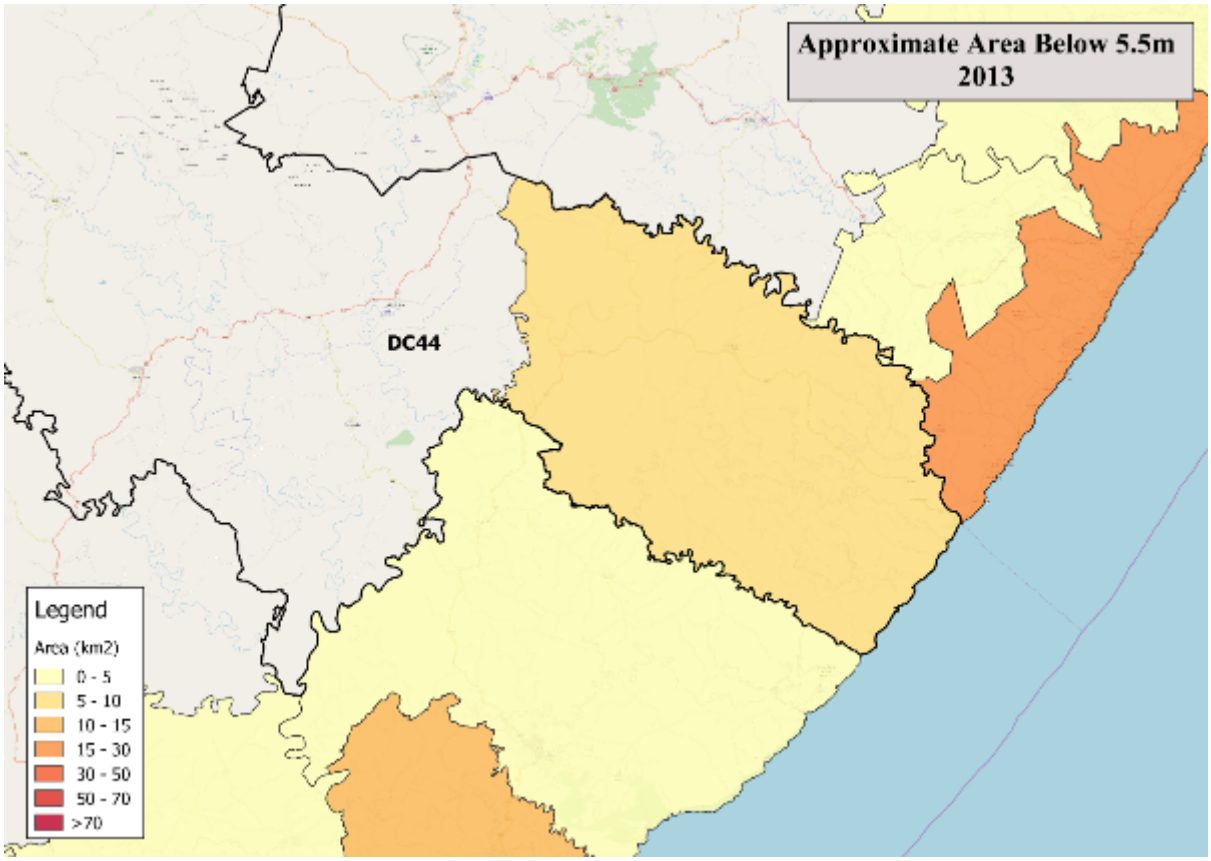

Figure 18: Approximate area below 5.5m in the District Municipal Area (Department of Environmental Affairs 2013f)

In addition to the predicted effects of climate change, the coastal zone in South Africa is susceptible to anthropogenic impacts such as ecosystem overuse (e.g. overfishing) and degradation, increased pollution, and the increased nutrient runoff from coastal developments leading to eutrophication of wetlands, estuaries, etc. (Department of Environmental Affairs 2013e). The anthropogenic and climate change impacts have already negatively affected biodiversity and ecosystems services in the coastal zone (and across South Africa) and are expected to worsen these issues unless climate change adaptation and mitigation responses are developed and implemented (Department of Environmental Affairs 2013e).

According to the *Alfred Nzo District Municipality Integrated Development Plan 2017 – 2022,* a *Coastal Zone Management Plan* for the Alfred Nzo District Municipality was due to be completed by

the start of the 2017/2018 municipal financial year (Alfred Nzo District Municipality 2017). Furthermore, a '*C-Plan'* for the coastal protected areas is set to be developed by the Alfred Nzo District Municipality's only local municipality on the coast, the Mbizana Local Municipality (Alfred Nzo District Municipality 2017).

4.5 Alfred Nzo DM Health Sector Summary

A great proportion (82.4 %) of South Africa's population are dependent on the public health sector for health related services of which there are 3,880 public facilities (Health Systems Trust 2012). These public facilities are divided into two main groups: 3,487 primary health care facilities (consisting of 3,074 clinics; 238 community health centres; 125 satellite clinics; 44 community day centres; four specialised clinics and two health posts) and 391 hospitals (of which six are central hospitals; 10 tertiary; 55 regional; 254 district and 66 specialised hospitals) (Health Systems Trust 2012). Of the above, 73 clinics, two community health centres, six district hospitals, and two other hospitals fall within the Alfred Nzo District Municipal Area (Massyn et al. 2016).

According to a health care facilities audit by the Health Systems Trust, the Alfred Nzo District Municipal Area received a score of 39 % on vital measures in the six ministerial priority areas for health care facilities and 54 % for the infrastructure of health facilities (Health Systems Trust 2012). The score on vital measures in the six ministerial priority areas relates to patient-centred care, specifically focusing on: positive and caring attitudes; waiting times; cleanliness; patient safety; infection prevention and control; and availability of medicines and supplies (Health Systems Trust 2012). The infrastructure score meanwhile is based on the assessment of mainly: building and site infrastructure, facility infrastructure management and standards around the availability of space (Health Systems Trust 2012).

The total population of the Alfred Nzo District Municipal Area was approximately 801,344 people in 2011 (Statistics South Africa 2011). The District Municipal Area is youthful, with children under the age of 15 making up 40.89 % of the total population, while those aged between 15 and 39 account for a further 37.19 % (Statistics South Africa 2011). Furthermore, the 40 to 64 age group makes up 15.74 % of the population and the elderly (>64yrs age group) make up the remaining 6.18 % of the population (Statistics South Africa 2011). Furthermore, the young (<5yrs age group) and elderly (>64yrs age group) constitute 20.12 % of the total population (Statistics South Africa 2011). These two groups are said to be the most vulnerable to climate change impacts. The darker areas on the map indicate higher percentages of young and elderly people (Figure 19).

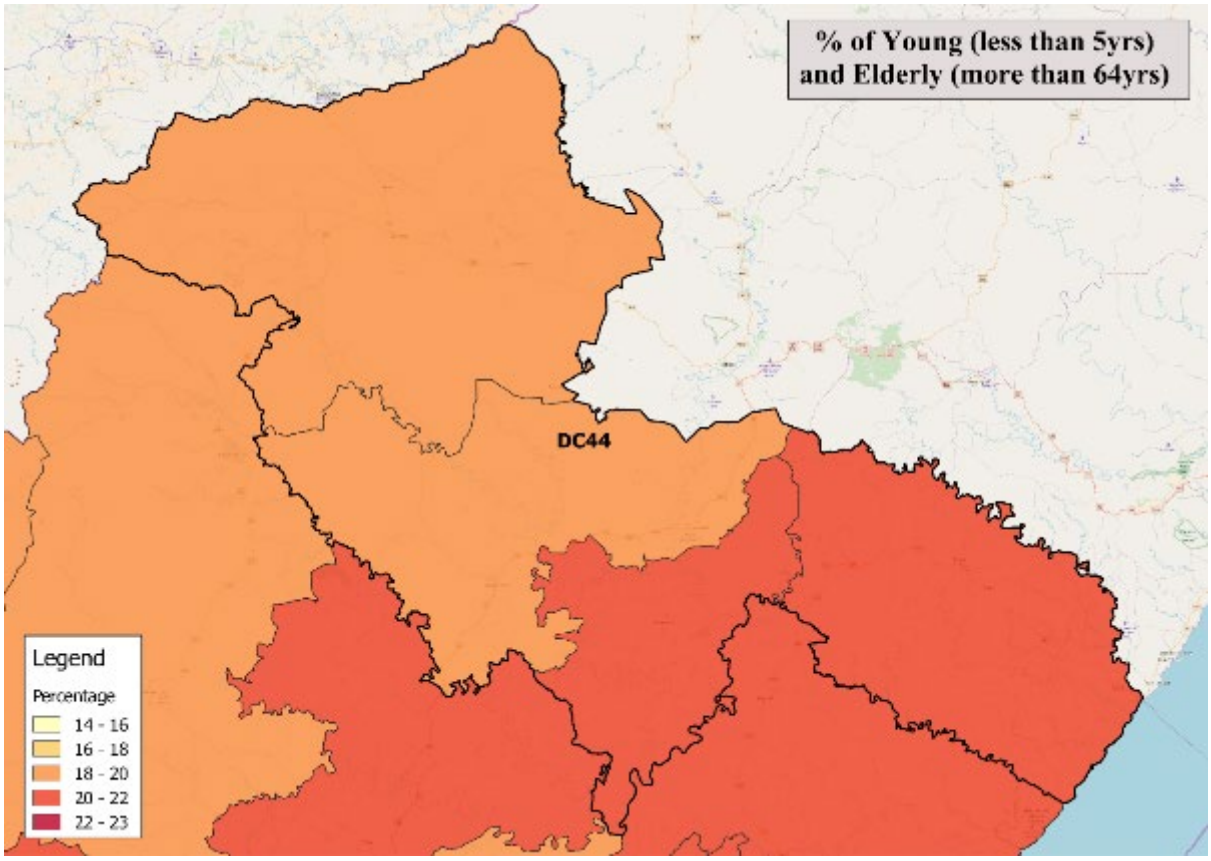

Figure 19: Percentage of young (<5yrs age group) and elderly (>64yrs age group) across the Alfred Nzo District Municipal Area (Statistics South Africa 2011)

In 2015, the total number of deaths in South Africa was 460,236, of which 4,980 occurred in the Alfred Nzo District Municipal Area (Statistics South Africa 2015). The distribution of deaths by age for South Africa revealed that in, 2015, 7 % of the deaths occurred in children under the age of five, while individuals over the age of 64 accounted for 34.4 % of the deaths (Statistics South Africa 2015).

In 2015, the top ten underlying natural causes of death within the Alfred Nzo District Municipal Area were: tuberculosis; other viral diseases; other forms of heart diseases; HIV; cerebrovascular diseases; intestinal infectious diseases; influenza and pneumonia; diabetes mellitus; chronic lower respiratory diseases; and hypertensive diseases (Statistics South Africa 2015).

Specifically, the leading causes of death for children under five years of age, for the 2009 to 2014 period, in the Alfred Nzo District Municipal Area were a group of communicable (infectious) diseases together with perinatal, maternal and nutritional conditions (Massyn et al. 2016). Diarrhoeal diseases (28.4 %) were the leading cause of children's (<5yrs age group) deaths, followed by lower respiratory infections, which accounted for 19.6 % of deaths (Massyn et al. 2016).

Additionally, the leading causes of death for the elderly (>64yrs age group) in the Alfred Nzo District Municipal Area were a group of non-communicable diseases (which cannot be transferred from one person to the next) that accounted for 46.4 % of the deaths between 2009 and 2014 (Massyn et al. 2016). Of these non-communicable diseases, cerebrovascular disease was the leading cause (14.2 %) of deaths, followed by hypertensive heart disease (9.9 %) (Massyn et al. 2016).

Concerning waterborne and communicable diseases, approximately 74.34 % of the Alfred Nzo District Municipal Area's households do not source water from piped water schemes (Statistics South Africa 2011) and are therefore vulnerable to waterborne diseases. For the "children under five

years diarrhoea case fatality" (that is children under five years who died in hospital from diarrhoeal disease) the District Municipal Area ranked 49th (where 1st represents the best performance and 52nd represents the worst performance in South Africa) with a diarrhoea case fatality rate of 5.2 % during the 2015/16 period (Massyn et al. 2016). The national average for "children under five years diarrhoea case fatality" was 2.2 % over the same time period (Massyn et al. 2016).

Furthermore, for the "Child under 5 years severe acute malnutrition case fatality rate" (that is children under five years who died from acute malnutrition) the Alfred Nzo District Municipal Area ranks 42nd (where 1st represents the best performance and 52nd represents the worst performance in South Africa) with a rate of 11.9 % during the 2015/16 period (Massyn et al. 2016). This is higher than the national average of 8.9 % over the same time period (Massyn et al. 2016).

In terms of risks posed by working conditions, about 16.2 % of the Alfred Nzo District Municipal Area's economically active population are employed, of which roughly 19.9 % are employed within the informal sector (Statistics South Africa 2011). Many of the people employed in the informal sector work outdoors in poor conditions, with limited infrastructure and services such as shade, and limited access to amenities such as water and sanitation (Statistics South Africa 2011).

Additionally, 58.83 % of the Alfred Nzo District Municipal Area's households are involved in agricultural activities (Statistics South Africa 2011). People who work outdoors, like those involved in agricultural activities, are especially vulnerable to the impacts of extreme weather conditions. Moreover, climate change is forecast to exacerbate the frequency and severity of extreme weather events (Department of Environmental Affairs 2013c). Consequently, predicted impacts for households involved in agriculture include reduced agricultural yields and water security as well as increased food insecurity.

The main disaster risks that are likely to affect human health in the Alfred Nzo District Municipal Area are wild fires, drought, severe storms, strong winds, hailstorms and floods (Conservation South Africa 2015; Alfred Nzo District Municipality 2016a). It is predicted that these disasters will be exacerbated by climate change (Conservation South Africa 2015).

From the information above, the predicted impacts of climate change on human health and health services are mostly negative. Hence, there is a need for climate change adaptation (and mitigation) to limit the negative impacts and encourage any positive effects of climate change on human health in the Alfred Nzo District Municipal Area.

4.6 Alfred Nzo DM Human Settlements Sector Summary

The Alfred Nzo District Municipality's population is approximately 801,344 (Statistics South Africa 2011). The population is unevenly distributed amongst the four Local Municipalities (Alfred Nzo District Municipality 2016a). Mbizana Local Municipality has the highest population (35.1% of the District's population) while Ntabankulu Local Municipality is home to the smallest population (15.4%). Within the District Municipal Area children under 15 years old make up 40.89 % of the total population (Statistics South Africa 2011). The second largest proportion (37.19 %) of the population are people between 15 and 39 years old, while people between the ages of 40 and 64 constitute 15.74% of the population (Statistics South Africa 2011). Those who are over 64 years old constitute the smallest (6.18%) part of the total population (Statistics South Africa 2011).

The District Municipal Areais characterised by low literacy levels (Department of Cooperative Governance and Traditional Affairs n.d.), with only 12.53% of the population having attained a matric and 4.62% of the population having earned a post-school qualification (Statistics South Africa 2011). However, a great proportion of the population (34.98%) have some secondary schooling, while 32.21% have some or completed primary schooling (Statistics South Africa 2011). The remaining 15.68% have been classified as "other" in terms of their level of education (Statistics South Africa 2011).

The non-economically active population constitutes 61.67% of the District's working-age population (those aged 15 to 64) (Statistics South Africa 2011). The District Municipality is characterized by high unemployment (Figure 20) (Department of Cooperative Governance and Traditional Affairs n.d.). Of the working-age population, only 16.20% are employed (Statistics South Africa 2011). The largest employer is the formal sector, within which the community services sector accounts for 27% of the working-age population and the wholesale sector which accounts for 15% (Alfred Nzo District Municipality 2016a). Additionally, the unemployed constitute 12.45% of the working-age population, while the remaining 9.68% are discouraged work-seekers (Statistics South Africa 2011).

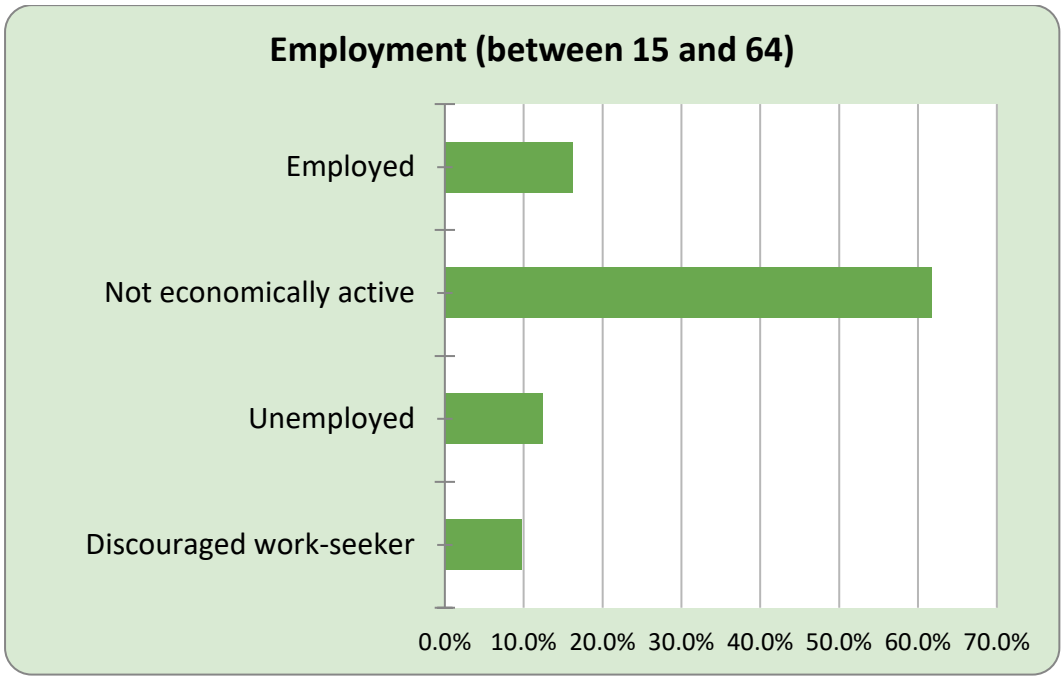

Figure 20: Employment status in the District Municipal Area (Statistics South Africa, 2011)

The Alfred Nzo District Municipal Area is predominantly rural (Department of Cooperative Governance and Traditional Affairs n.d.; Alfred Nzo District Municipality 2016a) with only five towns, namely, Mount Ayliff, Mount Frere, Matatiele, Ntabankulu, and Mbizana (Alfred Nzo District Municipality 2016a). A great proportion of the population (94%) reside in rural areas (Alfred Nzo District Municipality 2016a). There are 169,257 households in the District Municipal Area, most of of which (59,628) are in Matatiele Local Municipality (Alfred Nzo District Municipality 2016a). There are on average five persons per household in the District Municipal Area(Alfred Nzo District Municipality 2016a). Half of the District Municipal Area's dwellings are traditional[1], 25.2% are formal[2], 5.9% are backyard flats and 18.9% of dwellings have not been specified (Figure 21) (Statistics South Africa 2011).

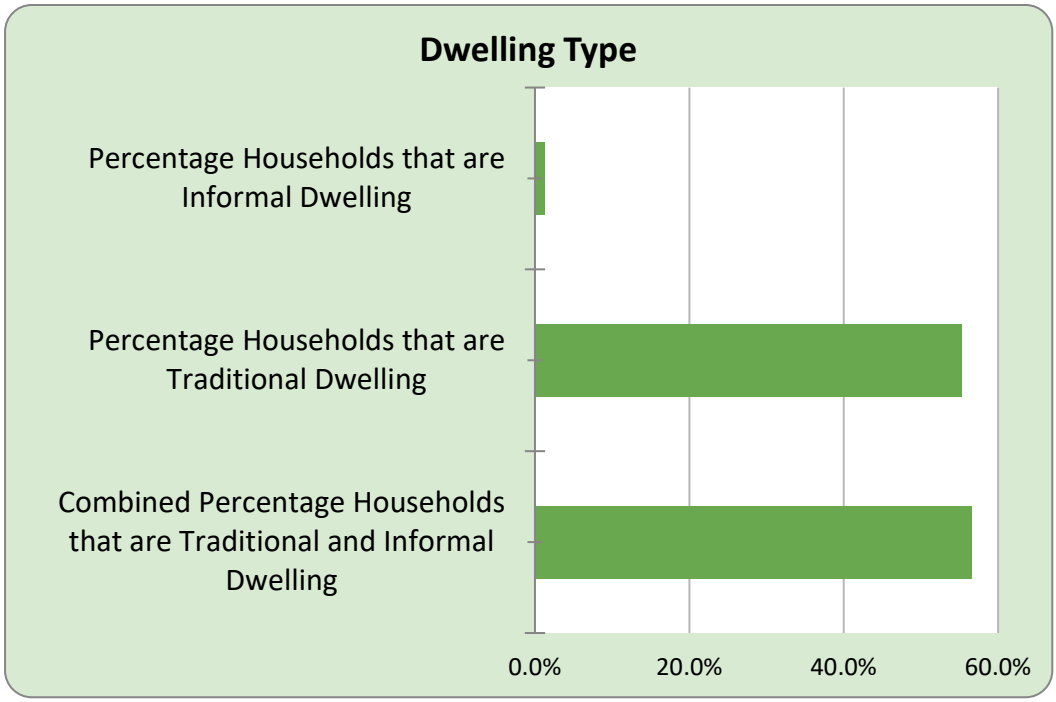

Figure 21: Households by type of dwelling in the District Municipal Area (Statistics South Africa, 2011)

Eskom is the main electricity provider in the district and there are high backlogs in electricity provision in the District Municipal Area (Alfred Nzo District Municipality 2016a). Roughly 71.63% of the households within the District Municipality use alternatives to electricity for cooking, while 53.07% use alternatives to electricity for cooking, heating and lighting (Statistics South Africa 2011).

More than half of the District Municipal Area's population (74.34%) do not source water from piped water schemes (Figure 22) (Statistics South Africa 2011). However, approximately 25.66% of the population source water from service providers, while 3.09% rely on water tanks and 4.99% on boreholes for their water supply (Statistics South Africa 2011).

[1] "Traditional Structure" includes dwelling/hut/structure made of traditional materials.
[2] "Formal House" includes cluster houses, flat or apartment, house/flat/room in backyards, house or brick/concrete block structure on a separate stand or yard or on a farm, room/flatlet on a property or larger dwelling/servant's quarters/granny flat and semi-detached houses.

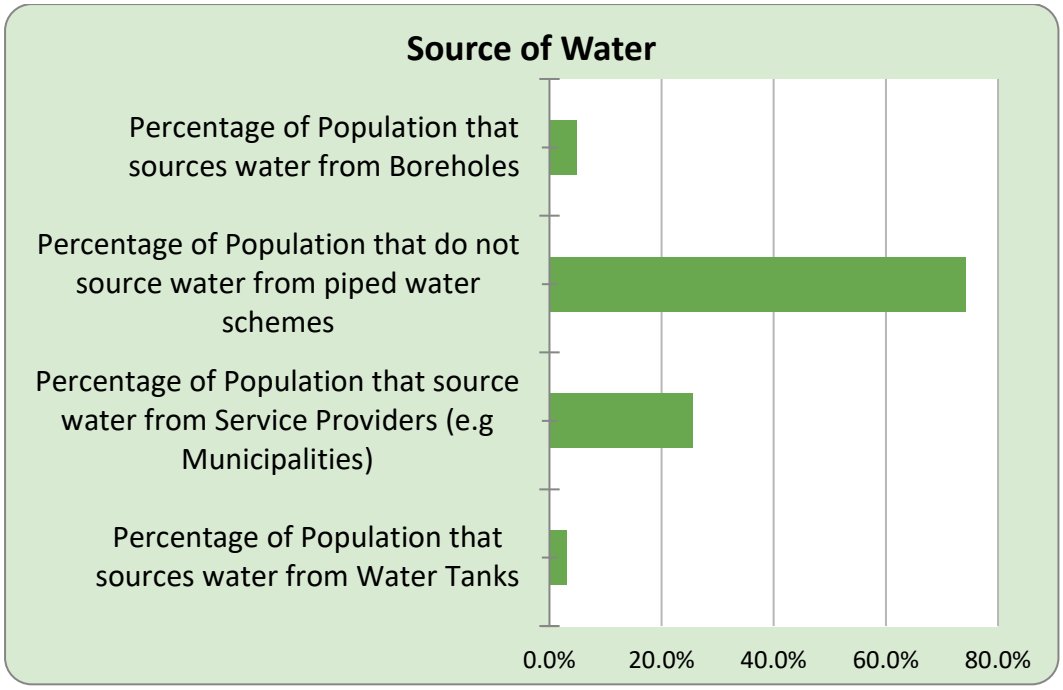

Figure 22: Household water sources in the District Municipal Area (Statistics South Africa 2011)

Regarding sanitation services (Figure 23), 68.30% of the population are using pit latrines, while 4.64% of the population have access to flush toilets (Statistics South Africa 2011). In addition, 11.69% of population has access to other toilet facilities and 15.37% of the population have no toilet facilities (Statistics South Africa 2011).

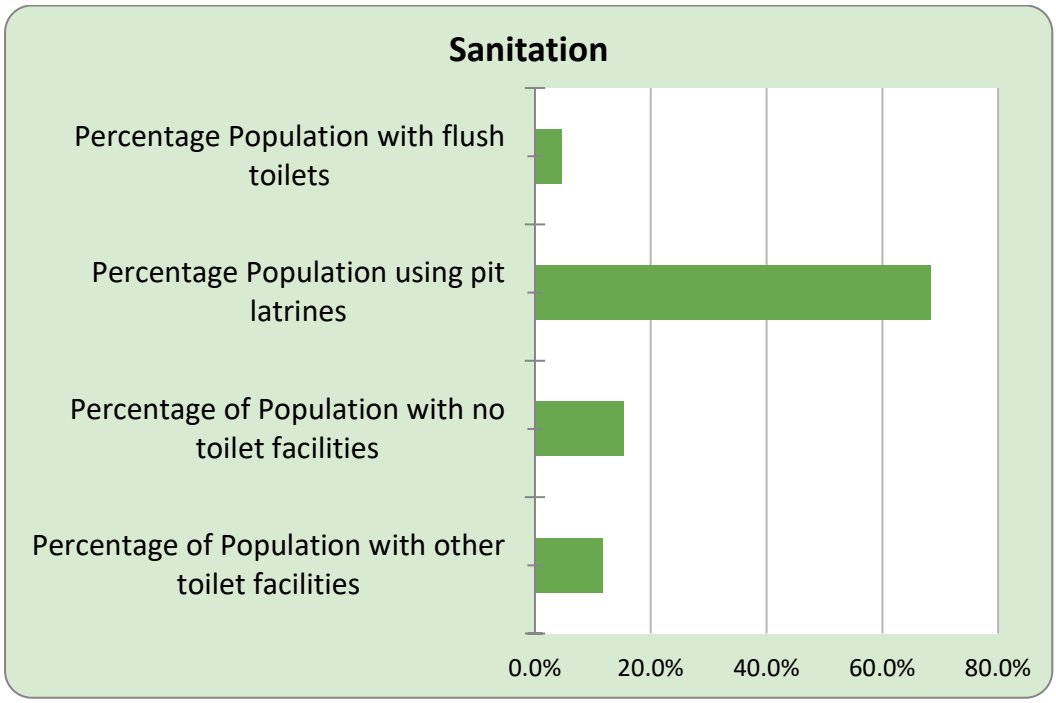

Figure 23: Sanitation facilities in the District Municipal Area (Statistics South Africa 2011)

With regards to transport infrastructure, the N2 passes through the District Municipal Area linking the Eastern Cape and KwaZulu-Natal provinces (Alfred Nzo District Municipality 2016a). Other important access routes to the district are the R56 and R61 (Alfred Nzo District Municipality 2016a).

Among the priority disaster risks in the district's *Disaster Management Plan* are climatic risks such as extreme weather conditions (storms, hail, high winds), and forest and veld fires (Conservation South Africa 2015; Alfred Nzo District Municipality 2016a). The risk of veld fires is high along the coastline and extreme inland the District Municipal Area (Figure 24) (Department of Agriculture, Forestry and Fisheries 2010). Floods have previously been part of the priority risks (Conservation South Africa 2015). In addition, sea level rise is a risk with possible negative impacts on settlements, infrastructure and tourism, which has been identified as an important income generator in the District Municipality (Conservation South Africa 2015; Alfred Nzo District Municipality 2016a).

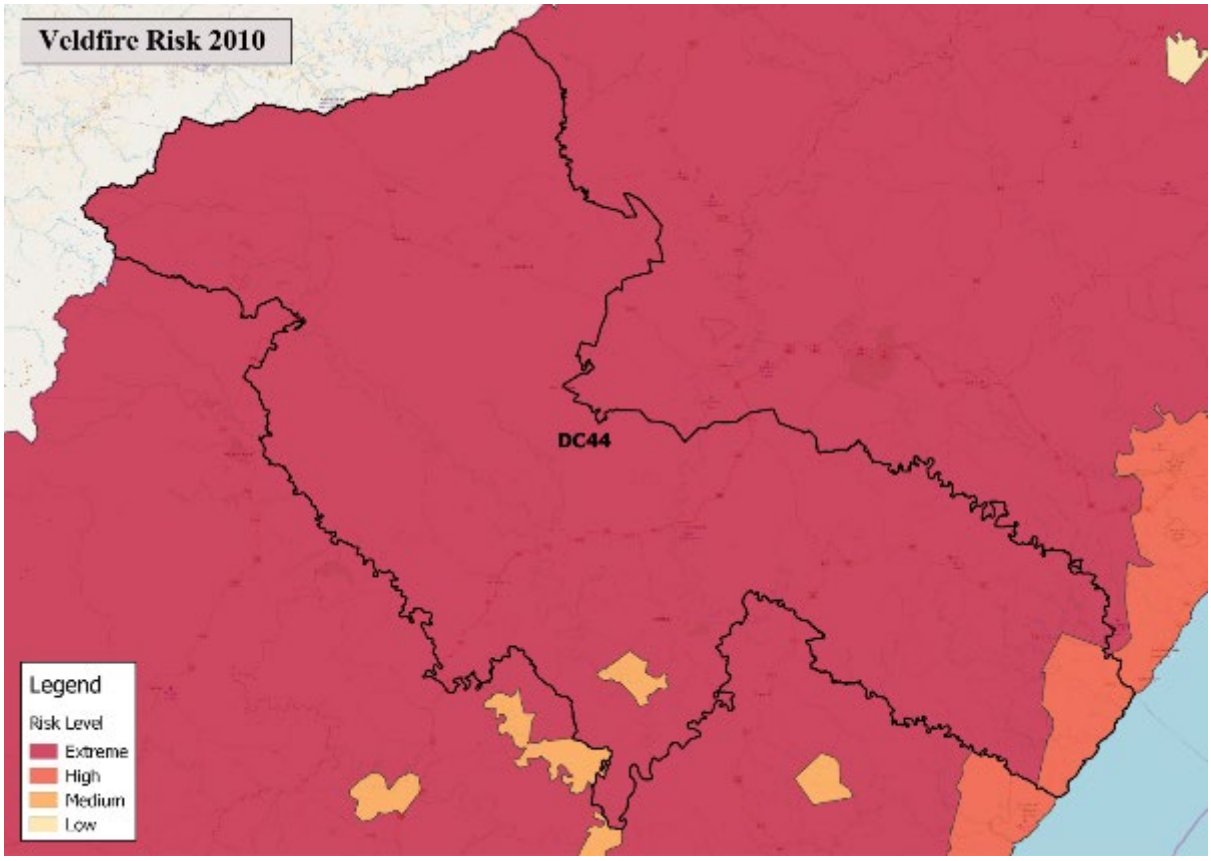

Figure 24: Veld fire risk for the District Municipal Area (Department of Agriculture, Forestry and Fisheries 2010)

4.7 Alfred Nzo DM Water Sector Summary

The Alfred Nzo District Municipality falls mainly under the Mzimvubu-Tsitsikama hydrological zone (Figure 25) with a small part in the north fall within the Pongola-uMzimkhulu hydrological zone (Department of Environmental Affairs 2013d). As outlined above (in Figure 1), in the warmer wetter future scenario, the Mzimvubu-Tsitsikama hydrological zone is predicted to experience an increase in rainfall in all seasons (Department of Environmental Affairs 2013d). While in the hotter and drier scenario, the region will experience a decrease in rainfall in all seasons and a strong decrease in rainfall in summer and autumn (Department of Environmental Affairs 2013d).

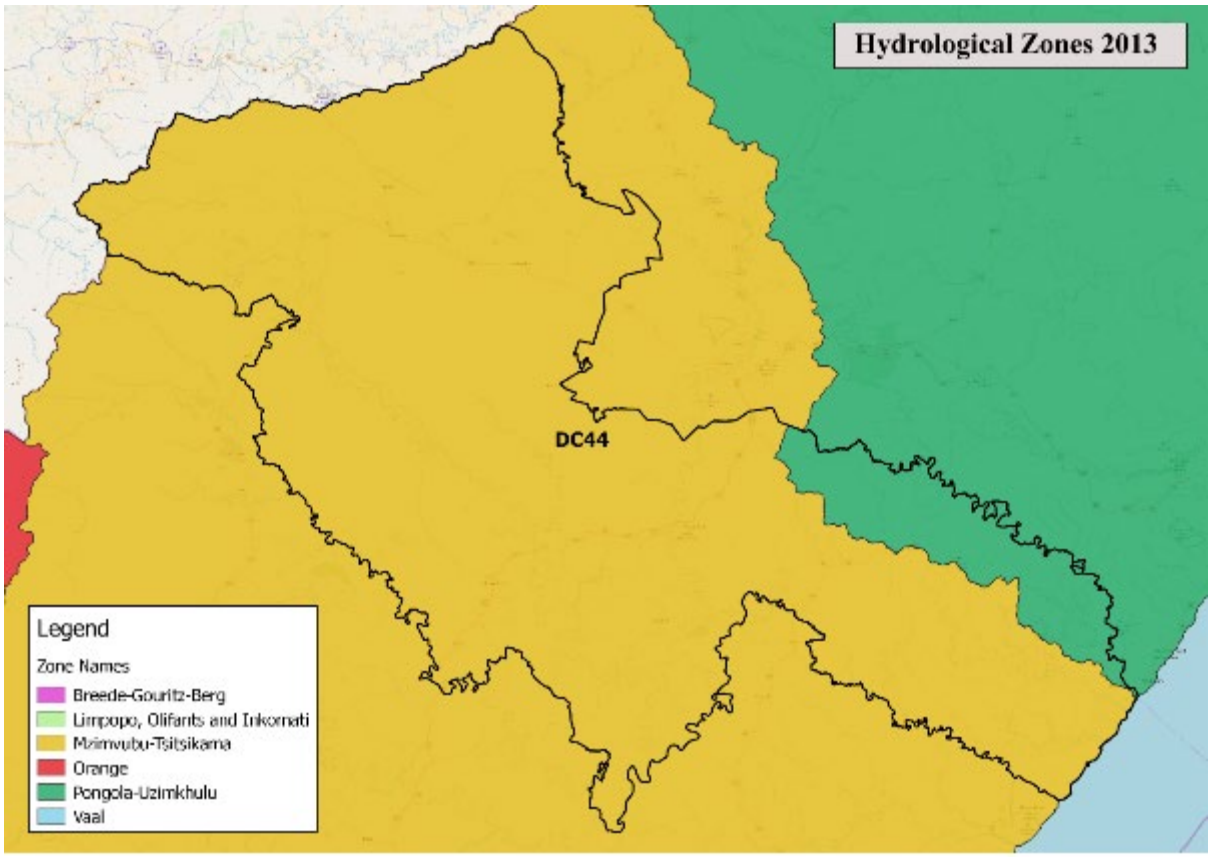

Figure 25: Hydrological Zone for the District Municipal Area (Department of Environmental Affairs 2013d)

Most of the Alfred Nzo District Municipality falls under the Mzimvubu-Tsitsikama Water Management Area (Figure 26), while a small part falls within the Pongola-uMzimkhulu Water Management Area (Department of Environmental Affairs 2013d). Inside the Pongola-uMzimkhulu Water Management Area, the Alfred Nzo District Municipal Area mainly overlaps with one catchment, the Umzimvubu Catchment (Department of Water and Sanitation 2016b). Within the Alfred Nzo District Municipal Area there are three main water resources: the Belfort, Ludeke and Ntenetyana Dams (Department of Water and Sanitation 2016b). These water resources are evenly spread throughout the Alfred Nzo District Municipal Area (Figure 27). While there is a decent supply of water in the Alfred District Municipal Area from rainfall, springs and snow melt, steep river valleys pose a challenge regarding the pumping of water to surrounding communities (Alfred Nzo District Municipality 2017). Furthermore, rivers such as Mzintlava River are heavily strained by upstream commercial farmers (Alfred Nzo District Municipality 2017).

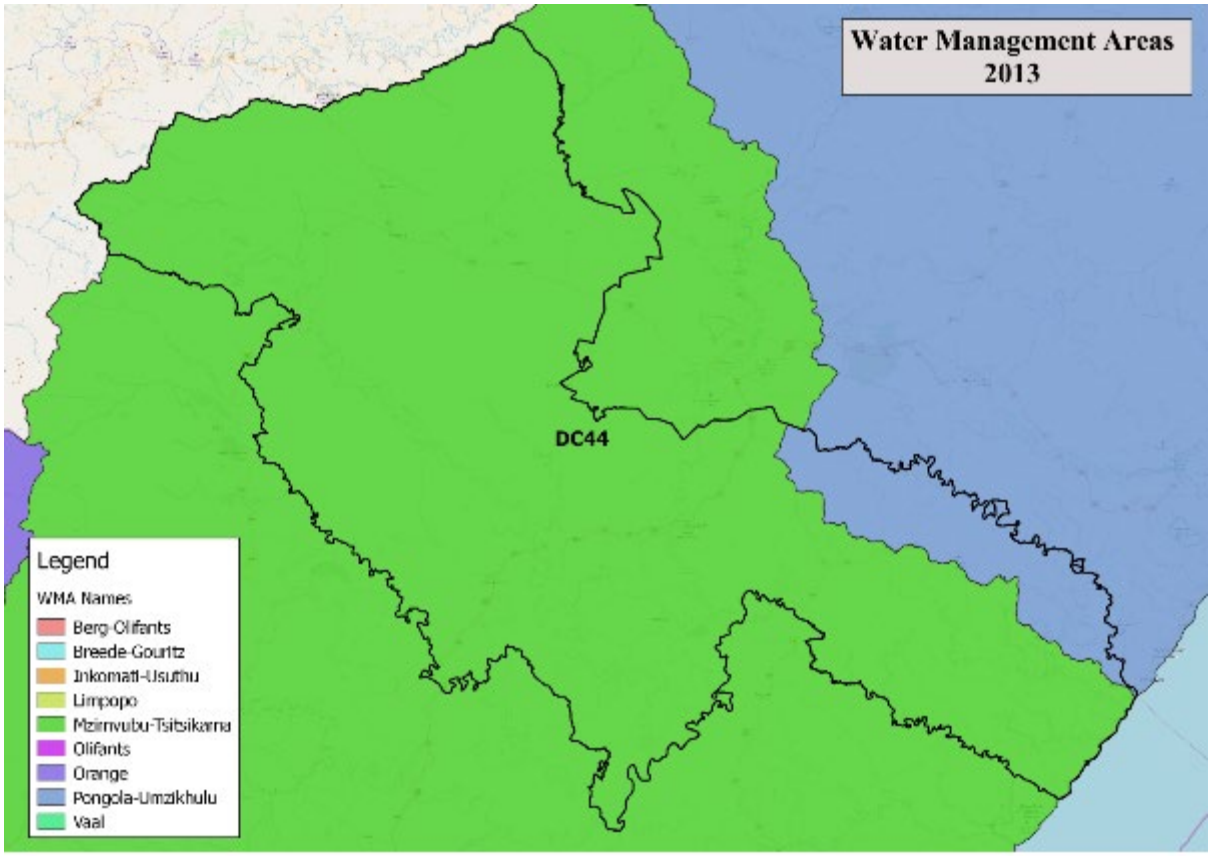

Figure 26: Water Management Area for the District Municipal Area (Department of Water Affairs 2013)

Figure 27: Water resources within the District Municipal Area (Department of Water and Sanitation 2016b)

The Rivers in the Alfred Nzo District Municipality stem from the Drakensburg Mountains and due to land-use and development pressures, have been classified as vulnerable and endangered (Alfred Nzo District Municipality 2017). The river quality within the Alfred Nzo District Municipal Area is highly variable, which means that many rivers are unable to contribute towards river ecosystem biodiversity targets (SANBI 2011). The health of a river system is graded into one of several categories (SANBI 2011). These categories are listed in Text Box 1.

Text Box 1: Freshwater Ecosystem Priority Areas (FEPAs) classification for river ecosystem conditions

River conditions in South Africa have been classified according to the Freshwater Ecosystem Priority Areas (FEPAs) for river ecosystems (SANBI 2011). The different grades are provided below:

A = Unmodified, Natural
B = Largely Natural with Few Modifications
Ab = A or B Above
C = Moderately Modified
D = Largely Modified
E = Seriously Modified
F = Critically/Extremely Modified
Ef = E or F Above
Z = Tributary Condition Modelled as Not Intact, According to Natural Land Cover

Rivers that are unmodified or in their natural state are able to contribute towards river ecosystems biodiversity targets (SANBI 2011). In contrast, rivers that are categorised as 'largely modified' or worse are unable to contribute towards river ecosystems as they are not in a good state.

Many of the main rivers in the Alfred Nzo District Municipal Area (Figure 28) such as the Mzimvubu, Kinira, Tshisa, Tina and Mzintlava Rivers are classified as 'moderately modified' (SANBI 2011). Additionally, some smaller rivers such as the Mnceba and Ncome Rivers are classified as 'tributary condition modelled as not intact, according to natural land cover' (SANBI 2011).

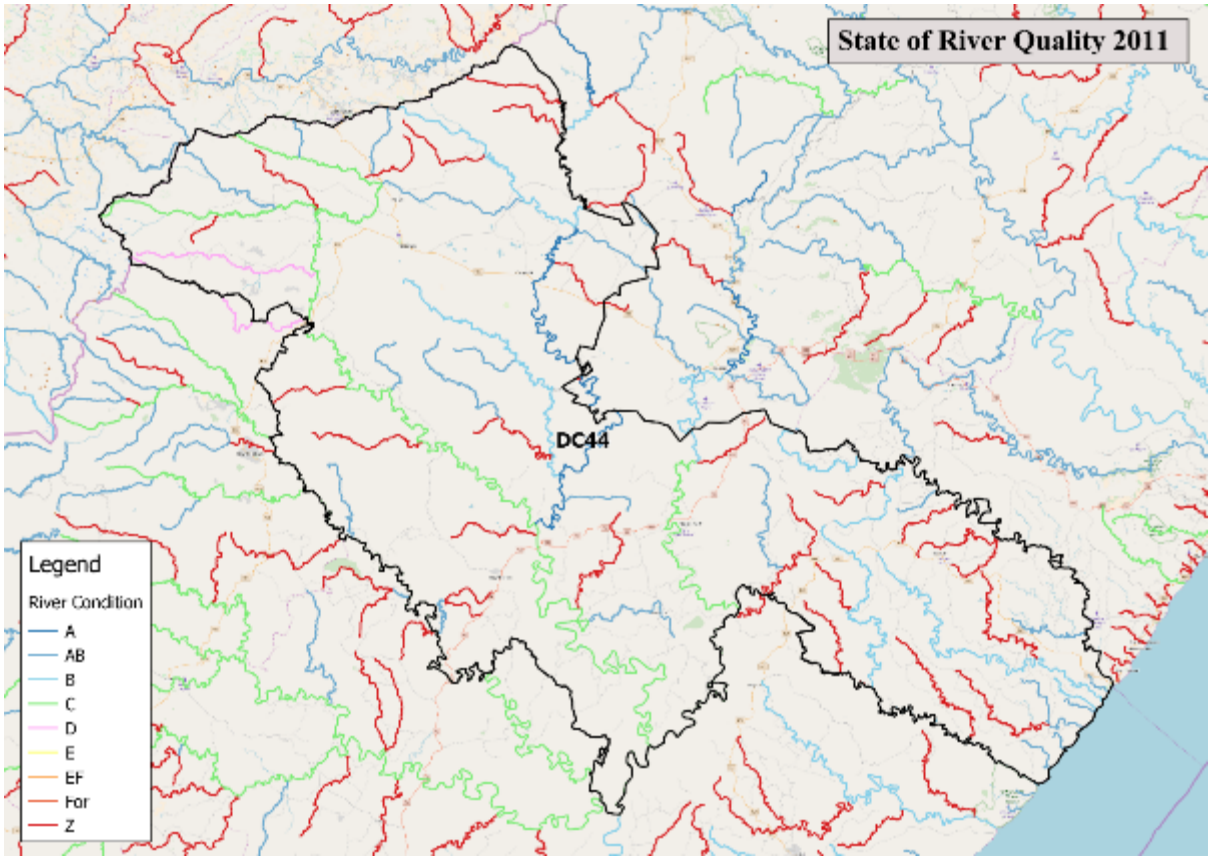

Figure 28: State of water quality in rivers in the District Municipal Area (SANBI 2011)

Water resources in any catchment are largely depended on rainfall. The Historical Climate Monthly Averages include long-term historical monthly average rainfall totals and monthly averaged minimum and maximum temperatures for a particular spot (Climate System Analysis Group 2017b). Due to the unavailability of weather data stations, the Historical Climate Monthly Averages for the Alfred Nzo District Municipal Area have been calculated using the nearest weather data station to the Municipality, which is the measuring station at uMtata (Figure 29). The graph (in Figure 29) shows that average temperatures peak in the same months as highest rainfall, indicating that the Alfred Nzo District Municipal Area is in a summer rainfall area (Climate System Analysis Group 2017b). Resultantly, there is less rainfall during winter seasons with the lowest average monthly rainfall historically occurring in August, which averages less than 13 mm (Climate System Analysis Group 2017b).

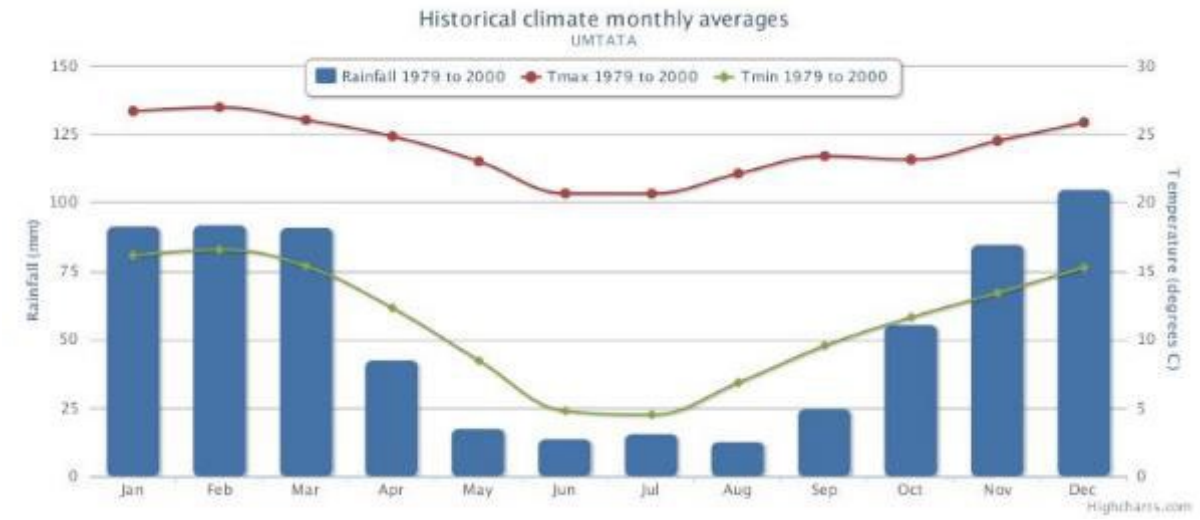

Figure 29: Historical Climate Monthly Averages for uMtata (Climate System Analysis Group 2017b)

Linked to the rainfall and rivers in the Alfred Nzo District Municipal Area are the water and sanitation services. Specifically, a total of 74.34 % of households in the Alfred Nzo District Municipal Area do not receive their water from piped water schemes, which is much higher than the national average of 21.82 % (Statistics South Africa 2011). Water supply challenges in the Alfred Nzo District Municipal Area are due to *inter alia* inadequate and ageing water infrastructure as well as a lack of maintenance and municipal capacity (Alfred Nzo District Municipality 2017). Furthermore, the percentage of the population with flush toilets in the Alfred Nzo District Municipal Area is 4.64 % while the national average is 56.51 % (Statistics South Africa 2011). This indicates a critical lack of sanitation facilities within Alfred Nzo District Municipality.

The Alfred Nzo District Municipality in its 2017/2018 *Integrated Development Plan* has identified these water and sanitation issues as key development challenges that need to be addressed (Alfred Nzo District Municipality 2017). As part of their 2017/2018 *Integrated Development Plan,* the Alfred Nzo District Municipality developed a *Water Service Development Plan* in response to these challenges (Alfred Nzo District Municipality 2017).

Directly linked to water and sanitation services in the Alfred Nzo District Municipal Area are the Blue and Green Drop scores. Blue Drop scores rate the quality of drinking water, while Green drop scores rate the quality of wastewater. Blue Drop scores rate the quality of drinking water supplied by water service providers. The Blue Drop score can be understood using the following scale: 90 – 100 % = 'Excellent situation'; 75 - <90 % = 'Good status'; 50 - <75 % = 'Average performance'; 33 - <50 % = 'Very poor performance'; and, 0 - <33 % = 'Critical status' (Department of Water Affairs 2011). The 2014 Blue Drop score for the Alfred Nzo District Municipality was 62.87 %, indicating an 'average performance' (Department of Water and Sanitation 2014).

The Green Drop score rates the quality of wastewater management in municipalities. The Green Drop score can be understood using the following scale: 90 – 100 % = 'Excellent situation'; 80 - <90 % = 'Good status'; 50 - <80 % = 'Average performance'; 30 - <50 % = 'Very poor performance'; and, 0 - <30 % = 'Critical state' (Department of Water and Sanitation 2016a). The 2013 Green Drop score for Alfred Nzo District Municipality was 39.21 % (Department of Water and Sanitation 2013). The Green Drop score indicates that the wastewater services in the Alfred Nzo District Municipality are 'very poor' and are not being managed according to the expectations of the Department of Water and Sanitation as assessed by the Green Drop score.

In addition to a 'very poor' Green Drop score, just 5.03 % of households have their refuse removed by local authority/private company in the Alfred Nzo District Municipal Area (Statistics South Africa 2011). As the national average for household refuse removal is 59.40 %, this indicates a lack of resources in the Alfred Nzo District Municipality (Statistics South Africa 2011). Uncollected waste often ends up in water and sanitation infrastructure, blocking stormwater drains and polluting rivers. It is predicted that climate change will affect these water and sanitation challenges.

Climate change is predicted to have an impact on rainfall patterns in South Africa. Future rainfall projections for the Alfred Nzo District Municipality (using the measuring station at uMtata) for the period 2020 to 2040 (Figure 30) are made using the Representative Concentration Pathways (RCP) 4.5 greenhouse gas concentration trajectories (Climate System Analysis Group 2017a).

The bar charts (Figure 30) show the potential change in rainfall, with the blue bars indicating a potential increase in average rainfall and the red bars indicate a potential decrease in average rainfall (Climate System Analysis Group 2017a). The grey lines represent the various models used for this projection. It is therefore projected across most of the models that Alfred Nzo District Municipality could experience an increase in rainfall in the months of January, February, July, September, October, November and December, and a decrease in rainfall during March, April, May, June and August (Climate System Analysis Group 2017a).

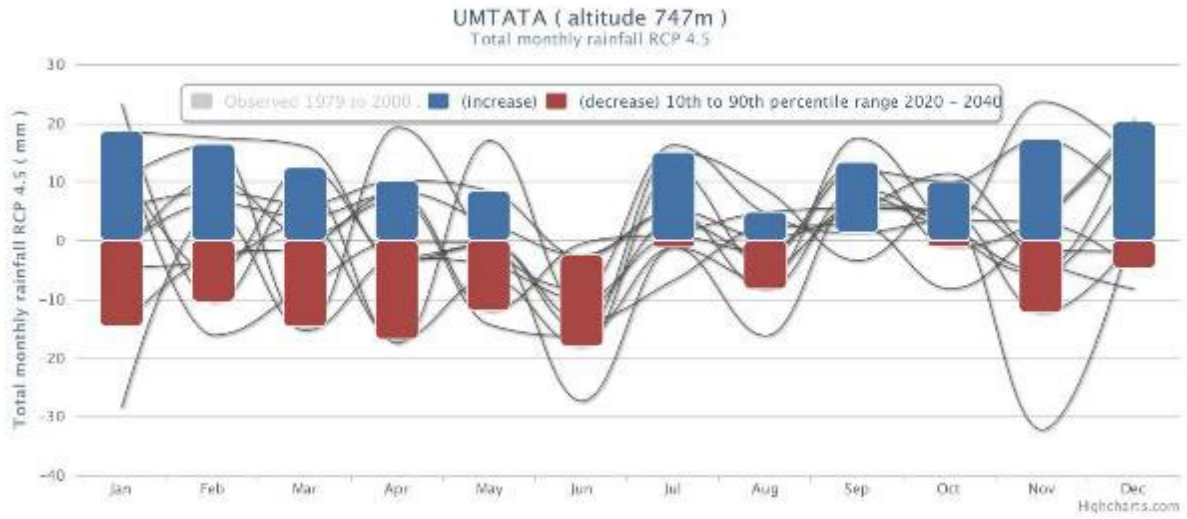

Figure 30: Rainfall Projections for uMtata (Climate System Analysis Group 2017a)

5 Vulnerability Assessment Results

The following section provides a summary of the Vulnerability Assessment conducted for Alfred Nzo District Municipality.

5.1 Agriculture

Table 4: Agriculture Vulnerability Indicator Table Alfred Nzo District Municipality

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
1	Change in grain (maize, wheat & barley) production	Areas towards the west of RSA are likely to become less suitable for grain production.	Do you grow or have potential to grow grains in your area?	Yes	There is maize grown throughout the DM, especially in rural areas. Overall maize suitability is unlikely to change that much, but there will be variability across the District.	How important is grain to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low/No Priority Crop = Low	High	Maize is important for livelihoods.	Medium	Subsistence farmers rely on rain for maize. A Grain Production Master Plan was developed to guide the development of the grain production industry in the District. A recent study in the District highlighted that sorghum however, is a more resilient crop. In addition to this, the Agri park business plan has been developed as an overarching plan for the implementation of Agri Parks in the District Municipality.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
2	Change in Sorghum production	Sorghum yields are projected to increase in parts of western KZN, inland areas of the Eastern Cape and the eastern Free State, with some areas in the north registering losses compared with present climatic conditions.	Do you grow or have potential to grow Sorghum in your area?	Yes	There is no sorghum production in the DM, however according to the District's CC Strategy and the Grain Master Plan, there is potential for sorghum to be grown the DM as it is more heat resistant than maize.	How important is sorghum to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low/No Priority Crop = Low	Low	Not currently a priority crop	Low	
3	Change in Soya Bean Production	Areas in the east of RSA lost to potential production, with an expansion of suitable areas inland towards the central/west or RSA.	Do you grow or have potential to grow Soya Bean in your area?	Yes	There is no Soya Bean production in the DM but there is potential for soybean. Not a priority crop but could be a good complimentary crop for maize for animal feed purposes.	How important is soya bean to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low/No Priority Crop = Low	Low	Not a priority crop		

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
4	Change in Sugarcane Production	Increase in <10% in many parts of the present cane growing areas, but by up to 30% in new growth areas further inland.	Do you grow or have potential to grow Sugarcane in your area?	Yes	There is no sugarcane grown due to a lack of infrastructure, however there is potential for sugarcane to be grown in the District. Although sugarcane is not grown in the Alfred Nzo District, there is potential in the Mbizana area but is currently underdeveloped due to the lack of resources.	How important is sugarcane to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low/No Priority Crop = Low	Low	Not a priority crop.		
5	Change in viticulture (grapes) production	Areas suitable for viticulture could be substantially reduced or shift to higher altitudes and currently cooler, more southerly locations.	Do you grow or have potential to grow grapes in your area?	No	No grapes in the DM	How important is viticulture (grapes) to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low /No Priority Crop = Low				

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
6	Change in fruit production	Projected reduction of the area suitable for fruit production (e.g. 28% reduction in apple and pears) by as early as 2020.	Do you grow or have potential to grow fruit in your area?	Yes	There is some fruit, but not at a commercial scale.	How important is fruit to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low/No Priority Crop = Low	Medium	Not a priority crop because of seasonality and lack of financial resources.	Medium	There is research available on the feasibility of peach value addition in the Umzimvubu area.
7	Change in other crop production areas (e.g. vegetables, nuts, etc.)	Crop production may vary depending on a warmer wetter or warmer drier climate.	Do you grow or have potential to grow other crops in your area?	Yes	Spinach, cabbage, turnip, amadumbe and potato.	How important are other crops to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low/No Priority Crop = Low	High	Not a priority crop but important at a subsistence level. Vegetables more especially potatoes and turnip are important for communities in the District.	Medium	Agriculture Policy Plan and Agri-Parks initiative

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
8	Increased areas for commercial plantations	The total area suitable for commercial forestry plantations would increase along the eastern seaboard and adjacent areas.	Do you have or have potential for commercial forestry plantations in your area?	Yes	There are extensive commercial plantations in the DM, owned by government and some owned by communities. There are also a growing number of small scale saw millers. Forestry is identified as an area of growth in the District's IDP.	Is there capacity for commercial plantation expansion (water use licence, land availability, demand for plantation products)? High Potential for Expansion = High; Medium Potential for Expansion = Medium; Low/No Potential for Expansion = Low	High	Forestry has been highlighted as one of the key economic sectors with significant potential in the District. Pine, gum and wattle can be grown. 27,000 hectares of potential land for forestry has been identified. The IDP also notes the potential for processing activities, such as pulp and paper and furniture.	Medium	DAFF and Sappi are key stakeholders in forestry sector in the District. The IDP notes that the DM will be working closely with DAFF to develop this sector.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
9	Increased exposure to pests such as eldana, chilo and codling moth	Exposure to eldana would increase in areas suitable for sugarcane by ~10% to > 30%. The area subject to damage by chilo would increase substantially (sugarcane). The area subject to damage by codling moth would increase substantially (apples, pears, walnuts and quince).	Are you or will you be exposed to agricultural pests in your area?	Yes	There have been problems with the Army Fall Worm in Cedarville and Ntabankulu.	How important are crops that are vulnerable to pests to the local economy and livelihoods? High Priority Crop = High; Medium Priority Crop = Medium; Low/No Priority Crop = Low	High	Army Fall Worm is a pest that affects maize which is a priority crop in the District.	Medium	Unsure about capacity to deal with agricultural pests.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
10	Increased risks to livestock	Projected decreases in rainfall and hence herbage yields would result in negative health impacts for livestock.	Do you or will you have livestock in your area?	Yes	There is significant livestock across the DM, including goats, sheep, beef and dairy. Extensive livestock farming and subsistence livestock farming.	How important is livestock farming to the local economy and livelihoods? High Priority = High; Medium Priority = Medium; Low/No Priority = Low	High	The District's CC Strategy highlights that livestock may experience heat stress with increases in temperatures. Soil erosion in the District will impact on the grazing land. Loss of grassland will also impact on grazing land.	High	There are a number of livestock support projects included in the IDP with allocated budgets. Livestock farming is also supported by the Provincial Dept. of Agriculture.
11	Reduced food security	Reduced food security, particularly of subsistence farmers, and resultant increase in malnutrition.	Do you or will you have food insecurity in your area?	Yes	There are very high levels of food insecurity in all LMs, especially Ntabankulu, and the rural areas.	Percentage households involved in agricultural activities More than 20% = High; Between 20% & 10% = Medium; Less than 10% = Low	High	55% of households are involved in agriculture in the District.	Medium	Agri-Parks initiative has been introduced by the government to deal extensively with food security. There are also programmes such as Siyazondla which aim at addressing food security.

5.2 Biodiversity and Environment

Table 5: Biodiversity Vulnerability Indicator Table Alfred Nzo District Municipality

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
12	Loss of High Priority Biomes	High Priority Biomes (including Grasslands, Nama-Karoo, Indian Ocean Coastal Belt, Fynbos, Forest) to be replaced by other biomes such as savanna and desert.	Do you currently have high priority biomes in your area?	Yes	Grassland and Indian Ocean Coastal Belt	How much of this High Priority Biome will be lost due to climate change? A significant amount= High; A moderate amount= Medium; None/a low amount = Low	High	Under a high risk scenario, the Savanna biome will replace a significant amount of the grassland biome and almost all of the Indian Ocean Coastal Belt biome.	Low	An Environmental Management Plan (2010) has been developed for the District but does not cover the entire District. The District's Climate Change Strategy highlights the District's ecological infrastructure as its 'primary climate response asset' and focuses on ecosystem based adaptation as a key response to climate change.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
13	Increased impacts on threatened ecosystems	Loss of threatened ecosystems due to changes in climate.	Do you currently have threatened ecosystems in your area? (Classified as critically endangered, endangered or vulnerable)	Yes	Vulnerable ecosystems found in Mbizana and Ntabankulu LMs. Wetlands in Matatiele, Bizana and Ntabankulu. There are also some forests.	How much of your Municipality is covered by threatened ecosystems? A significant amount= High; A moderate amount= Medium; None/a low amount = Low	Medium	A moderate amount of land area is covered by vulnerable ecosystems.	Medium	An Environmental Management Plan (2010) has been developed for the District but does not cover the entire District. The District's Climate Change Strategy highlights the District's ecological infrastructure as its 'primary climate response asset' and focuses on ecosystem based adaptation as a key response to climate change. Rural communities especially are dependent on functioning ecosystems to provide key resources such as fuel and water.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
14	Increased impacts on environment due to land-use change	Loss of biodiversity and degradation of natural habitat due to significant land use change (such as alien invasion, soil erosion and urbanisation) which impacts on ability to respond to climate change	Are you currently experiencing land use change?	Yes	Soil erosion in the whole district. There is also increased impacts due to alien infestation across the District.	Have you experienced significant loss of habitat since 1990? Above 10% = High; Between 5-10% = Medium; Under 5%= Low	High	Land degradation and transformation has occurred in the District.	Low	The land areas that have been transformed have been mapped spatially in the District's Climate Change Strategy. In addition, the remaining areas have been prioritised according to their ecosystem based adaptation value. This mapping exercise can be used when assessing new developments so that the most critical areas that provide ecosystem services are protected and managed.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
15	Loss of Priority Wetlands and River ecosystems	Changes in rainfall patterns and temperature are likely to impact on wetlands and the ecosystem services they provide.	Do you have priority wetlands and river ecosystems in your area?	Yes	Cederberg wetlands, Matatiele, Bizana, Mzimvubu River and Kinira River.	How important are wetlands and river ecosystems in providing ecosystem services in your Municipality? A significant amount= High; A moderate amount= Medium; None/a low amount = Low	High	There is an extensive network of wetlands in the District, especially in the north, and these wetlands provide crucial ecosystem services including improving water quality and providing storm attenuation.	Low	The importance of preserving wetlands is extensively covered in the District's Climate Change Strategy and responses have been included to protect wetland resources for the ecosystem services they provide.

5.3 Coastal and Marine

Table 6: Coastal and Marine Vulnerability Indicator Table Alfred Nzo District Municipality

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
16	Impacts on Marine and Benthic Ecosystems	Changes in precipitation and freshwater flow; sea-level rise; increased temperatures and coastal storminess have led to changes in physical processes and biological responses which impacts marine and benthic ecosystems.	Does this or will this take place in your area?	Yes	Sea-level rise and coastal surge risk is currently minimal. In the medium and long term there will be greater risk of sea-level rise and storm surges, but the risk is lower than most coastal districts in SA.	What is the Benthic Coastal Threat Status of the area? Critically Endangered and Endangered = High; Vulnerable = Medium; Least Threatened = low	High	Several threatened coastal ecosystem types. Endangered- 'Natal Inshore Reef', and many vulnerable ecosystems.	Low	A Coastal Zone Management Plan is scheduled for development in the 16/17 municipal financial year.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
17	Impacts on estuary ecosystems	Changes in precipitation and freshwater flow; sea-level rise; increased temperatures and coastal storminess have led to changes in physical processes and biological responses which impacts on estuarine ecosystems.	Does this or will this take place in your area?	Yes	Sea-level rise and coastal surge risk is currently minimal. In the medium and long term there will be greater risk of sea-level rise and storm surges, but the risk is lower than most coastal districts in SA.	Have estuaries in the area been modified? Critically or Seriously Modified = High; Largely or Moderately Modified = Medium; Unmodified or Natural = Low	Medium	Mtamvuna estuary is classified as 'moderately modified'. None of the estuaries in the District classified as 'largely modified', 'seriously modified' or 'critically/extremely modified.	Medium	A Coastal Zone Management Plan is scheduled for development in the 16/17 financial year.
18	Impacts on Coastal Livelihoods	An increase in the intensity and frequency of extreme weather events is likely to impact on fishing activity by reducing the number of viable sea fishing days, affecting catches.	Does this or will this take place in your area?	Yes	Subsistence harvesting and recreational.	How important is fishing to the local economy and livelihoods? High Priority = High; Medium Priority = Medium; Low/No Priority = Low	Low	Mainly rural. Accessing the coast is a challenge.		

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
19	Loss of land due to sea level rise	Increased loss of land due to sea level rise and storm surges	Does this or will this take place in your area?	Yes	Sea-level rise and coastal surge risk is currently minimal. In the medium and long term there will be greater risk of sea-level rise and storm surges, but the risk is lower than most coastal districts in SA. The Climate Change Strategy also highlights that mining of dunes and any coastal development (which is possible) will increase the risks of coastal storms and sea-level rise.	Do you have significant areas below 5m elevation? Significant areas = High; Some areas = Medium; Few or no areas = Low	Low			

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
20	Increased damage to property from sea level rise	Increased damage to property and damage to infrastructure (including coastal roads and railways, small fishing ports and harbours, and critical infrastructure such as Koeberg nuclear power station) as a result of rising sea-levels and storm surges.	Does this or will this take place in your area?	Yes	Sea-level rise and coastal surge risk is currently minimal. In the medium and long term there will be greater risk of sea-level rise and storm surges, but the risk is lower than most coastal districts in SA. Very few buildings are currently located in areas of coastal risk. The Climate Change Strategy also highlights that mining of dunes and any coastal development (which is possible) will increase the risks of coastal storms and sea-level rise.	Do you have significant areas below 5m elevation? Significant areas = High; Some areas = Medium; Few or no areas = Low	Low	Relatively little coastal zone below 5.5m. Bizana, Wild Coast Casino Sun.		

5.4 Human Health

Table 7: Health Vulnerability Indicator Table Alfred Nzo District Municipality

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
21	Health impacts from increased storm events	Increased storms will result increased risk of drowning, injuries and population displacement impacts.	Are you or will you experience increased storm events in your area?	Yes	The Climate Change Strategy highlights that an increase in surface water runoff will result in damage to infrastructure and human health.	How populated are areas vulnerable to storms events (e.g. flood zones)? Densely populated = High; Partially populated = Medium; Sparsely or not populated = Low	High	All local municipalities' infrastructure is at risk from flooding and the Bizana coastal area.	Low	A flood risk assessment for infrastructure is included in the Climate Change Strategy, and each local municipality has been given a risk rating. Road infrastructure is affected mostly which hinders responsiveness. There is a backlog due to finances.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
22	Increased heat stress	Increases in average temperatures and extreme events (such as heat waves) are projected to induce heat stress, increase morbidity, and result in respiratory and cardiovascular diseases.	Are you or will you experience increased heat waves in your area?	Yes	The District's Climate Change Strategy highlights an average increase of temperature of 1.7 degrees Celsius up until 2050, and 3.7 degrees Celsius thereafter up until 2100. The temperature increases are substantial in the long term.	Is there a high percentage of young and elderly in the area? More than 20% = high; Between 15% & 20% = Medium; Less than 15% = low	Medium	The young (<5yrs age group) and elderly (>64yrs age group) make up 20.12% of the population. Increased risk to young and elderly is noted in the strategy. Most of the population is comprised of youth.	Medium	Capacity needs to be increased for ITO professional resources however, there's threat of socio cultural issues.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
23	Increased vector borne diseases from spread of mosquitoes, ticks, sandflies, and blackflies	Vector borne diseases such as malaria is projected to spread within regions bordering current malaria areas, which are presently too cold for transmission.	Are vector borne diseases present or likely in your area?	Yes	Climate Change Strategy highlights the possibility of an increase in vector borne diseases such as malaria in areas that did not have these diseases previously. There are blackflies in the District.	Are you in or neighbouring an area with vector borne diseases (e.g. malaria)? Already in a vector borne disease area = High; Neighbouring a vector borne disease area = Medium; Not near a vector borne disease area = Low	Low	Alfred Nzo DM is currently malaria free and does not neighbour a malaria area.	Medium	Poverty and literacy levels are a concern as areas could be experiencing high spread of blackflies. Socio-cultural issues also affect the increase in vector borne diseases.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
24	Increased water borne and communicable diseases (e.g. typhoid fever, cholera and hepatitis)	Favourable conditions for the incubation and transmission of waterborne diseases may be created by increasing air and water temperatures.	Are waterborne and communicable diseases present or likely in your area?	Yes	Climate Change Strategy highlights the possibility of an increase in communicable water borne diseases such as cholera.	Have you had an incidence of waterborne and communicable diseases (e.g. typhoid fever, cholera and hepatitis) in the past 3 years Yes = High: No = Low	Medium	Unsure of how many cases of cholera, typhoid and hepatitis in the last three years. However, the District's 2014 Disaster Management Sector Plan highlights human diseases (HIV, TB, Cholera) as one of five priority hazards. In children, diarrhoeal diseases accounted for 28.4% of deaths in 2009-2014 period. One of the highest incidences of diarrhoea for children under five years in the province.	Low	The Health sector is reactive in responding to cases however water treatment works are a challenge as piped water and water sources are a risk.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
25	Increased malnutrition and hunger as a result of food insecurity	Climate Change will affect food systems, compromising food availability, access and utilisation, leading to food insecurity (particularly of subsistence farmers).	Do you or will you have food insecurity in your area?	Yes	According to the District's Climate Change Strategy, there are very high levels of food insecurity at 86%, with 40% living below the poverty line.	Child under 5 years severe acute malnutrition case fatality rate More than 10% = high; Between 5% & 10% = Medium; Less than 5% = low	High	11.9% fatality rate of malnutrition cases in children under 5 years old.	Low	Social Development has food security programmes but due to climate conditions, food security is still a challenge. There is insufficient knowledge in crop production in relation to climate change affecting food security.
26	Increased air pollution	Health impacts in resulting from exposure to air pollutants include eye irritation, acute respiratory infection, chronic respiratory diseases and TB, and sometimes death.	Do you or will you have air pollution in your area?	Yes	District's Climate Change Strategy highlights air pollution as a potential result of climate change.	Would you consider your area a high priority in terms of air pollution (e.g. SAAQIS Priority Areas)? Yes = High; Somewhat = Medium; No = Low	Low	Does not fall within an SA Air Quality Priority area but there is fuel usage in households such as wood and paraffin.	Medium	There needs to be an assessment of indoor air pollution and adaptive capacity. The District is mostly affected by veldfires and dust.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
27	Increased Occupational health problems	Temperature is a common climatic factor that affects occupational health (for example, agricultural labourer's productivity) by causing heat stress and dehydration.	Do people work outside or are in conditions that cannot be cooled in your area?	Yes	People work outdoors in agriculture across the District, and there is also a large percentage of people working outdoors in the informal sector.	Do a significant percentage of people work outside or are in conditions that cannot be cooled? Significant = High; Some = Medium; Low/No = Low	High	Increased risk to farm labourers and other people working outdoors is noted in the District's Climate Change Strategy.	Low	Mostly affected are Heard Boys, farm workers and forestry workers.

5.5 Disaster Management, Infrastructure and Human Settlements

Table 8: Disaster Management, Infrastructure and Human Settlements Vulnerability Indicator Table Alfred Nzo District Municipality

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
28	Loss of industrial and labour productivity	Direct impacts of weather on construction, electricity generation and other industries, resulting in loss of productivity.	Do you have industrial activities in your area?	Yes	Very small manufacturing sector. No major commercial centres. The construction industry provides around 10% of jobs in the District, with potential to grow the sector. Most of small industries are misplaced, some are next to riverbanks and some are close to residential areas. Most of these sand mining is unlicensed.	How significant is the Mining/Industrial/Manufacturing sector for the local economy? Significant = High; Somewhat = Medium; Low/No = Low	Medium	Medium significance as manufacturing is a very small sector, but construction is growing. Manufacturing has been identified as a key sector in the IDP going forward. Negative impact in the sense of sand mining because it somehow redirects the river and affects the natural environment.	Low	Growth in construction may negatively impact on adaptive capacity of natural environment to changes in climate.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
29	Increased impacts on strategic infrastructure	Increased disruptions to key strategic infrastructure (e.g. WWTW, storm water, roads, rail, bridges) as a result of extreme weather events.	Do you have strategic infrastructure in your area?	Yes	Significant infrastructure includes the N2 freeway which links the Eastern Cape and KZN provinces. Eroded bridges and access roads. Destruction of school buildings.	How important is this strategic infrastructure to the functioning of your municipality? Significant amount = High; Moderate amount = Medium; Minimal or no = Low	High	Key transport infrastructure includes the R56 and R61 which connect people across the district. Water and sanitation infrastructure is old and requires rehabilitation. Some people resort to use conservancy tanks (improperly managed), this results to water scarcity. Illegal trucks fetching water from rivers.	Low	Key infrastructure is old and requires maintenance and rehabilitation. According to the IDP the Municipality has started an Asset Replacement Programme. There needs to be an increase in capacity to accommodate more communities to cater for urbanisation.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
30	Increased impacts on traditional and informal dwellings	Increased risk of extreme weather events to already vulnerable traditional and informal dwellings, that are often unplanned, and without extensive service or infrastructure.	Do you have traditional and informal dwellings in your area?	Yes	The District is largely rural with a large proportion of people living in traditional dwellings.	What percentage of households are in traditional and informal dwellings in your area? More than 15% = high; Between 15% & 10% = Medium; Less than 10% = low	High	55.31% of households live in traditional dwellings. Only 1.19% live in informal dwellings.	Low	Disaster Management Sector Plan in place. There needs to be awareness regarding proper construction of houses. Tree planting needs to be encouraged. Conduct intergovernmental relations sessions.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
31	Increased isolation of rural communities	Physical isolation of rural communities as a result poor rural roads and increased flooding and erosion.	Do you have isolated rural communities in your area?	Yes	The District's Climate Change Strategy states that there are a number of rural communities that are isolated due to poor road infrastructure. This impacts on service delivery, and affects emergency services. Many of the rural settlements are dispersed which impacts on the delivery of services such as electricity provision and waste collection.	Is your area predominantly Rural? Mostly Rural = High Equally Urban and Rural = Medium Mostly Urban = Low	High	The District is mostly rural.	Low	There are large backlogs in the provision of services and infrastructure to remote rural settlements.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
32	Increased migration to urban and peri-urban areas	Increased migration from rural settlements to urban and peri-urban settlements.	Do you have rural urban migration in your area?	Yes	The IDP highlights that people are moving from the low density rural villages to the peri-urban settlements and small towns.	Is there a strong rural economy? Low opportunities in rural areas = High; Some opportunities in rural areas = Medium; Strong rural economy = Low	High	The IDP states that there is limited economic potential in the rural parts of the District and poor investment as the land is owned by Traditional Authorities. Outsourced small rural business such as Spaza shops. There is a lack of basic services.	Low	The IDP notes that the District has been selected for the implementation of the AgriParks initiative, a presidential initiative which aims to transform rural economies in the agriculture sector. There is also an Agriculture Policy Plan and Grain Production Master Plan aimed at increasing production and employment.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
33	Increased risk of wildfires	Increased risk of wildfires linked to higher ambient temperatures, dry spells and more frequent lightning storms.	Is this or will this take place in your area?	Yes	Veld/forest fires are identified as one of the top five hazards in the District's Disaster Management Sector Plan. More frequent veld fires are highlighted as an impact of changes in climate in the Climate Change Response Plan	What is the Veld Fire Risk Status of the area? Extreme or High = High; Medium; Low	High	Veld fire risk is high along the district's coastline and extreme inland. Traditional dwellings and informal dwellings are at most risk due to the materials used (e.g. thatch).	Low	The District has a fire and rescue unit and projects with budgets in the IDP to build capacity and respond to fire. However, there is little capacity in Matatiele, Bizana, Ntabankulu and Mount Ayliff. Lack of traditional fire by-laws.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
34	Decreased income from tourism	Reduced income from tourism as a result of reduced recreational opportunities and increased impact on tourism-supporting infrastructure, such as conservation area access roads.	Do you have tourism assets that can be impacted by climate change in your area?	Yes	Poor management of ecological infrastructure and mining are predicted to impact on the natural resources and biodiversity in the District which will have an impact on eco-tourism. This will have an impact on rural livelihoods. The Wild Coast is a key tourism asset.	How significant is tourism to the local economy? Significant contributor = High; Some contribution = Medium; Low/No contribution = Low	High	According to the IDP, tourism contributes significantly to the local economies and there is potential for this sector to grow. Infrastructure is a key barrier to the development of the sector.	Medium	Some of the locals have tourism strategies and tourism is included in the District's LED strategy.

5.6 Water

Table 9: Water Vulnerability Indicator Table Alfred Nzo District Municipality

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
35	Decreased quality of drinking water	Deterioration in water quality due to increased salt concentrations in dams, wetlands and soil/plant systems from enhanced evaporation rates.	Is this or will this take place in your area?	Yes	Whole District for agriculture and human consumption. The Climate Change Strategy highlights that heavy rainfall events may have an impact on water quality in the District.	What is the Blue Drop Score for the area (2012 Report)? Less than 50% = high; Between 50% & 90% = Medium; More than 90% = low	Medium	Blue Drop Score 2014 62.87 %	Medium	Water Services and Sanitation Master Plan developed. The District's Climate Change Response Plan highlights that it is ecological infrastructure is its greatest asset in combating climate change, and highlights the need to invest in ecological infrastructure which will improve water quality in the District.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
36	Decreased water quality in ecosystem due to floods and droughts	More frequent floods result in increased effluent overflow into rivers. Increased drought means less water is available to dilute wastewater discharges and irrigation return flows to rivers.	Is this or will this take place in your area?	Yes	High salt effluent from overgrazing.	What is the Green Drop Score for the area? Less than 50% = high; Between 50% & 90% = Medium; More than 90% = low	High	Green Drop Score 24% in 2011	Low	Water Services and Sanitation Master Plan developed. The District's Climate Change Response Plan highlights that its ecological infrastructure is its greatest asset in combating climate change, and highlights the need to invest in ecological infrastructure which will improve water quality in the District. Waste Water Risk Abatement Plan 2013/14 score.
37	Less water available for irrigation and drinking	Increased periods of drought mean less water is available.	Is this or will this take place in your area?	Yes	This is only relevant to Ntabankulu LM. Expecting less water due to effects of climate change. However, the availability of water is unlikely to change substantially according to the District's Climate Change Response Plan. The IDP however highlights drought as a priority.	Years of drought over the past 20 years More than 7 incidence = High; Between 7 & 2 incidence = Medium; Less than 2 incidence = Low;	Medium	Unsure of number of years of drought over the past 20 years, but recent experience of drought in the District has made it a priority risk in the IDP.	Low	Water services trucks available and have been used in the recent drought. Drought relief projects implemented.

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
38	Increased impacts of flooding from litter blocking storm water and sewer systems	Human health and ecosystem impacts, associated with increased rainfall intensities, flash floods and regional flooding resulting in litter and washed-off debris blocking water and sanitation systems.	Is this or will this take place in your area?	Yes	No provision of waste management services, especially in the rural areas.	Percentage of Households using no rubbish disposal More than 10% = High; Between 10% & 5% = Medium; Less than 5% = Low	High	17.37% of households have no form of rubbish disposal, with only 5% of households receiving weekly waste collection services.	Medium	An Integrated Waste Management Plan was developed in 2014 and has been adopted by Council.
39	Increased fish mortality	Increased freshwater fish mortality due to reduced oxygen concentrations in aquatic environments and mortality of temperature-sensitive fish species.	Do you have fresh water fish in your area?	Yes	Fishing and fish hatcheries	How significant is fresh water fish to livelihoods? Significant to livelihoods = High; Some dependence = Medium; Low/No dependence = Low	Low	Unsure of significance to livelihoods.		

No	Indicator Title	Indicator Description	Exposure Question	Exposure Answer	Exposure Comment	Sensitivity Question	Sensitivity Answer	Sensitivity Comment	Adaptive Capacity Answer	Adaptive Capacity Comment
65	High rate of soil erosion leading to siltation in dams. Impact of invasive alien plants on dams.	-	-	Yes	Impacts on water supply for households	How sensitive is your area to this particular indicator?	High	Water quality compromised (Turbidity)	Medium	Adaptive capacity depends on availability of funds for addressing indicator.

5.7 Vulnerability Assessment Summary

The tables below list the high and medium priority climate change indicators for the municipality.

5.7.1 High Priority Climate Change Indicators

Based on the above vulnerability assessment the following indicators were identified as high priority climate change vulnerabilities for the municipality. These were shortlisted by answering "yes" to exposure, "high" to sensitivity and "low" to adaptive capacity.

Table 10: High Priority Indicators Alfred Nzo District Municipality

No	Sector	Name Indicator Title	Exposure Answer	Sensitivity Answer	Adaptive Capacity Answer
12	Biodiversity and Environment	Loss of High Priority Biomes	Yes	High	Low
14	Biodiversity and Environment	Increased impacts on environment due to land-use change	Yes	High	Low
15	Biodiversity and Environment	Loss of Priority Wetlands and River ecosystems	Yes	High	Low
16	Coastal and Marine	Impacts on Marine and Benthic Ecosystems	Yes	High	Low
21	Human Health	Health impacts from increased storm events	Yes	High	Low
25	Human Health	Increased malnutrition and hunger as a result of food insecurity	Yes	High	Low
27	Human Health	Increased Occupational health problems	Yes	High	Low
29	Human Settlements, Infrastructure and Disaster Management	Increased impacts on strategic infrastructure	Yes	High	Low
30	Human Settlements, Infrastructure and Disaster Management	Increased impacts on traditional and informal dwellings	Yes	High	Low
31	Human Settlements, Infrastructure and Disaster Management	Increased isolation of rural communities	Yes	High	Low
32	Human Settlements, Infrastructure and Disaster Management	Increased migration to urban and peri-urban areas	Yes	High	Low
33	Human Settlements, Infrastructure and Disaster Management	Increased risk of wildfires	Yes	High	Low
36	Water	Decreased water quality in ecosystem due to floods and droughts	Yes	High	Low

5.7.2 Medium Priority Climate Change Indicators

Based on the above vulnerability assessment the following indicators were identified as medium priority climate change vulnerabilities for the municipality. These were shortlisted by answering “yes” to exposure, “medium” or “high” to sensitivity and “low” or “medium” to adaptive capacity.

Table 11: Medium Priority Indicators Alfred Nzo District Municipality

No	Sector	Name Indicator Title	Exposure Answer	Sensitivity Answer	Adaptive Capacity Answer
1	Agriculture	Change in grain (maize, wheat & barley) production	Yes	High	Medium
2	Agriculture	Change in Sorghum production	Yes	Low	Low
6	Agriculture	Change in fruit production	Yes	Medium	Medium
7	Agriculture	Change in other crop production areas (e.g. vegetables, nuts, etc.)	Yes	High	Medium
8	Agriculture	Increased areas for commercial plantations	Yes	High	Medium
9	Agriculture	Increased exposure to pests such as eldana, chilo and codling moth	Yes	High	Medium
10	Agriculture	Increased risks to livestock	Yes	High	High
11	Agriculture	Reduced food security	Yes	High	Medium
13	Biodiversity and Environment	Increased impacts on threatened ecosystems	Yes	Medium	Medium
17	Coastal and Marine	Impacts on estuary ecosystems	Yes	Medium	Medium
22	Human Health	Increased heat stress	Yes	Medium	Medium
23	Human Health	Increased vector borne diseases from spread of mosquitoes, ticks, sandflies, and blackflies	Yes	Low	Medium
24	Human Health	Increased water borne and communicable diseases (e.g. typhoid fever, cholera and hepatitis)	Yes	Medium	Low
26	Human Health	Increased air pollution	Yes	Low	Medium
28	Human Settlements, Infrastructure and Disaster Management	Loss of industrial and labour productivity	Yes	Medium	Low

No	Sector	Name Indicator Title	Exposure Answer	Sensitivity Answer	Adaptive Capacity Answer
34	Human Settlements, Infrastructure and Disaster Management	Decreased income from tourism	Yes	High	Medium
35	Water	Decreased quality of drinking water	Yes	Medium	Medium
37	Water	Less water available for irrigation and drinking	Yes	Medium	Low
38	Water	Increased impacts of flooding from litter blocking storm water and sewer systems	Yes	High	Medium
65	Water	High rate of soil erosion leading to siltation in dams. Impact of alien invasive plants on dams.	Yes	High	Medium

6 Sector Response Plans

The section below summarises responses that have been identified to address the key vulnerabilities identified above.

6.1 Biodiversity and Environment

6.1.1 Introduction

	Project Name
	Biodiversity and Environment Sector Adaptation to Climate Change
	Project Custodian/Driver
	Overview of Key Issues
	Biodiversity is crucial to ecosystem health, and healthy ecosystems are central to human well-being. Healthy ecosystems interlinked with working landscapes and other open spaces form the ecological infrastructure of the country and are the foundation for clean air and water, fertile soil and food. All South Africans depend on healthy ecosystems for economic and livelihood activities, including agriculture, tourism and a number of income generating and subsistence level activities. These natural ecosystems are under pressure from land use change and related processes causing degradation, as well as invasive alien species. Accelerated climate change (resulting in increasing temperature, rising atmospheric CO_2 and changing rainfall patterns) is exacerbating these existing pressures. Well-functioning ecosystems provide natural solutions that build resilience and help society adapt to the adverse impacts of climate change. This includes, for example, buffering communities from extreme weather events such as floods and droughts, reducing erosion and trapping sediment, increasing natural resources for diversifying local livelihoods, providing food and fibre, and providing habitats for animals and plants which provide safety nets for communities during times of hardship. Sustainably managed and/or restored ecosystems help in adapting to climate change at local or landscape level.
	Objectives
12	Manage Loss of High Priority Biomes
14	Manage Increased impacts on environment due to land-use change
15	Manage Loss of Priority Wetlands and River ecosystems

6.1.2 Responses

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
12	**Manage Loss of High Priority Biomes**	Implement the guidelines of the Conservation SA resource handbook and the DEA's 'Lets respond' Toolkit				25%	50%	75%	100%
		Initiate awareness on programs on implementation of guidelines of the Conservation SA resource handbook and the DEA's "Let's respond" Toolkit by September 2018.				25%	50%	75%	100%
		Initiate an afforestation project in Ntabankulu and Bizana by June 2019.				25%	50%	75%	100%
14	**Manage Increased impacts on environment due to land-use change**	Enhance a programme of establishing nature reserves in the catchment areas by ECPTA.				25%	50%	75%	100%
		Promote EbA activities that maintain the biodiversity tourists come to see at all local municipalities.				25%	50%	75%	100%
		Upscale natural resources management programmes, including land user incentives.				25%	50%	75%	100%
		Avoid deforestation.				25%	50%	75%	100%
		Implement soil conservation.				25%	50%	75%	100%
		Implement conservation tillage.				25%	50%	75%	100%

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
		Zoning and land use planning to avoid ecological infrastructure and other important landscapes.				25%	50%	75%	100%
15	**Manage Loss of Priority Wetlands and River ecosystems**	Upscale natural resource management programmes, including land user incentives.				25%	50%	75%	100%
		Mainstream conservation planning into decision making.				25%	50%	75%	100%
		Adopt a local wetland protection by law that require vegetated buffers around all wetlands				25%	50%	75%	100%
		Control invasive wetland plants				25%	50%	75%	100%
		Encourage infrastructure and planning designs that minimize the number of wetland crossings				25%	50%	75%	100%
		Establish volunteer wetland monitoring and adoption programs				25%	50%	75%	100%
		Identify priority wetlands and River ecosystems to be conserved				25%	50%	75%	100%
		Restrict discharges of untreated wastewater and stormwater into natural wetlands				25%	50%	75%	100%

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
		Maintain natural vegetation buffers along river systems to support water yield and flood attenuation.				25%	50%	75%	100%

6.2 Coastal and Marine

6.2.1 Introduction

	Project Name
	Coastal and Marine Sector Adaptation to Climate Change
	Project Custodian/Driver
	Overview of Key Issues
	Climate change will affect the Coastal and Marine Environment, having various impacts on productivity and diversity of South Africa's coastal, marine and estuarine ecosystems. A changing climate is likely to result in changes in species availability and distribution impacting largely on fisheries. This could result in significant adverse impacts on subsistence fishing markets, community livelihoods as well as commercial industries. Changes in sea surface temperature, rising sea levels and increasing storm frequency will have adverse effects on coastal communities and infrastructure. To develop appropriate adaptation responses a more nuanced understanding of the challenges and options for the Coastal and Marine Sector is required, building on the insights of the existing coastal and marine plans. This understanding needs to consider the importance of associated ecological infrastructure in sustaining local economies and livelihoods as well and building resilient communities.
	Objectives
16	Manage impacts on Marine and Benthic Ecosystems

6.2.2 Responses

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
16	**Manage impacts on Marine and Benthic Ecosystems**	Commission research and improve understanding of climate change impacts on marine and benthic ecosystems.				25%	50%	75%	100%
		Develop a coastal management policy that will enable the management of the existing marine and benthic ecosystems in the face of the changing climate.				25%	50%	75%	100%
		Facilitate cooperation between the municipality and the relevant research institutions to jointly manage climate change impacts and provide environmental feedback to coastal communities.				25%	50%	75%	100%
		Identify and prioritise the conservation of marine and benthic Ecosystems that are rich in biodiversity.				25%	50%	75%	100%
		Implement continuous monitoring initiatives and management systems for marine and benthic Ecosystems.				25%	50%	75%	100%

6.3 Human Health

6.3.1 Introduction

	Project Name
	Human Health Sector Adaptation to Climate Change
	Project Custodian/Driver
	Overview of Key Issues
	South Africa faces complex and pressing public health challenges exacerbated by adverse socio-economic conditions including dense informal settlements which constrain effective service delivery. These health challenges include a disease complex with the highest global prevalence of Human Immunodeficiency Virus (HIV) and tuberculosis (TB), complicated by water-borne and chronic respiratory disease. Under-nutrition and socio-economic stress are important contributors to poor human resilience and contribute to conditions that facilitate the emergence and propagation of disease. Malnutrition and disease interact strongly, and there is a key relationship between environmental quality, food security, and the disease burden of communities. Adaptation to the potential effects of climate change on human health is viewed in this context. However, significant knowledge and information gaps are preventing well supported quantitative projections of human health impacts in South Africa.
	Objectives
21	Manage health impacts from increased storm events.
25	Manage increased malnutrition and hunger as a result of food insecurity.
27	Manage the increasing occupational health problems.

6.3.2 Responses

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
21	**Manage health impacts from increased storm events.**	Incorporate climate change issues into disaster plan with strong community awareness programmes and response units in Ntabankulu and Umzimvubu local Municipalities by the end of 2019. This is to be done by the Disaster Management Unit.				25%	50%	75%	100%
25	**Manage increased malnutrition and hunger as a result of food insecurity.**	Develop and implement a crop production change awareness programme by social needs cluster (Social development, health and agriculture departments) by 2018 in Umzimvubu and Ntabankulu Local Municipalities.				25%	50%	75%	100%
		Develop research unit within the District Municipality by June 2019.				25%	50%	75%	100%
27	**Manage the increasing occupational health problems.**	Educate communities and outdoor workers from all sectors on the risks of heat stress.				25%	50%	75%	100%
		Develop new work practices to accommodate temperature extremes /				25%	50%	75%	100%

6.4 Disaster Management, Infrastructure and Human Settlements

6.4.1 Introduction

	Project Name
	Human Settlements, Infrastructure and Disaster Management Sector Adaptation to Climate Change
	Project Custodian/Driver
	Overview of Key Issues
	South Africa is a diverse country, not just in terms of populations and biodiversity, but also in terms of its human settlements. These settlements face severe challenges, even before climate change is taken into account. The implications of the compounding impacts of climate change will be profound, and human settlements therefore represent a crucial part of national adaptation strategies. The overarching strategic framework for the development of human settlements is described in the National Development Plan (NDP) and, more specifically in relation to the implications for climate change, in the National Climate Change Response White Paper (NCCRWP). However, to develop appropriate adaptation responses a more nuanced understanding of the challenges and options for human settlements is required, building on the insights of the NCCRWP. This understanding needs to take into account the unusually diverse urban forms of human settlement in the South African context, and the importance of ecological infrastructure in supporting service delivery and building resilient communities.
	Objectives
29	Manage potential increased impacts on strategic infrastructure.
30	Manage increased impacts on traditional and informal dwellings
31	Manage potential increased isolation of rural communities.
32	Manage potential increase migration to urban and peri-urban areas.
33	Manage potential increased risk of wildfires

6.4.2 Responses

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
29	**Manage potential increased impacts on strategic infrastructure.**	Develop a road maintenance plan for each local municipality by 2018 with assistance from Department of Transport, Road and Public Works.				25%	50%	75%	100%
		Safe bridges for water crossings.				25%	50%	75%	100%
		Identify critical infrastructure at risk from climate change.				25%	50%	75%	100%
		Implementation of road maintenance plan.				25%	50%	75%	100%
		Facilitate the implementation of maintenance plans by through different departments such as Roads and Public Works, SANRAL, local municipalities, Water Affairs, and Department of Human Settlement by March 2018.				25%	50%	75%	100%
		Consider climate change impacts on surface water flows in the design specifications of any new dams, stormwater systems, culverts and bridges by ensuring that all the current projects have climate change responses.				25%	50%	75%	100%
		Consider ecological infrastructure in infrastructure planning by monitoring construction of new dams.				25%	50%	75%	100%
30	**Manage increased impacts on traditional and informal dwellings**	Commission a reliable early warning system (linked to radio stations, community leaders and social media) to alert communities and industries on the possible occurrences of storm events.				25%	50%	75%	100%

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
		Conduct a climate change risk assessment on informal dwellings.				25%	50%	75%	100%
		Conduct regular assessments of informal dwellings in order to identify priority areas for interventions to reduce climate change risk.				25%	50%	75%	100%
		Implement informal settlement upgrades.				25%	50%	75%	100%
		Update community emergency plans that will assist with responding to climate change related impacts/risks.				25%	50%	75%	100%
31	**Manage potential increased isolation of rural communities.**	Mobilise tourism as part of a livelihoods diversification strategy for agricultural communities by encouraging maintenance in roads that lead to tourism sites. To be done by April 2018.				25%	50%	75%	100%
32	**Manage potential increase migration to urban and peri-urban areas.**	Assess drivers and dynamics of migration.				25%	50%	75%	100%
		Develop and implement rural development programs to create economic opportunities.				25%	50%	75%	100%
		Identify alternative basic service provision options for rural areas, such as water tanks, new sanitation services, etc.				25%	50%	75%	100%

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
33	**Manage potential increased risk of wildfires**	Promote behavioural change within communities that will contribute towards the building of economic nodes within rural areas and consequently reduce the need for migration.				25%	50%	75%	100%
		Plan appropriately and develop capacity for fire management in settlements by capacitating the available fire and rescue units.				25%	50%	75%	100%
		Improve fire management for sustainable grasslands by establishing fire safety bylaws and traditional leader awareness to ensure fire safety bylaws are enforced.				25%	50%	75%	100%

6.5 Water

6.5.1 Introduction

	Project Name
	Water Sector Adaptation to Climate Change
	Project Custodian/Driver
	Overview of Key Issues
	South Africa's climate is generally arid to semi-arid, with less than 9% of annual rainfall ending up in rivers, and only about 5% recharges groundwater in aquifers. In addition, rainfall and river flow are unpredictable in time and unevenly distributed in space, with only 12% of the land area generating 50% of stream flows. Decadal rainfall variability also results in extended dry and wet periods across the country. The main users of surface water resources are agricultural irrigation, domestic, industrial, mining and power generation, while plantation forestry intercepts and reduces runoff before it reaches the rivers and groundwater. Surface water resources were already over-allocated by the year 2000 in five of nineteen water management areas historically used for water planning and management purposes. The potential demand for water is expected to increase with economic growth, increased urbanisation, higher standards of living, and population growth. Because of the critical importance of water in the South African economy the country has a sophisticated water resources planning capacity, founded on a good understanding of the country's variable rainfall. This planning capacity will be a key capability for adaptation planning under ongoing and future climate change.
	Objectives
36	Manage decreased water quality in ecosystem.

6.5.2 Responses

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
36	**Manage decreased water quality in ecosystem.**	Catchment management that conserves natural resources.				25%	50%	75%	100%
		Develop investment opportunities in ecosystem goods and services.				25%	50%	75%	100%

6.6 Cross Cutting

6.6.1 Introduction

	Project Name
	Cross Cutting Adaptations to Climate Change
	Overview of Key Issues
	Climate change is a new and growing responsibility for local stakeholders in South Africa. Institutional capacity and the availability of skilled personnel and resources, including finances, is a major challenge for South African municipalities. It is therefore crucial that municipalities adopt an integrated approach to climate change that cuts across different sectors and departments. Appropriate institutional structures to guide this approach are required, and it is important that climate change is integrated into city planning documents like integrated developments plans with budget allocations so that climate change related projects come to fruition. Climate change is a relatively new field in South Africa and awareness programmes on climate change and the development of skills in the sector are required for the field to get the attention that is needed.
	Objectives
59	Coordinate climate change response in the Municipality
62	Build human capacity to respond to climate change
63	Disseminate information and build awareness on climate change

6.6.2 Responses

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
59	**Coordinate climate change response in the Municipality**	Include all sectors in early warning systems and disaster risk reduction.				25%	50%	75%	100%
		Develop enhanced EWS and disaster risk reduction approaches.				25%	50%	75%	100%
62	**Build human capacity to respond to climate change**	Build institutional capacity to be flexible in the face of changing conditions.				25%	50%	75%	100%

No	Project	Sub-Project	DAO	Activity Manager	Annual Target	Q1 Target	Q2 Target	Q3 Target	Q4 Target
63	**Disseminate information and build awareness on climate change**	Develop early warning systems, as well as risk management and decisions support tools for farmers.				25%	50%	75%	100%

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