Msunduzi Municipality

CLIMATE CHANGE ADAPTATION AND MITIGATION STRATEGY

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PREPARED BY:

MSUNDUZI MUNICIPALITY

ENVIRONMENTAL MANAGEMENT UNIT

Table of Contents

Glossary

Term	Definition
Adaptation	In the climate change context, adaptation implies an adjustment in natural or human systems in response to a changing/changed climate. Even if emissions are stabilized relatively soon, climate change and its effects will last many years and adaptation will be necessary (Singh & Bartholomew, 2014). Adaptation also refers to efforts that reduce vulnerability against current or expected impacts of climate change.
Alien invasive species	Species that are classified as such by the National Environmental Management: Biodiversity Act (10 of 2004).
Anthropogenic	Human induced impacts which (in this case refers to climate change) result in climate change effects (Singh & Bartholomew, 2014).
Biodiversity	The variability that exists within and between biotic systems and species from both terrestrial and marine sources (National Environmental Management: Biodiversity Act, 2004).
Biomass	The total sum of organic matter existing within a specified area (Wood & Kellogg, 1988).
Carbon Sequestration	The process of removing carbon from the atmosphere and depositing it into a reservoir / sink (Singh & Bartholomew, 2014).
Carbon Sink	Reservoirs or sinks can be natural or manmade ranging from forests (which naturally absorb and store CO_2) to underground storage units designed to hold CO_2 pumped from vents (IPCC AR4 WG3, 2007)
Climate Change	A change in climate over time which is in excess of natural climate variability and is caused by the modification of the atmosphere by anthropogenic activities.
Ecological Infrastructure	Naturally functioning ecosystems that deliver valuable services to

	people, such as water and climate regulation, soil formation and disaster risk reduction. It is the nature-based equivalent of built or hard infrastructure, and can be just as important for providing services and underpinning socio-economic development. Provides cost effective, long-term solutions to service delivery that can supplement built infrastructure solutions.
Ecosystem	A multifaceted system of animal, plant and micro-organism communities that interact with the non-living environment as one functional entity.
Ecosystem Goods & Services	Ecosystem services are the specific results of ecosystem processes that either directly sustain or enhance human life (as does natural protection from the sun's harmful ultraviolet rays) or maintain the quality of ecosystem goods (as water purification maintains the quality of streamflow) (Brown *et al.,* 2007).
Environmental Management Programme (EMPr)	An Environmental Management Program for developments, which should address these key aspects, amongst other context-specific phases: ➢ Mitigation measures for environmental impact ➢ Responsibilities of stakeholders ➢ Site establishment and housekeeping plans for construction camps ➢ Landscaping and rehabilitation of the site ➢ Follow up maintenance and alien plant removal
Environmental Management Inspector (EMI)	A person authorised in terms of the National Environmental Management Act to enforce the provisions of NEMA
Eutrophication	A phenomenon which involves the increase of the nutrient load of a watercourse, which further results in the excessive growth of flora and the consequent deterioration of the watercourse.
Greenhouse Effect	The formation of an insulating layer in the atmosphere by Greenhouse Gases (see below) that reduces the amount of heat that is able to escape back into space and therefore makes the earth warmer (Department of Environmental Affairs, 2011).
Greenhouse Gases (GHGs)	Atmospheric gases that create a greenhouse effect by increasing

	the amount of heat retained by the Earth's atmosphere, thus contributing to an increase in global temperatures (Singh & Bartholomew, 2014).
Greening	The planting of non-invasive trees or other indigenous vegetation which, in the context of this strategy, will serve to sequestrate carbon from the atmosphere.
Integrated Development Plan (IDP)	The Msunduzi Municipality Integrated Development Plan
Mitigation	Climate change mitigation generally involves reductions in human emissions of greenhouse gases. Mitigation may also be achieved by increasing the capacity of carbon sinks. Climate change mitigation can be referred to as a human intervention which can reduce sources or enhance the sinks of GHG's (IPCC, 2013)
Offset	According to BBOP (nd): 2015, refers to "measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve no net loss. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risks". A carbon offset is a reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for or to 'counterbalance' an emission made elsewhere (Goodward & Kelly, 2010)
Polluter Pays Principle (In Terms Of Section 2 (4) Of NEMA "Polluter Pays Principle")	According to the White Paper on Environmental Management Policy in South Africa, the cost of reparation of a damaged environment and any health impacts that an activity may have had, as well as further preventative measures, is to be borne by the parties who caused that damage. (Department of Environment Affairs and Tourism, 1997).
Renewable Energy	Energy that is derived from renewable sources (such as wind energy or solar energy) rather than non-renewable sources (such as coal), which in the context of this strategy, helps to mitigate climate change by reducing the amount of fossil fuels that are burned and consequently reducing the amount of Greenhouse Gases released

	into the atmosphere.
Riparian	According to the National Water Act: includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those adjacent areas.
Species Diversity	Species diversity is an element of Biodiversity that integrates the actual number of species within an ecological community with the evenness of the occurrence of these species (McGinley, 2014).
Urban heat island effect	The increase in air temperatures within an urban area caused by development and anthropogenic activities (Magee *et al*., 1999). For example, the hard-surfacing of a vast area can cause an urban heat island.
Waste Hierarchy	A tool that determines desirability of measures for waste management during the life-cycle of waste. The Waste Hierarchy (Appendix 3) comes in the form of an inverted triangle with the most desirable waste management strategy at the top (National Waste Management Strategy, 2011).

Abbreviations

AQMP	Air Quality Management Plan
DAFF	Department of Agriculture, Forestry and Fisheries
DEDTEA	Department Of Economic Development, Tourism And Environmental Affairs
EMF	Environmental Management Framework
EMI	Environmental Management Inspector
EMPr	Environmental Management Programme
EPWP	Extended Public Works Programme
GHG	Greenhouse Gas
IDP	Integrated Development Plan
NEMA	National Environmental Management Act
SEA	Strategic Environmental Assessment

SEMP	Strategic Environmental Management Plan

1. Introduction

1.1. Background

Climate change refers to a change in climatic conditions over a period of time, usually characterised by:

- Fluctuating temperatures (warmer but drier climate in some regions and warmer but wetter climate in some regions)
- Increased rainfall/Decreased rainfall
- Increase in extreme weather events
- Higher incidence of flooding/drought

These effects of climate change are caused by the release of excessive amounts of Greenhouse Gases (GHGs) into the atmosphere by industries and domestic residents alike. The effects will be worst felt by the poorest communities that are the most reliant on ecosystem services. GHGs come in the form of Carbon Dioxide (CO_2), ozone (O_3), water vapour (H_2O), methane (CH_4) and many others. Examples of activities which could cause the release of these gases are:

- The burning of fossil fuels for energy (e.g. Coal)
- Industrial activities
- The domestic burning of wood for fuel
- An increased generation of waste

These activities and their effects on climate could result in the following detrimental consequences, to name but a few:

- An increase in disease outbreaks
- Even higher energy usage (To cope with higher temperatures e.g. Air conditioners)
- Extreme weather events which damage infrastructure

- Higher flood and drought occurrences
- Negative impacts on food security
- Water quality and quantity issues
- Negative impacts on biodiversity

The World Bank's paper "Turn Down the Heat: Why a 4°C Warmer World Must be Avoided" predicts that there will be increased disruptions from extreme weather events, with more frequent storms and flooding, with more severe droughts and heat waves (The Potsdam Institute for Climate Impact Research and Climate Analytics, 2012). This will result in large scale disturbances of agricultural land and may lead to significant losses in biodiversity. Climate projections suggested that the uMgungundlovu District Municipality (UMDM), in KwaZulu-Natal, will experience a warmer future with uncertain changes in mean annual rainfall, with substantial increases of flash flood and storm events due to an increase in intense short duration rainfall (Adaption Fund, 2014, Page 20). Other issues of concern that are highlighted by the Adaption Fund is that floods, severe storms and wild fires are already being experienced within Kwa-Zulu Natal and projections indicated that these risks may worsen due to climate related impacts (Adaption Fund, 2014, Page 20).

These impacts on human health, as well as the health of the natural environment are worst felt at a local level where impacts are direct, highlighting the need for the Msunduzi Local Municipality to plan for and implement measures to protect its residents, as well as its infrastructure and environment by adhering to and enforcing its Climate Change Policy (2014) and implementing this Climate Change Adaptation and Mitigation Strategy.

1.2. Climate Change Impacts at each scale

The expected impacts of Climate Change are different for each continent on a global scale. Africa is affected mostly with regard to water issues such as drought, flooding and issues related to watercourses, as well as snow, ice and permafrost. Its biological systems are also substantially affected with the most emphasis on marine ecosystems, followed by terrestrial ecosystems. It also seems that there is a low climate risk associated with livelihoods and food production that is expected to increase substantially in the long-term (IPCC, 2015).

South Africa, as a developing country, is especially vulnerable to climate-related impacts due to its socio-economic and environmental condition. It is however, compared to most of Africa, a significant contributor to GHG emissions. This is mostly as a result of the country's reliance on fossil fuels for energy generation. One of the major climate-related impacts that South Africa will face is the increased scarcity of water resources. As a country that is naturally deficient in water, availability of the resource is set to decrease substantially with climate change (DEA, 2011).

Kwa-Zulu Natal (KZN) is a province with a large rural population. This means that there are a substantial amount of people reliant on agriculture-related livelihoods and natural water resources for survival. Climate change will therefore affect these communities more than the smaller urban populations. The Kwa-Zulu Natal Provincial Growth & Development Strategy (PGDS) has expressed key areas of concern for KZN related to climate change. These areas include water scarcity, extreme weather events, and biodiversity & coastal loss due to land degradation & rising sea-levels (Kwa-Zulu Natal Provincial Planning Commission, 2011).

There is a lack of information within the Msunduzi Municipality regarding the emissions of greenhouse gases and the sectors involved, as well as the projected impacts of climate change.

1.3. Development of a Climate Change Adaptation & Mitigation Strategy

The Climate Change Adaptation and Mitigation strategy is derived from the Msunduzi Municipality's Climate Change Policy (approved by Council in March 2015) and focuses on both ***adaptation*** and ***mitigation*** strategies. It is also based on the following international, national, provincial and local policies:

a) International Panel on Climate Change – Fifth Assessment Report (2015)
b) National Climate Response White Paper (2011)
c) KZN Provincial Growth & Development Strategy (2011)
d) uMgungundlovu Vulnerability Assessment
e) Msunduzi Strategic Environmental Assessment (2010)
f) Msunduzi Strategic Environmental Management Plan (2010)
g) Msunduzi Environmental Management Framework (2010).

This strategy is derived primarily from the SEMP (refer to Appendix 4) and has been drafted by the Environmental Management Unit of the Msunduzi Municipality. The First Draft will be circulated to internal and external stakeholders and thereafter revised and re-drafted.

The Final Draft will then be advertised for public comment and once again revised and re-drafted. This draft will then be put through all relevant Council structures for approval and formal adoption.

1.4. Adaptation and Mitigation Explained

The **adaptation** responses that are discussed in detail in this document focus on ensuring that the City of Msunduzi and its communities are able to identify and implement strategies and plans which are implementable and realistic when faced with threats associated with direct and indirect impacts of a changing climate.

On the other hand, the **mitigation** responses contained in this document are aimed at reducing the severity of, or avoiding irreversible climate change impacts altogether, by ensuring that certain strategies are implemented and / or are evaluated.

Focus on these two strategies, defined in the Msunduzi Municipality Climate Change Policy and SEMP (Appendix 4), also support and contribute to the realisation of the Msunduzi Municipality's 2030 vision and strategic goals (as set out in the 2013-2017 IDP) which includes:

- A well-serviced city
- An accessible, connected city
- A clean, green city
- A friendly, safe city
- An economically prosperous city
- A financially viable and well governed city

2. Possible Climate Change Impacts on Msunduzi

In order to formulate mitigation and adaptation strategies, we first need to define future impacts of climate change on the City. The following table includes these possible impacts, and the departments/business units that will be impacted.

Climate Variables	Cause	Departments Affected	Impacts
Increase in extreme weather events ➢ **Rain/Thunderstorms** ➢ **Wind** ➢ **Heat** ➢ **Cold** ➢ **Lightning**	Changing temperatures alter weather patterns.	Disaster Management	Flooding and other disasters
		Environmental Management	Climate change
		Roads & Drainage	Damage to infrastructure
		Housing	Damage to housing
		Water & Sanitation	Damage to infrastructure
		Environmental Health	Contamination of water sources Disease outbreaks
		Parks, Sport & Recreation	Fallen trees
Damage to infrastructure	Increase in extreme weather events.	Water & Sanitation	Damage to infrastructure
		Roads & Drainage	Damage to infrastructure
		Electricity	Damage to infrastructure
		Housing	Damage to and loss of housing
Increased temperatures	Increased Greenhouse Effect causes the atmosphere to become warmer.	Environmental Management Unit	Natural processes are affected by warmer atmospheres

		Electricity	Stresses on energy usage for cooling appliances
		Environmental Health	Disease outbreaks Heat-related emergencies
Higher incidence of flooding of the Msunduzi River	Increased precipitation and extreme weather events.	Housing	Damage to and loss of housing
		Environmental Management	
		Roads & Drainage	Damage to infrastructure
		Water & Sanitation	Damage to infrastructure Contamination of water sources
		Disaster Management	Protocols
		Electricity	Damage to infrastructure
Higher energy usage for high/low temperatures	Changing temperatures cause the need for cooling/heating facilities dependent on energy.	Building Control & Signage	Green Building Design
		Electricity	Higher demand on energy supply
Reduced water quality	Flooding contributes to the contamination of water. Less water causes higher concentrations of pollutants and pathogens.	Water & Sanitation	Pollution of natural water sources
		Environmental Management	Pollution of natural water sources
		Environmental Health	Pollution of natural water sources adversely affects health of residents
Increase in disease outbreaks	Warmer temperatures enabling	Disaster Management	Protocols

	enteric and water-borne pathogens to survive.	Parks, Sport & Recreation	Conservation areas affected by disease outbreaks in fauna
Increased proliferation of alien vegetation	Changing temperatures and weather conditions allow certain species to flourish where they would not normally.	Environmental Health	Certain alien plants (e.g. Famine Weed) have adverse health impacts on residents
		Water & Sanitation	Alien vegetation uses more water than indigenous vegetation therefore reducing natural water supplies
		Environmental Management	Alien plants lead to a decline in indigenous vegetation
		Parks, Sport & Recreation	Alien plant clearing programmes Alien plants invade conservation areas
Threatened biodiversity	Increased proliferation of alien invasive species. Land degradation.	Environmental Management	Alien plants lead to a decline in indigenous vegetation
		Parks, Sport & Recreation	Alien plant clearing programmes Alien plants invade conservation areas
Increased likelihood of drought/Reduced precipitation	Changing temperatures alter weather patterns.	Department of Agriculture	Drought causes reduced crop yields and therefore decreased food security

		Water & Sanitation	Decreased water security
		Environmental Management	Less water in natural water sources
		All other business units	Ability to perform functions is reliant on adequate water supply

3. Goals for the Msunduzi Municipality relating to Climate Change

The following goals have been identified in the Msunduzi Municipality's Strategic Environmental Management Plan (SEMP) and have both ***adaptation*** and ***mitigation*** components. They are based on key areas likely to be unpacked by Climate Change in the Msunduzi Municipal area. The key areas are: Biodiversity, Water, Health, Waste, Agriculture & Food Security, Energy Usage, Infrastructure and Climate Change Awareness & Research.

Goal		**Key Theme**
Goal 1	Biodiversity resources are protected against degradation by Climate Change and the consequent goods and services provided to Msunduzi by ecosystems are preserved for mitigation purposes	Biodiversity
Goal 2	Msunduzi's natural and potable water quality is kept at a good standard and water quantity is preserved for possible drought instances	Water
Goal 3	Msunduzi implements strategies ensuring that communities are made aware of possible diseases and aware of treatment methods, thereby ensuring that the city becomes resilient against disease outbreaks arising from Climate Change impacts	Health
Goal 4	Air pollution and greenhouse gas emissions are reduced via energy efficiency control and monitoring programmes	Energy
Goal 5	Reduce, re-use and recycle ideologies are at the forefront of waste management and community efforts	Waste Management
Goal 6	Msunduzi and its infrastructure is made resilient against disasters such as flooding and extreme precipitation events	Infrastructure

Goal 7	Agriculture and food security are preserved in the face of a changing climate	Agriculture & Food Security
Goal 8	Msunduzi has a dedicated research programme focusing on relevant and continuously updated information that is made available to all sectors of society	Climate Change Awareness & Research
Goal 9	The Msunduzi Municipality prioritises Climate Change and integrates it into its decision-making, plans, processes and policies	Governance

Goal Background: Biodiversity

Biodiversity and natural ecosystems provide us with valuable goods and services which help to buffer the city against harmful impacts of climate change. Carbon sequestration is one of the services that our ecological infrastructure provides, and by protecting and raising awareness of it, we are allowing natural systems to take in carbon dioxide and consequently mitigate climate change. Below are adaptation and mitigation strategies for the preservation of biodiversity:

SEA Sustainability Criteria: **"Areas of high biological diversity, are utilised and managed to promote the ecosystem goods and services they supply"** **"Alien invasive species are controlled and managed to prevent further infestation"** (Msunduzi Strategic Environmental Assessment, 2010).					
No.	**Objective**	**Benefit**	**Adaptation/Mitigation**	**Implementing Agent**	**Timeframes**
1.1.	**Increase greening programmes both in and around the city** ➢ In accordance with Msunduzi's Tree Management Policy ➢ The use of indigenous and non-invasive trees is essential (Appendix 1) ➢ Maintenance of the trees	Reduces amount of Carbon Dioxide in the atmosphere (carbon sequestration) and promotes biodiversity. Also decreases urban heat island effect and helps with	Mitigation/Adaptation	Manager: Parks, Sport & Recreation Manager: Environmental Management	On-going

	and plants after they have been planted ➢ Identification of specific areas in need of greening (SEMP, 2010) ➢ Careful review of landscape plans submitted by developers in order to encourage indigenous species use (SEMP, 2010)	stormwater infiltration.			
1.2.	**Indigenous Environmental Landscaping is included in EMPrs of all new developments** ➢ Environmental Management by-laws developed and implemented to include this clause	Protection and promotion of biodiversity and indigenous species. Also decreases urban heat island effect and helps with stormwater infiltration.	Mitigation/Adaptation	Manager: Environmental Management	On-going

1.3.	**Areas of environmental significance and high species diversity are identified, protected and zoned accordingly** ➢ Environmental Management by-laws developed and implemented to include this clause ➢ Zoning to reflect conservation and environmentally sensitive areas as well as areas that act as important ecological corridors to allow for the linking of important biodiversity areas	Protection and promotion of biodiversity and indigenous species. The protection of these areas allows for healthy ecosystems to provide free services which will increase cost savings, mitigate damage to infrastructure, and improves water quality and quantity amongst other benefits.	Mitigation/Adaptation	Manager: Environmental Management Manager: Town Planning Manager: Parks, Sport & Recreation	On-going

	➢ All environmentally significant areas to be reflected in the Msunduzi Municipality Ecosystem Services Plan (currently in progress), as well as various planning tools such as Local Area Plans ➢ Landowners are engaged in this process in order to facilitate protection of these areas				
1.4.	**All development projects that negatively affect biodiversity are to incorporate offset areas for biodiversity conservation** ➢ Environmental Management by-laws developed and	Protection and promotion of biodiversity and indigenous species, as well as ecosystem functioning which will provide free ecosystem	Adaptation	Manager: Environmental Management	On-going

	implemented to include this clause ➢ Develop a municipal Offset Policy to include specifications for offsets	services for the development itself as well as surrounding communities.			
1.5.	**Environmental Education programmes for communities and Municipal Staff are implemented** ➢ Area based environmental education campaigns to be conducted which are tailored to different contexts and issues in different communities ➢ Education programmes for municipal staff which consist of climate change	Communities and staff become aware of anthropogenic impacts on biodiversity	Mitigation	Manager: Environmental Management Manager: Area Based Management Manager: Human Resource Development DEDTEA	On-going

	issues and how to tackle them in a municipal setting ➢ The education programme must include the understanding of and appreciation for biodiversity and ecological infrastructure.				
1.6.	**Remove alien invasive plants (Appendix 2) from municipal and privately owned land** ➢ According to the National Environmental Management: Biodiversity Act (Act no. 10 of 2004): "A person who is the owner of land on which a listed invasive species occurs must-	Indigenous plants have a chance to flourish and biodiversity is protected	Adaptation	Manager: Parks, Sport & Recreation Manager: Environmental Management DEDTEA	On-going 2-phase alien clearing project: By 31 December 2016

	(a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land; (b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and (c) Take all the required steps to prevent or minimise harm to biodiversity." This means that landowners must be educated about their responsibilities regarding this Act and appointed EMIs must then enforce the provisions of the Act.				

	➢ A 2-phase alien clearing project must be initiated and carried out on all municipal land as indicated in NEMBA: "All organs of state in all spheres of government must prepare an invasive species monitoring, control and eradication plan for land under their control, as part of their environmental plans in accordance with section 11 of the National Environmental Management Act." (NEMBA, 2004). 1. Mapping of alien plants and land in need of clearing				

	2. Development of a plan for clearing, including human resource provisions.				
1.7.	**Adopt measures for the proper management of areas with high grazing potential to avoid overgrazing** ➢ Environmental Management by-laws developed and implemented to include this clause ➢ Formulate a structure of management systems which encompass and adapt to grassland and livestock specifics (SANBI, 2014).	Sustaining natural resources and therefore promoting biodiversity	Adaptation	Manager: Environmental Management Manager: Town Planning Department of Agriculture	By 31 December 2018

	➢ Adopt the Action Plan for Land Rehabilitation included in the Msunduzi SEMP (Appendix 5).				

Goal 2

Goal Background: Water

Climate change poses threats to the quality of water resources due to the fact that increased flooding instances and runoff into watercourses bring contaminants into the water, as well as increased nutrients from waste and vegetation washed into the rivers from flood events, which will cause eutrophication. The following strategies will help reduce the effect of climate change on our water resources:

SEA Sustainability Criteria:

"Aquatic ecosystems are in a healthy state to ensure that the resource remains fit for all other uses and minimum water quality targets are maintained"

"Wetland areas, streams and rivers are preserved, rehabilitated and managed to maintain ecological function"

"Flood prone areas are managed to promote ecosystem goods and services and minimise flood risks and impacts to flood regimes"

"A basic level of water supply is provided to all residents without affecting the integrity of natural ecosystems" (Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
2.1.	**Improve and impose more stringent conditions on stormwater retention and Stormwater Management Plans in the city** ➢ Stormwater Management Policy to	Ensure that increased heavy precipitation does not damage infrastructure	Adaptation	Manager: Roads & Drainage Manager: Environmental Management	On-going Stormwater Management Policy: By 31 December 201en6

	be developed in order to impose controls on stormwater management ➢ Stormwater Management by-laws to be developed ➢ Increase human resources in this functional area for enforcement of these policies and laws ➢ Storm water systems to be based on best practice guidelines such as Sustainable Urban Drainage Systems (SUDS). Stormwater systems must be incorporated into the landscape design plan				

	with indigenous species planted in drainage channels and attenuation ponds.				
2.2.	**Predict and develop an estimate of the potential future demand for potable water in Msunduzi** ➢ A study must be conducted which includes current water demands, climate change scenarios and ultimately, future water demands	Allows measures to be put in place now which will provide for the future demand on water	Adaptation	Manager: Roads & Drainage Manager: Water & Sanitation Manager: Environmental Management	By 31 December 2017
2.3.	**The upgrading of infrastructure, planning and zoning must incorporate extreme precipitation events**	Ensures that infrastructure is resilient to extreme weather	Adaptation	Manager: Roads & Drainage Manager: Town Planning Manager: Water & Sanitation	On-going

	into their forecasting and development ➢ To be addressed in the Stormwater Management Policy ➢ Town Planning policies must work to include the potential for extreme weather events in forward planning	events			
2.4.	**Improve and continuously monitor the water quality of the Msunduzi Catchment** ➢ Identify gaps in and expand existing water quality monitoring and implement regular borehole testing	"Aquatic ecosystems are in a healthy state to ensure that the resource remains fit for all other uses and minimum water quality targets are maintained"	Adaptation & Mitigation	Manager: Water & Sanitation Manager: Environmental Health Manager: Human Resources Manager: Roads & Drainage	On-going

	➢ Provide boreholes in areas where continuously low water quality is detected ➢ Implement response protocols for surcharging sewers that are discharging untreated effluent into the catchment ➢ Enforce the Polluter Pays Principle on industries who discharge industrial effluent into the catchment by developing EMI capacity within Msunduzi and a Trade Effluent Policy	(Msunduzi Strategic Environmental Assessment, 2010).			
2.5.	**Assess, identify and map areas that are prone to**	Reduces vulnerability of	Adaptation	Manager: Water & Sanitation Manager: Environmental	By 31 December 2017

	flooding ➢ Adjust zoning to incorporate the 1:100 year and 1:50 year flood lines ➢ Allow no developments on floodplains ➢ Buffer zone Precautionary Principle will apply until the aforementioned flood plains are determined ➢ Informal settlements occurring on flood plains must be assessed and if possible, relocated	residents to flooding as well as degradation of the environment		Management Manager: Human Settlements Manager: Town Planning Manager: Informal Settlements	
2.6.	**Increase the buffer area between watercourses and**	Allows water quality to be improved and	Adaptation	Manager: Environmental Management Manager: Roads & Drainage	On-going

	developments ➢ Approve the Msunduzi Spatial Development Framework and ensure compliance ➢ Enforce the Msunduzi Environmental Management Framework ➢ Enforce the Msunduzi Environmental Management by-laws which include a 40m buffer zone	ecosystems to provide goods and services			
2.7.	**Implement a water use efficiency programme for all water users** ➢ Offer rates rebates for	The sustainable use of water resources lessens the likelihood of current and future water	Adaptation	Manager: Disaster Management Manager: Water & Sanitation	On-going

	water users who implement this programme and consequently save water ➢ Implement rainwater harvesting ➢ Cluster water uses in order to allow for the efficient reuse of water ➢ Developments must install water efficient toilets, urinals, taps and appliances with flow inhibitors or low flow rates: **Washroom Taps**: 6 litres per minute aerator or a 1.7 litre per minute spray	shortages, and rainwater harvesting uses increased precipitation to supplement water shortages and reduce stormwater runoff			

	Kitchen Taps: 6 litres per minute aerator **Showerheads:** 6 - 10 litres per minute **Toilets:** 3.6 litres per flush (when low and high flush flows are combined) dual flush system **Urinals**: either waterless or a maximum of 1.9 litres per flush For residential and commercial kitchens and laundry rooms, water-efficient dishwashers and				

	washing machines should be included as part of the base building.				
2.8.	**Evaluate and update Disaster Management Plan** ➢ Update this plan every two years to include changes in weather events and anticipated disasters (This is a legislated requirement)	Allows Msunduzi to become resilient against and up to date with climate change related disasters. Water scarcity could occur due to changing climates and this would require disaster management protocols to be put in place.	Adaptation	Manager: Disaster Management	Every 5 years
2.9.	**Conserve all riparian areas and increase permeable**	Allows natural systems to	Adaptation & Mitigation	Manager: Roads & Drainage Manager: Water & Sanitation	On-going

	surfaces in urban areas ➢ New developments to have permeable surfaces which is to be reflected in the Town Planning Scheme zone controls as well as the Stormwater Management Policy and By-Laws ➢ Projects to be implemented focusing on the protection and rehabilitation of riparian areas	function productively and prevents excessive runoff from hardened surfaces		Manager: Environmental Management Manager: Town Planning	

Goal 3

Goal Background: Health

Disease outbreaks are worsened by climate change due to the fact that changing temperatures allow for vector-borne diseases to spread to areas in which they would not normally occur. Also, flooding and increased precipitation would cause water-borne diseases to be more prevalent. Other health impacts such as heat stress, dehydration, malnutrition and respiratory diseases will also be felt. This has severe implications for the health of the residents of Msunduzi, and would require the municipality to be aware of and well prepared for the change. In order to do this, the following strategies need to be in place:

SEA Sustainability Criteria:

"Minimum air quality standards for the protection of human health and wellbeing and natural systems are maintained"

"A carbon neutral state is achieved through appropriate greenhouse gas emission reductions, the use of alternative technology and carbon off-setting schemes" (Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
3.1.	**Implement education programmes on dealing with climate change related health issues** ➢ Municipal staff at clinics and hospitals must be educated on these	Residents and staff become resilient against health impacts	Adaptation	Manager: Human Resources & Development Manager: Environmental Management Manager: Area Based Management	On-going

	specific health issues ➢ Health education campaigns must target communities and hospitals with specific emphasis on climate change and related health issues			Manager: Occupational Health Manager: Environmental Management Manager: Disaster Management	
3.2.	**Develop heat wave emergency protocols for extreme temperatures** ➢ An official heat wave emergency protocol to be developed and communicated to all municipal staff and communities	The city becomes resilient against excessive and prolonged high temperatures	Adaptation	Manager: Disaster Management Manager: Area Based Management Manager: Occupational Health Manager: Environmental Management	By 31 December 2017
3.3.	**Plant more trees in and around the city**	Reduces temperatures and acts as a	Adaptation & Mitigation	Manager: Parks, Sport & Recreation Manager:	On-going

	➢ In accordance with Msunduzi's Tree Management Policy and the identification of "heat islands" within the city ➢ The use of indigenous and non-invasive trees is essential ➢ Maintenance of the trees and plants after they have been planted ➢ Green Design and landscape programmes must be included in all new developments and substantial expansions to warehouses/workshops. ➢ All new developments	carbon sink. Beautifies the city and encourages biodiversity.		Environmental Management Manager: Area Based Management	

	must comply with Msunduzi Green Building Guidelines as mentioned in Goal 4				
3.4.	**Improvement of air quality in Msunduzi through the implementation of an Air Quality Management Plan (AQMP)** ➢ Air Quality Management Plan for Msunduzi to be developed and implemented ➢ Air quality standards from SANS 1929:2005 guidelines to be complied with as set out in the Msunduzi Strategic Environmental	Improves air quality, reduces GHG emissions and protects the health of residents	Adaptation & Mitigation	Manager: Environmental Health Manager: Environmental Management	By 30 June 2018

	Assessment (2010) sustainability criteria ➢ Ensure that in accordance with the Msunduzi EMF, Tier 1, 2 or 3 Air Quality Assessments are included in the AQMP for areas with high, medium and low air quality constraints.				
3.5.	**Air quality monitoring to take place on a regular basis** ➢ Air quality monitoring network to be restored and adequately staffed ➢ Air quality monitoring schedule to be put in place	Makes the identification of problem areas and sectors possible	Adaptation & Mitigation	Manager: Environmental Health Manager: Environmental Management Umgungundlovu District Municipality	On-going

	➢ Response strategies must be developed which address air quality issues and anomalies that are found whilst performing regular air quality monitoring ➢ The Municipality should aim to be carbon neutral through the reduction of GHG emissions, carbon offsets and the substitution of current technology with more efficient technology (Msunduzi Strategic Environmental Assessment, 2010). ➢ Link to a Carbon Emissions Inventory in order to determine				

	the Carbon Footprint of Msunduzi (SEMP, 2010)				
3.6.	**Water quality testing to be done on a regular basis** ➢ Set schedules and specific stations for water quality monitoring whilst ensuring synchronisation with other organisations that perform the same testing ➢ Ensure surcharging sewers are identified and responded to as quickly as possible ➢ Enforce the Polluter	Makes the identification of problem areas and sectors possible	Adaptation	Manager: Environmental Health Unit Manager: Water & Sanitation	On-going

	Pays Principle upon industries who discharge industrial effluent into the catchment				
3.7.	**Forestation and the development of larger scale carbon sinks must be investigated and implemented** ➢ Identify land suitable for forestry purposes ➢ Investigate afforestation options either by rehabilitation of existing indigenous forests or by creation of new indigenous forests. This project must tie in with	Reduces the amount of carbon in the atmosphere and improves air quality	Mitigation	Manager: Environmental Management Manager: Real Estate & Investment Opportunities	By 31 December 2017

	the alien invasive species control plan ➢ Rehabilitate natural grassland areas to sequestrate carbon effectively ➢ Developments larger than a certain size to include rooftop gardens in their building designs				

Goal 4

Goal Background: Energy

Higher energy usage is a significant consequence of climate change. This will occur as average temperatures rise and more electricity is needed for cooling purposes, which leads to increased burning of fossil fuels. The electricity in Msunduzi is provided by Eskom, with very limited renewable energy sources currently used for generation. Other fuel sources such as biomass, liquid fuels, wood and coal are used for energy generation, and these may contribute greatly towards the pollution of the air, particularly within the Northern areas and Mkondeni. The strategies discussed below will aid in the prevention of excessive air pollution and energy usage:

SEA Sustainability Criteria:

"The use of renewable resources is promoted and the reliance on non-renewable resources is reduced"

"A carbon neutral state is achieved through appropriate greenhouse gas emission reductions, the use of alternative technology and carbon off-setting schemes"

"Clean, renewable and efficient energy sources; and, transportation options that reduce fossil fuel dependence are promoted, so as to reduce energy costs and produce low greenhouse gas emissions and other air contaminants"

"Green design principles are used to ensure environmental efficiency and minimise use of resources" (Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
4.1.	**Energy efficiency education programmes to be implemented for**	Lowers the use of energy and therefore	Adaptation & Mitigation	Manager: Electricity Manager: Area	Currently being implemented

	communities and businesses ➢ Develop an energy efficiency education campaign ➢ Involve big businesses for promotional purposes ➢ Communicate to communities	lessens the amount of fuel burned, which improves air quality		Based Management Pietermaritzburg Chamber of Business	
4.2.	**Implement rebates and financial incentives for electricity users who switch wholly or partially to renewable energy**	Reduces the use of energy from fuel and therefore lessens the amount of fuel burned, which	Adaptation & Mitigation	Manager: Electricity Manager: Building Control & Signage	By 31 December 2018

	➢ Develop a rebate system and reflect this rebate on monthly electricity bills of users to encourage them to save more energy and implement energy saving techniques ➢ Develop financial or other incentives to support and encourage renewable energy technology,	improves air quality			

	green infrastructure, Green Industry and Green Jobs ➢ Renewable resource use must be encouraged and non-renewable resource use must be discouraged (Msunduzi Strategic Environmental Assessment, 2010).				
4.3.	**Retrofit all municipal-owned buildings with energy saving and renewable energy**	Lowers the use of energy from fuel and therefore	Adaptation & Mitigation	Manager: Electricity Manager: Environmental	On-going

	technologies ➢ Undertake a review of energy saving technologies for municipal buildings ➢ All municipal buildings must be energy efficient and no unnecessary use of energy must be permitted ➢ Undertake a phased programme to retrofit municipal buildings with energy saving	lessens the amount of fuel burned, which improves air quality		Management Manager: Building Control & Signage	

	technology ➢ Retrofitting must include occupancy and daylight sensors for lighting, and time switches for equipment that will turn off machinery that is not in use				
4.4.	**All new developments to incorporate green building design and renewable energy technology** ➢ Enforce this through the development of	Lowers the use of energy from fuel and therefore lessens the amount of fuel burned, which improves air quality	Adaptation & Mitigation	All business units	By 31 December 2016

	bylaws for electricity and environmental management ➢ Building regulations must be complied with in this respect ➢ Minimum standards for green building design and renewable energy must be formulated and implemented by all business units ➢ Use LED (light emitting diode) lights instead of regular				

	fluorescent lighting in order to increase energy efficiency ➢ Conduct an energy efficiency audit in order to determine energy consumption in buildings as well as possible reduction measures				
4.5.	**Develop an air quality constraints model using the existing traffic model (SEMP, 2010)** ➢ Use an	Ensures that transportation planning and other relevant departments will recognise air quality constraints	Adaptation & Mitigation	Manager: Environmental Health Manager: Transportation Planning	By 31 December 2018

	emissions inventory and traffic model to map sensitive areas in terms of air quality ➢ Circulate this to all departments that may be affected and ensure that it informs all future planning	and put mitigation measures in place to reduce their contribution to GHG emissions			
4.6.	**Install Building Management Systems (BMS) into all new major buildings** ➢ Full	Ensures that all building systems are operating at peak efficiency which in turn	Mitigation	All business units	On-going

	commissioning to be done at practical completion ➢ Re-commissioning to be done after one year of occupation ➢ Undertake building tuning in order to ensure proper functionality of all building systems, with a 12 month troubleshooting and adjustment	saves energy and water			

	period				
4.7.	**Ensure compliance with all SANS Regulations and National Building Regulations** ➢ Where glass areas are larger than 15% of the net floor area, shading devices or performance glazing is required (SANS 10400-XA) ➢ A minimum thermal	Lowers the use of energy from fuel and therefore lessens the amount of fuel burned, which improves air quality	Mitigation	Manager: Electricity Manager: Building Control & Signage Manager: Environmental Management Manager: Town Planning	On-going

	resistance of R-value 2.7 as prescribed by SANS 10400-XA for the Msunduzi Local Municipality in climatic zone 5 (sub-tropical coastal) which translates into 100mm of insulation required by SANS 10400-XA Deemed-to-Satisfy criteria ➢ Exposed hot				

	water pipes with a diameter of less than or equal to 80mm should be insulated with a minimum R-value of 1.00. Exposed hot water pipes with a diameter of greater than 80mm should be insulated with a minimum R-value of 1.50 ➢ More than half of the annual				

	hot water must be provided by means other than electric resistance heating (geyser) or fossil fuels. ➢ Passive design in buildings must be encouraged ➢ SANS 10400-XA stipulates that ceiling voids should be designed so as to minimise air				

	infiltration. Accordingly, wall plate and roof junctions shall be sealed. The joints in sheeted roofs shall be sealed. ➢ Develop Green Building Guidelines for Msunduzi				

Green Building Guidelines for Steve Tshwete and Kwa-Dukuza Local Municipalities:

Research\KDM_Green_Building_Guidelines.pdf

Research\STLM_Green_Building_Guidelines.pdf

Goal 5

Goal Background: Waste Management

Waste generation contributes somewhat to exacerbating climate change due to the fact that methane, a gaseous by-product of decomposition of waste, is a greenhouse gas. The New England Road Landfill Site, being a large landfill, produces substantial amounts of methane. Strategies focused on implementing the waste hierarchy (Appendix 3) are beneficial in this instance. In addition to this, using recycled waste to develop new products is in most cases more energy efficient than using new products. The strategies outlined below will focus efforts on waste management:

SEA Sustainability Criteria:

"All residents have an income; access to appropriate, secure and affordable housing; and, have access to public services to meet basic needs and live with dignity"

"The waste stream to landfill has been reduced to a minimum, with recovery, re-use and recycling of materials undertaken as standard practice"

(Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
5.1.	**Expand recycling programmes to include all producers of waste** ➢ Extend kerbside recycling to all wards of Msunduzi ➢ Encourage	Waste to landfill will be reduced which will significantly reduce GHG emissions and serve to mitigate climate change	Mitigation	Manager: Waste Management Manager: Area Based Management	By June 2016

	businesses and industries to recycle by explaining the revenue that recycling could bring ➢ Provide incentives for "Green Jobs" and "Green Businesses"				
5.2.	**Develop Materials Recovery Facilities** ➢ Build and promote materials recovery facilities as outlined in the Integrated Waste Management Plan for Msunduzi	Waste to landfill will be reduced which will significantly reduce GHG emissions and serve to mitigate climate change	Mitigation	Manager: Waste Management Manager: Landfill	By 31 December 2018
5.3.	**Develop composting facilities at Garden Refuse**	Waste to landfill will be reduced which will	Mitigation	Manager: Waste Management Manager: Parks, Sport	By 31 December 2018

	Sites and other applicable locations ➢ Install wood chippers at garden refuse sites and set aside an area for a compost heap ➢ Employ or train staff to operate the wood chippers ➢ Sell the compost that is produced to businesses and communities, or use it for municipal purposes ➢ Donate the compost to schools/old age homes/public hospitals and	significantly reduce GHG emissions and serve to mitigate climate change		& Recreation Manager: Landfill	

	encourage them to start community gardens				
5.4.	**Enforce the Polluter Pays Principle contained in NEMA via the training and designation of Environmental Management Inspectors** ➢ Waste Management must designate and train Environmental Management Inspectors to deal with the continuous issue of dumping ➢ A Municipal Court must be established which will allow	The likelihood of polluters repeating offences is lessened	Adaptation & Mitigation	Manager: Waste Management Manager: Environmental Health	By 31 December 2017

	designated municipal officials to prosecute contraventions of the City By-Laws more efficiently				
5.5.	**Enforce Msunduzi's Waste Management By-Laws** ➢ The EMIs that are appointed can enforce the Waste Management by-laws of Msunduzi ➢ Appointed Peace Officers must enforce the by-laws and issue fines for contraventions ➢ A Municipal Court must be established which will allow	The likelihood of polluters repeating offences is lessened	Adaptation & Mitigation	Manager: Waste Management Manager: Environmental Health	On-going

	these designated municipal officials to deal with specific issues on a regular basis				
5.6.	**Extend basic service delivery (refuse collection) to Vulindlela and other areas not currently being serviced** ➢ Employ co-operatives to service Wards 1-9 ➢ Extend the EPWP clean-up initiatives or a similar project to all wards of Msunduzi	Dumping and burning of waste will stop once residents' refuse is collected, improving the quality of the environment	Mitigation	Manager: Waste Management Manager: Area Based Management	By 30 June 2016
5.7.	**Explore landfill gas-to-**	Emissions from	Mitigation	Manager: Landfill	Currently being implemented

	energy initiatives ➢ Explore case studies of other South African municipalities who have implemented this project or a similar initiative ➢ Implement a gas-to-energy project at the New England Road Landfill Site	the landfill are captured, which decreases GHGs emitted into the atmosphere. In addition, energy produced from this gas reduces the need for fossil fuel burning for energy		Manager: Waste Management	
5.8.	**Develop a protocol for illegal dumping instances in streams/rivers** ➢ Illegal dumping in streams/rivers must be cleared by municipal teams on	Ensures that pollution does not affect watercourses detrimentally	Adaptation	Manager: Landfill Manager: Waste Management Manager: Environmental Health Manager: Environmental Management	Complete

	a weekly basis ➢ A response protocol must be developed and put in place for illegal dumping instances that have been reported				

Goal 6

Goal Background: Infrastructure

One of the greatest consequences of climate change is the increase in disasters such as flooding and extreme precipitation and weather events. These events have a huge impact on both residents of Msunduzi, as well as the municipality's ability to deliver basic services. The most important effects of these instances are damage to infrastructure, damage to housing and loss of life. The implementation of the adaptation and mitigation strategies below will ensure the resilience of the city against disaster:

SEA Sustainability Criteria:

"Flood prone areas are managed to promote ecosystem goods and services and minimise flood risks and impacts to flood regimes"

"Areas of geotechnical or geological risk or instability are delineated and are avoided in land development"

"Msunduzi is prepared to respond rapidly and to deal effectively with known hazards and emerging threats, to limit the adverse impacts of events and effectively manage emergencies" (Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
6.1.	**Improve storm drainage and stormwater infrastructure design** ➢ Assess the stormwater infrastructure throughout the	The upgrading of drainage systems to take into account increased precipitation will ensure that infrastructure	Adaptation	Manager: Roads & Drainage Manager: Water & Sanitation Department of Transport	On-going

	municipal area ➢ Determine which areas are sensitive to extreme weather events such as flooding and increased precipitation ➢ Upgrade and reinforce this infrastructure by reviewing current design principles such as pipe size and outfall design ➢ Investigate and implement soft technologies i.e. green infrastructure ➢ Review and refine stormwater	remains intact for longer			

	infrastructure design and minimum standards to accommodate increased flow and extreme weather events				
6.2.	**Develop a Stormwater Management Policy and by-laws with Climate Change provisions** ➢ Stormwater Management Policy to be developed in order to impose controls on stormwater management and to address extreme	Ensures that all future stormwater processes are standardised and made resilient against climate change	Adaptation	Manager: Roads & Drainage Manager: Water & Sanitation Manager: Environmental Management	By 31 December 2016

	storm events arising from climate change ➢ Stormwater Management by-laws to be developed ➢ Develop standard infrastructure designs and standard operating procedures for maintenance				
6.3.	**Impose more stringent conditions on Stormwater Management Plans** ➢ The Stormwater Management Policy and By-laws should address this aspect	Allows for infrastructure to remain resilient against extreme and increased precipitation	Adaptation	Manager: Roads & Drainage	On-going
6.4.	**No domestic waste is to enter stormwater systems**	Ensures that no blockages in the	Adaptation	Manager: Waste Management	On-going

	and all waste found on the street is to be cleared as soon as possible ➢ Rapid response teams are to be set up within the Waste Management Department so that any dumping, once reported, is cleared immediately ➢ Catch-pits to be designed with a filter that does not allow solid waste into the system ➢ Stormwater drains to be cleared on a regular basis and waste management	stormwater system occur, and infrastructure is therefore protected			

	staff must be educated and supervised regarding this function				
6.5.	**Conserve riparian areas, wetlands and flood plains and keep these areas as pristine as far as possible** ➢ No inappropriate developments to be allowed in these areas ➢ A Flood Risk Assessment must be done for the Msunduzi Municipality which involves desktop studies, mapping of	This will mitigate the impact of increased flooding events resulting from climate change	Mitigation	Manager: Environmental Management Manager: Parks, Sport &Recreation	On-going

	flood-lines mitigation measures, development of policies and plans, as well as education of communities (SEMP, 2010) ➢ Continuous maintenance of riparian vegetation ➢ Detailed wetland assessments must be undertaken using approved tools e.g. WET-Health and WET-EcoServices				

Goal 7

Goal Background: Agriculture & Food Security

Rural areas that are dependent on agriculture make up a fair portion of the Msunduzi municipal area. It is for this reason that agricultural practice must be protected against the effects of climate change. Changing temperatures and precipitation patterns pose a challenge to sustainable food production, which necessitates the following strategies:

SEA Sustainability Criteria:

"High potential agricultural land is used (or can potentially be used) for sustainable agricultural production"

"Alternative sustainable livelihood strategies are promoted."

"Most of the daily food needs of Msunduzi are sustainably grown, processed and packaged in urban and rural agricultural schemes in the city and surrounding agricultural areas" (Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
7.1.	**Educate subsistence and commercial farmers on sustainable farming practices** ➢ Launch an education campaign in	Farmers become well equipped to deal with changing climates and agriculture continues to thrive	Adaptation	Manager: Area Based Management Manager: Environmental Management Manager: Parks, Sport & Recreation Support from DEDTEA DAFF	On-going

	collaboration with the Department of Agriculture, Forestry and Fisheries that deals with specific farming methods, both sustainable and resilient against climate change				
7.2.	**Educate and encourage communities to grow their own food crops** ➢ Context-specific community engagement that fully educates communities on the benefits of	Food security no longer depends solely on commercial agriculture and communities become resilient against climate impacts upon food security	Adaptation	Manager: Environmental Management Manager: Area Based Management Manager: Parks, Sport & Recreation Support from DEDTEA	On-going

	growing their own crops ➢ Help communities launch their subsistence farming operation				
7.3.	**Identify and reserve land with high agricultural potential for farming purposes only** ➢ Survey all municipal land and use the Msunduzi Municipality EMF to identify land with farming potential ➢ Land with high agricultural	Protecting agricultural land ensures less land degradation and better potential for the promotion of agriculture	Adaptation	Manager: Town Planning Manager: Environmental Management	On-going (Through implementation of the EMF)

	potential must be zoned accordingly and reserved ➢ Another fresh produce market for the sale of this agricultural produce should be developed to include other areas of Msunduzi				
7.4.	**Rehabilitate municipal-owned land with high agricultural potential** ➢ Survey all municipal land for farming potential ➢ Land of high agricultural	Restoring agricultural land ensures less land degradation and better potential for the promotion of agriculture	Adaptation	Manager: Environmental Management Manager: Parks, Sport & Recreation Manager: Town Planning	On-going

	potential that is degraded must be restored				
7.5.	**Classify areas of high grazing potential and thereafter, identify methods of preserving such land for current and future use** ➢ Survey all municipal land for high grazing potential ➢ Identify strategies to conserve this land and prevent it from being overgrazed ➢ Identify carrying capacity of grazing	Ensures no land degradation and sustainability of livestock farming	Adaptation	Manager: Environmental Management Manager: Town Planning Manager: Area Based Management Manager: Land Survey DAFF	On-going

	land to ensure sustainability (SANBI, 2014). ➢ Adopt the Action Plan for Land Rehabilitation included in the Msunduzi SEMP (Appendix 5).				

Goal 8

Goal Background: Climate Change Awareness & Research

The key to mitigating and adapting to climate change is to understand the phenomenon and have relevant information pertaining to it. If information specific to Msunduzi Municipality is not updated on a regular basis, strategies cannot be formulated to tackle impacts. It is for this reason that Msunduzi must have a dedicated climate change monitoring facility that deals with updating and analysing data, as well as distributing processed information to all sectors of Msunduzi to ensure that everyone has an understanding of climate change and the conservation of natural resources.

SEA Sustainability Criteria:

"Environmental issues are prioritised and the Msunduzi council is committed to achieving environmental sustainability"

"Environmental issues and priorities are embedded in the Performance Management System and Key Performance Areas of all components of the municipality; and, are integrated into municipal planning"

"Access to environmental information is facilitated and encouraged"

"Communities are informed, empowered and involved in the process of democratic governance" (Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
8.1.	**Establish a Council on Climate Change (IDP review for 2013/14-2016-17)** ➢ Develop a Terms of	Climate change adaptation and mitigation measures are formalised, implemented and overseen by a	Adaptation & Mitigation	Manager: Environmental Management All other business units will be involved Research Institutions	By First Quarter of 2017

	Reference for this Council ➢ This Council will oversee all the Action Plans in this Strategy ➢ The Council on Climate Change will communicate adaptation and mitigation measures to communities and the Municipality itself ➢ This Council will consist of representatives from municipal departments as well as external experts	professional body			
8.2.	**Develop a climate change**	A new generation	Mitigation	Manager:	By 31 December 2017

	programme targeted at Eco-Clubs within schools ➢ This programme must include basic climate change definitions and explanations ➢ It must also include mitigation measures from a household scale to a larger scale ➢ Adaptation measures need also be encompassed	of climate-based thinking will be created, and this knowledge will be passed on in the future which will ensure increased mitigation, adaptation and understanding		Environmental Management Manager: Area Based Management DEDTEA Manager: Environmental health	
8.3.	**Develop a climate change education campaign aimed at vulnerable communities**	Communities are well educated and prepared for climate change impacts	Adaptation & Mitigation	Manager: Environmental Management Manager: Area Based Management	By 31 December 2017

	➢ Context-specific education programmes taught in home languages ➢ Learning is to be specific to the vulnerabilities of each community ➢ Support and response protocols for climate change related impacts must be communicated to communities ➢ Develop capacity in Ward Committees in order to carry out this function				
8.4.	**Undertake a detailed vulnerability assessment of the Msunduzi area**	All residents of Msunduzi will be resilient to the	Adaptation & Mitigation	Manager: Human Settlements Manager:	By 31 December 2018

	(SEA, 2010) ➢ The Msunduzi SEA (2010), states that an environmental vulnerability assessment must be undertaken in order to determine communities at risk and subsequently develop and implement strategies for risk minimisation	effects of climate change and will live sustainable lives with basic service provision		Environmental Management Manager: Town Planning	

Goal Background: Governance

It is imperative that governance strategies are put in place in order to ensure that national, provincial and local policies align. In addition to this, structures must exist which allow for the management of climate change and related issues within the local authority. These structures may consist of internal and external departments as well as research institutions.

SEA Sustainability Criteria:

"Environmental issues are prioritised and the Msunduzi council is committed to achieving environmental sustainability"

"Environmental issues and priorities are embedded in the Performance Management System and Key Performance Areas of all components of the municipality; and, are integrated into municipal planning"

"Decision-making processes are defensible, clear and transparent"

"Participation in LA21 is increased and the public is encouraged to participate in municipal planning initiatives"

"Capital investment projects undertaken or facilitated by the Municipality adhere to legislated requirements and Integrated Environmental Management principles" (Msunduzi Strategic Environmental Assessment, 2010).

No.	Objective	Benefit	Adaptation/Mitigation	Implementing Agent	Timeframes
9.1.	**Ensure that environmental policy and legislation is highlighted within all municipal projects** ➢ Environmental	Natural resources are preserved and socio-economic challenges are avoided	Adaptation & Mitigation	All business units	On-going

	Management by-laws developed and implemented to enforce environmental considerations in all municipal projects ➢ Education of all employees on municipal environmental policy and climate change				
9.2.	**Develop Municipal Adaptation Plans through a discussion forum consisting of municipal representatives** ➢ Representatives from various departments to sit on a tribunal relating to risk adaptation planning within the	Adaptation of communities and other stakeholders to climate change risk is made possible	Adaptation	All business units	On-going

	municipal area ➢ Discussions from this forum to be formed into Municipal Adaptation Plans				
9.3.	**Undertake a Sustainability Appraisal and review of all Municipal Plans, Policies and Programs (SEMP, 2010)** ➢ Refer to the IDP in order to identify plans, policies and programs in need of appraisal ➢ The SEA sustainability framework must be used to develop a generic appraisal tool ➢ After the undertaking of the appraisals, the	Environmental issues are considered significantly in the decision-making process	Mitigation	All business units Manager: Environmental Management	By 30 November 2016

	appraisal tool must be refined continuously and used for future plans, policies and programs				

4. Existing Programmes relating to Climate Change

Programme	Explanation	Progress
Ecosystem Services Plan	The Msunduzi Municipality has seen a dramatic increase in infrastructural development, largely due to the strategic location of Pietermaritzburg in relation to the primary provincial corridor presented by the N3 highway. The resultant pressures on vacant/available land necessitate a need for the protection and conservation of open space areas within such development. This action plan assists in identifying areas considered as valuable from both an environmental and a social perspective through the use of the Draft Conservation Plan (C-Plan). This C-Plan is a GIS spatial layer that extends across the entire municipal area and displays the relative biodiversity importance for each planning unit, being 1ha in size, and is referred to as an Irreplaceability Map which allows for the identification of critical biodiversity areas and evaluates them accordingly. This Draft C-Plan which consists of 20 000 hectares (ha) of land classified as irreplaceable will then need to be groundtruthed, a process of gathering data in the field that either complements or disputes data that was captured by less accurate means such as aerial photography. This process of grountruthing will commence with the following five key areas:	Draft

	1. Key area 1: Bisley Valley Nature Reserve and the Upper and Lower Mpushini Valley – Total extent of area 5 900ha 2. Key area 2: Ferncliffe Nature Reserve, Clarendon and Worlds' View – Total extent of area 2 600ha 3. Key area 3: Albany Park, Sweetwaters – Total extent of area 450ha 4. Key area 4: Hesketh Conservation Area and Sobantu – Total extent of area 1 480ha 5. Key area 5: Bishopstowe – Total extent of area 1 853ha 6. Key area 6: Greater Edendale – Total extent of area 10 000ha 7. Key area 7: Thornville/Umlaas road – Total extent of area 4 100ha	
Environmental Management Framework	The Msunduzi EMF helps identify areas that may or may not be suitable for development and further assists with the development application process by information provision. Sensitive areas which require protection are also identified in the EMF protection in order to safeguard ecosystem goods and services. The implementation of the EMF is done by DEA, DEDTEA and the Msunduzi Municipality.	Gazetted (3 September 2015)

Climate Change Policy	This policy identifies actions that must be implemented by the Msunduzi Municipality in order to protect residents and infrastructure against climate change risks and challenges. In addition, it allows for municipal Business Units to incorporate climate considerations into their daily operations and processes (Msunduzi EMF, 2010).	Approved by Council (March 2015)
Environmental By-laws	In terms of the council approved Msunduzi Integrated Environmental Management Policy (IEMP) section 7(d), 7(e) and 7(k) states: The Municipality shall: 7(d) develop an Environmental Management Programme (EMPr) for the City; 7(e) develop and implement appropriate bylaws to give a force of law to the environmental policy and; 7(k) develop management guidelines that will ensure protection of the environment.	Draft
Baynespruit Rehabilitation Project	The Baynespruit project is the contribution of Msunduzi Municipality to improve water quality and quantity within the Umgeni Catchment area as part of the Umgeni Ecological Infrastructure Partnership (UEIP). The key purpose and objective of the Baynespruit Rehabilitation Project is to enhance the water quality of the Baynespruit stream by implementing community based projects to improve ecological infrastructure and to reduce pollution events to the extent that surrounding communities have access to water that is considered safe enough for irrigation of agricultural crops, for fishing and recreational purposes.	In progress

Umgeni Ecological Infrastructure Partnership & Climate Change Compact	The Msunduzi Municipality is a signatory to a Memorandum of Understanding arising from a regional initiative called the Umgeni Ecological Infrastructure Partnership (UEIP) which seeks to formalise the relationship between authorities and the communities living near or using the rivers and streams and sets out how parties will co-operate with each other in order to facilitate the successful implementation of the UEIP strategy which is to ensure adequate supplies of clean water. The KwaZulu Natal Central Climate Change Compact allows for various stakeholders to share information on climate related initiatives within the province.	On-going
EIA processes	Climate considerations are included in Environmental Impact Assessment processes and comments.	On-going
Storm Water Management Policy	Provides guidelines for the approval of planning applications based on storm water management principles	Draft
Tree Management Policy	A framework for tree management within the Msunduzi Municipality which includes guidelines for planting, re-planting and maintenance, as well as selection of types of trees (Sutherland, Airey, Langley, Levieux, Muir, Seholoholo, & Van Der Spuy, 1997).	Approved by Council (1997)
Strategic Environmental Assessment	"The Msunduzi SEA takes the form of a sustainability framework by providing a set of criteria against which the Municipality can assess any policy, program or plan. The sustainability framework developed within this SEA process	Approved by Council (May 2010)

	was, for example, used to assess the sustainability of the recently adopted Spatial Development Framework (SDF)"(Msunduzi Strategic Environmental Assessment, 2010).	

Appendix 1: List of Indigenous Tree & Shrub Species recommended for use in Landscaping

BOTANICAL NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	FROST RESISTANT	DROUGHT RESISTANT	AGGRESSIVE ROOTS	GROWTH RATE/YR	SIZE	PLANTING SITES	EDIBLE FRUIT
Acacia caffra	Common Hook Thorn	D	Yes	Yes	Yes	Medium 700-900 mm	Medium 7-10m	Stream banks, Open space	
Acacia karroo	Sweet Thorn	Semi/D	Yes	Yes	Yes	Fast 1m	Medium 4-8m	Stream banks, Open space	
Acacia robusta	Splendid Thorn	D	Moderate	Moderate	No	Fast 1m	Medium 10m	Stream Banks, Open space, Moist areas	
Acacia sieberiana	Paperbark Thorn	D	Yes	Yes	No	Fast 1m	Large 10-12m	Open space	
Acokanthera oppositifolia	Common Poison-bush	E	Yes	Yes	No	Medium 500-700mm	Small 2-5m	All	
Apodytes dimidiata	White Pear	E	Yes	Yes	No	Medium 700mm	Medium 4-7m	Open space, Screen, Avenue	
Bauhinia galpinii	Pride-of-De Kaap	E	Yes	Yes	No	Fast 1m	Shrub 3-4m	Screen, Hedge	
Bolusanthus speciosus	Tree Wisteria	D/E	Moderate	Yes	No	Fast 800mm	Medium 4-8m	Avenue, Open space	
Bowkeria verticillata	Natal Shell-flower Bush	E	Yes	Moderate	No	Medium 500mm	Shrub 3-5m	Stream bank, screen	
Brachylaena discolor	Coast Silver Oak	E	Yes	Moderate	No	Very Fast 1,5m	Shrub 3-6m	Screen, Hedge	
Buddleja auriculata	Weeping Sage	E	Yes	Yes	No	Fast 1m	Shrub 2-3m	Stream bank	
Buddleja saligna	False Olive	E	Yes	Yes	No	Fast 800mm	Medium 2-7m	Stream banks, Open space, Screen	

Budleja salviifolia	Sagewood	E	Yes	Yes	Yes	Fast 600-800mm	Medium 4-8m	Stream banks, Rehabilitation sites	
Burchellia bubalina	Wild Pomegranate	E	Moderate	Moderate	No	Slow 300mm	Small 2-5m	Feature, Filler	
Calodendrum capense	Cape Chestnut	D/E	Moderate	Moderate	No	Medium 600mm	Large 8-10m	Street tree, Parking lots, Open Space, Parks	
Carissa macrocarpa	Amatungulu	E	No	Yes	No	Fast 700mm	Small 2-3m	Hedge, Screen	Yes
Cassine aethiopica	Kooboo-berry	E	Moderate	Yes	No	Medium 300-400mm	Small 3-4m	Filler, Screen	
Celtis africana	White Stinkwood	D	Moderate	Moderate	No	Fast 1-1,5m	Large 10-12m	Street tree, Open space, Parks, Avenue	
Chrysanthemoides monilifera	Bush-tick Berry	E	Moderate	No	No	Fast 1m	Small 1-3m	Filler, Screen	Yes
Clausena anisata	Horsewood	E	Moderate	Moderate	No	Fast 800mm	Small 3-4m	Filler, Stream banks	
Clerodendrum glabrum	Cat's Whiskers	D	Yes	Moderate	No	Fast 1.5m	Medium 5-8m	Stream banks, Rehabilitation sites	
Coddia rudis	Small Bone-apple	E	Moderate	Moderate	No	Med 400mm	Small 1-3m	Fill, Open space, Stream banks	
Combretum erythrophyllum	River Bushwillow	D	Yes	Yes	No	Fast 1m	Medium 6-10m	Stream banks, Street tree, Open space (moist area)	
Combretum kraussii	Forest Bushwillow	E	Yes	Moderate	No	Moderate	Large 5-20m	Verge, Open Space, Stream banks	
Combretum molle	Velvet Bushwillow	D	Moderate	Yes	No	Slow 400mm	Medium 4-8m	Rockery (Hot, dry area)	

Commiphora harveyi	Red-stem Corkwood	D	No	Yes	No	Fast 1m	Medium 5-10m	Rockery (Hot, dry), Verge Street tree	
Commiphora woodii	Forest Corkwood	D	No	No	No	Fast 1m	Large 8-12m	Stream banks, Forest, Verge (cool, moist area)	
Croton sylvaticus	Forest Fever-berry	D	Moderate	No	No	Fast 1,2m	Large 7-20m	Open space, Stream banks, Avenue/street tree	
Cussonia natalensis	Rock Cabbage Tree	D	Moderate	Moderate	No	Fast 1m	Medium 5-7m	Feature, Rockery (Hot, dry area)	
Dais cotinifolia	Pompon Tree	D/E	Moderate	No	No	Fast 1m	Medium 4-7m	Street tree, Stream banks, Open space	
Diospyros austro-africana	Fire-sticks	E	Yes	Yes	No	Slow 400mm	Small 2-3m	Rehabilitation sites, Stream banks	
Diospyros lycioides	Bluebush	D	Yes	Yes	No	Medium 600mm	Medium 2-7m	Filler, Rehabilitation sites	
Diospyros whyteana	Bladder-nut	E	Moderate	Moderate	No	Medium 600mm	Small 2-3m	Fill (full sun), Screen, Hedge	
Dodonaea angustifolia	Sand Olive	E	Yes	Yes	No	Fast 1m	Small 2-5m	Screen, Hedge	
Dombeya rotundifolia	Wild Pear	D	Moderate	Yes	No	Fast 1m	Medium 4-5m	Feature, Filler, Open space	
Dovyalis caffra	Kei-apple	E	Moderate	Yes	No	Medium 600mm	Medium 3-4m	Feature, Filler, Open space	Yes
Duvernoia adhatodoides	Pistol Bush	E	No	No	No	Fast 1m	Small 2-3m	Filler, Screen	
Ehretia rigida	Puzzle Bush	D	Yes	Yes	No	Fast 1m	Small 2-4m	Filler, Screen	Yes

Ekebergia capensis	Cape Ash	E	Moderate	Moderate	No	Fast 800mm	Large 10-12m	Street tree (moist), Avenue, Parking lot	
Erythrina lysistemon	Common Coral Tree	D	Moderate	Moderate	Yes	Fast 1,5m	Medium 5-7m	Feature, Open space	
Euclea crispa	Blue Guarri	E	Yes	Yes	No	Medium 500mm	Medium 2-4m	Screen, Pioneer, Rehabilitation sites	
Ficus natalensis	Natal Fig	E/D	No	No	Yes	Fast 1-1,5m	Large 10-12m	Stream banks	
Ficus sur	Broom Cluster Fig	E/D	Moderate	No	Yes	Fast 1,5-2m	Large 10-12m	Stream banks, Open space (wet areas)	Yes
Grewia lasiocarpa	Forest Raisin	E/D	Yes	No	No	Fast 1,2m	Small 3-5m	Screen	Yes
Grewia occidentalis	Cross-bery	E/D	Yes	Yes	No	Fast 1,5m	Small 2-3m	Screen, Filler, Rehabilitation sites (hardy)	Yes
Greyia sutherlandii	Natal Bottlebrush	E/D	No	No	No	Medium 700mm	Medium 2-4m	Feature (cool, moist area)	
Halleria lucida	Tree Fuchsia	E	Moderate	Moderate	No	Fast 900mm	Medium 3-4m	Screen, Filler	
Heteromorpha arborescens	Parsley Tree	D	Yes	Yes	No	Fast 1,5m	Large 5-10m	Feature (Bark)	
Heterophyxis natalensis	Lavender Tree	E/D	Moderate	Moderate	No	Fast 800mm	Medium 4-6m	Feature, Filler, Street tree	
Hippobromus pauciflorus	False Horsewood	E	Moderate	Yes	No	Medium 700mm	Shrub 2-4m	Screen	
Hypericum revolutum	Curry Bush	E	Yes	Moderate	No	Medium 800mm	Shrub 2-3m	Screen, Filler	
Ilex mitis	Cape Holly	E	Yes	No	No	Fast 900mm	Medium 7-10m	Stream banks, Street tree	Yes

Jasminum multipartitum	Wild Jasmine	E/D	Moderate	Yes	No	Fast 1m	Climber	Screen, Filler	
Kiggelaria africana	Wild Peach	E/D	Yes	Moderate	No	Fast 1m	Medium 5-8m	Street tree, Open space	
Loxostylis alata	Tarwood	E	Moderate	Moderate	No	Medium 700mm	Medium 4-5m	Screen, Open space, Street tree (small)	
Mackaya bella	River Bells	E	No	No	No	Fast 1m	Small 2-3m	Screen, Filler (moist, shady area)	
Maerua rosmarinoides	Needle-leaved Bush-cherry	E	Moderate	Moderate	No	Slow 300mm	Small 2-3m	Filler	
Maesa lanceolate	False assegai	E	Moderate	Moderate	No	Fast 1,5m	Medium 3-5m	Pioneer (moist areas)	
Maytenus acuminata	Silky Bark	E	Yes	Moderate	No	Medium 500mm	Medium 3-5m	Pioneer, Screen (dry area)	
Millettia grandis	Umzimbeet	E	Yes	Moderate	No	Fast 800mm	Large 8-12m	Street tree, Park	
Myrsine africana	Cape Myrtle	E	Yes	Moderate	No	Medium 400mm	Small 1,5-2m	Screen, Filler	
Ochna natalitia	Natal Plane	D	Moderate	Moderate	No	Slow 500mm	Small 1-2m	Filler, Screen	
Ochna serrulata	Carnival Bush	D	Moderate	Moderate	No	Slow 500mm	Small 1-2m	Filler, Screen	
Olea europaea subsp. africana	Wild Olive	E	Yes	Yes	Yes	Medium 800mm	Medium 5-7m	Rehabilitation sites (harsh areas)	Yes
Olinia emarginata	Mountain Hard Pear	E	Yes	No	No	Medium 500mm	Medium 5-10m	Stream banks, Street tree (moist areas)	
Ozoroa paniculosa	Common Resin Tree	D/E	Moderate	Moderate	No	Medium 500mm	Medium 3-5m	Open space	

Pappea capensis	Jacket-plum	E/D	Yes	Yes	No	Medium 500mm	Medium 5-6m	Filler, Open space	Yes
Pavetta lanceolata	Forest Bride's Bush	E	Moderate	No	No	Slow 400mm	Small 2-3m	Screen, Filler	
Peddiea africana	Green Flower Tree	E	Moderate	Moderate	No	Fast 1m	Small 2-3m	Filler, Feature	
Phoenis reclinata	Wild Date Palm	E	Moderate	Moderate	Yes	Medium	Medium 3-6m	Stream bank stabilization	Yes
Pittosporum viridiflorum	Cheesewood	E	Yes	Moderate	No	Medium 500mm	medium 3-6m	Stream banks, Open space	
Polygala myrtifolia	September Bush	E	Moderate	Yes	No	Fast 1m	Small 2-3m	Screen, Hedge, Filler	
Protorhus longifolia	Red Beech	E	Moderate	Yes	No	Medium 800mm	Medium 6-10m	Screen, Feature, Open space (moist areas)	
Ptaeroxylon obliquum	Sneezewood	D	Moderate	Yes	No	Medium 600mm	Medium 7-10m	Avenue, Street tree	
Rapanea melanophloeos	Cape Beech	E	Moderate	Moderate	No	Medium 500mm	Medium 3-8m	Feature, Stream banks (cool areas) Forest	
Rhamnus prinoides	Dogwood	E	Yes	Moderate	No	Medium 800mm	Small 2-4m	Stream banks (moist areas) Forest	Yes
Rhus chirindensis	Red Currant	D/E	Moderate	Yes	No	Fast 1m	Medium 6-10m	Open space, Stream banks, Parks	
Rhus dentate	Nana-berry	D	Yes	Moderate	No	Medium 700mm	Medium 3-4m	Open space, Feature, Stream banks	
Rhus lucida	Glossy Currant	E	Moderate	Yes	No	Fast 1m	Medium 4-6m	Open space, Parks (dry areas)	

Rhus pentheri	Common Crow-berry	E	Yes	Yes	No	Fast 1m	Medium 3-5m	Screen, Filler	
Rhus rehmanniana	Blunt-leaved Currant	E/D	Yes	Yes	No	Medium 500mm	Medium 3-5m	Screen, Rehabilitation sites	
Rothmannia capensis	Candlewood	E	Moderate	Moderate	No	Medium 500mm	Medium 5-8m	Feature (moist areas)	
Rothmannia globosa	September Bells	E	Moderate	Moderate	No	Medium 500mm	Medium 4-7m	Feature, Filler (moist areas)	
Salix mucronata subsp. Woodi	Natal Willow	E/D	Yes	Yes	Yes	Fast 900mm	Medium 2-5m	Stream banks	
Schotia brachypetala	Weeping Boer-bean	E/D	Moderate	Moderate	No	Medium 700mm	Large 8-12m	Open space, Parks	
Schrebera alata	Wild Jasmine	E	Moderate	Moderate	No	Medium 800mm	Medium 6-8m	Feature, Filler	
Scolopia mundii	Red Pear	E	Yes	Moderate	No	Slow 300mm	Medium 6-10m	Stream banks, Forest edge	
Scolopia zeyheri	Thorn Pear	E/D	Moderate	Moderate	No	Medium 500mm	Medium 3-10m	Screen, Hedge (barrier)	
Syzygium cordatum	Umdoni	Evergreen	No	No	Yes	Fast 1m	Medium 8-10m	Stream banks, Open space (moist areas)	Yes
Tarchonanthus camphorates	Camphor Bush	D/E	Yes	Yes	Yes	Medium 700mm	Medium 4-5m	Rehabilitation sites, Erosion control, Streams	
Trema orientalis	Pigeonwood	D/E	No	Moderate	No	Fast 1,5m	Medium 8-12m	Rehabilitation sites, Pioneer, Forest	
Vangueria infausta	Wild Medlar	D	Yes	Yes	No	Slow 300mm	Small 2-3m	Filler	Yes
Vepris lanceolata	White Ironwood	E	Moderate	Moderate	No	Medium 800mm	Medium 6-10m	Screen, Open space	

Xylotheca kraussiana	African Dog-rose	E/D	No	No	No	Slow 300mm	Small 2-3m	Feature, Screen	
Zanthoxylum capense	Small Knobwood	D	Yes	Yes	No	Medium 700mm	Small 3-5m	Feature, Verge, Open space	
Ziziphus mucronata	Buffalo-thorn	D	Yes	Yes	No	Fast 1m	Medium 3-10m	Open space, Stream banks, Verge, Parks (hardy)	Yes

Appendix 2: List of Alien Species found in Msunduzi

CARA AND NEMBA Category Descriptions:

CARA (Conservation of Agricultural Resources Act, 1983) amended in March, 2001:

Category 1: Remove and destroy.

Category 2: Permit required. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept plants as a gift.

Category 3: No planting. No selling. No importing, breeding, growing, moving, selling or buying, but existing plants may remain in your garden if kept under control.

NEM: BA (National Environmental Management: Biodiversity Act, 2004) – Alien and Invasive Species Regulations, 19 July 2013:

Category 1a: Remove and destroy. Listed invasive species that require compulsory control.

Category 1b: Remove and destroy. Listed invasive species that require control by means of an invasive species management programme.

BOTANICAL NAME	COMMON NAME	CARA CATEGORY	NEM:BA
Plectranthus comosus	Abyssinian coleus, Woolly plectranthus	3	
	Ageratum spps:- see Ageratum/ Invading /Mexican		
Ageratum Conyzoides	Ageratum/Invading Ageratum	1	
Sorghum halapense	Aleppo grass/ Johnson grass	2	
Pinus halepensis	Aleppo pine	2	
Rubus cuneifolius	American brumble	1	
Triplaris Americana	Ant tree, Triplaris	1	
Paraserianthes lophanta	Australian Albizia/ Stink bean	1	
Acacia melanoxylon	Australian blackwood	2	
Pttosporum undulatum	Australian chees wood/ Sweet pittosporum	1	
Leptospermum laevigatum	Australian myrtle	1	
Grevilea robusta	Australian silky oak	3	
Azolla filiculoides	Azolla /red water fern	1	
Acacia baileyana	Baileys Wattle	3	

Passiflora mollisima	Bananapoka, Bananadilla	1	
Casuarina cunninghamiana	Beef wood	2	*none*
Phytolacca dioica	Belhambra	3	*none*
Eucalptus sideroxylon	Black ironbark/ Red ironbark	2	
Robinia pseudoacacia	Black Locust	2	*none*
Rivina humilis	Bloodberry/ Rivina	1	
Echium Vulgare	Blue echium	1	
Passiflora caerulea	Blue Passion Flower	1	
Psidium guineense	Brazillian Guava	3	
Schinus terebinthifolius	Brazillian pepper tree	1	
Anredera cordifolia	Bridal wreath	1	
Salix fragilis	Brittle willow	2	
Solanum mauritianum	Bugweed	1	*none*
Achyranthes aspera	Burweed	1	
Bauhinia purpurea	Butterfly orchid tree	3	
	Cactus/ Prickly pear spps		
	Imbricate/jointe/Long spine/rosea		
	Saucepan/Moon/ Harrisa cactus		
	Cochineal/Creeping/ Droping/Large mission/ Large round-leaved/ Small round-leaved/ Sweet prickly pear/ Pest pear of Australlia		
Ligustrum ovalifolium	Californian Privet	3	
Alhagi maurorum	Camel thorn bush	1	
Cinnamomum camphora	Camphor tree	1	
Elodea Canadensis	Canadian Water Weed	1	
Pinus canariensis	Canary pine	2	
	Cassia SPPS		
	Peanut Butter/ Rambling Cassia		
Ricinus communis	Castor oil plant	2	*none*
Macfadyena unguis-cati	Cat's Claw Creeper	1	*none*
	Cestrum spps:- seeCrimson /inkberry/ Orange/ yellw		
Bryophyllum delagoense	Chandelier Plant	1	

Lantana camara	Cherry Pie/Tick berry/ Lantana	1	
Cestrum parqui	Chilean Cestrum	1	
Ligustrum sinense	Chinese Privet	3	*none*
Tamarix chinensis	Chinese Tamarisk	3	
Ligustrum lucidum	Chinese Wax-leaved Privet	3	*none*
Pinus Roxburghii	Chir Pine/ Longifolia Pine	2	
Chromolaena odorata	Chromolaena /Trifid weed/ Paraffin Bush	1	
Orobanche minor	Clover Broomrape/Lesser Broomrape	1	
Pinus pinaster	Cluster Pine	2	
Opuntia monacanthi	Chochineal/ DropingPrickly Pear	1	
	Cocklebur spp		
	Large/ Spiney Cocklebur		
Cuscuta campestris	Common dodder	1	*none*
Morus alba	Common Mulberry/ White Mulberry	3	
Ligustrum vulgare	Common Privet	3	
Datura stramonium	Common thorn Apple	1	*none*
Ardisa crenata	Coral Bush/ Coralberry	1	
	Cotoneaster spps:- see		
	Cotoneaser/ Silver-leaf		
Cotoneaster franchetii	Cotoneaster	3	*none*
Salix fragilis	Crack Willow, Brittle Willow	2	
Opuntia humifusa	Creeping/ Large floweredprickly pear	1	
Cestrum elegans	CrimsonCestrum	1	
Argentina adenophora	Crofton weed	1	
Parthenium hysterophorus	Demoina Weed/ Parthenium/Feverfew	1	
Egeria densa	Dense Water Weed	1	
Solanum Sisymbrifolium	Dense-thorned bitter apple/ Wild tomato		
Pasiflora suberosa	Devil's Pumki/ Indigo Berry	1	
Datura innoxia	Downy Thorn Apple	1	*none*
Opuntia monacantha	Drooping/ Cochineal Prickly Pear	1	*none*
Psidium X durbanensis	Durban Guava	1	

Rosa rubiginosa	Eglantine/ Sweetbriar	1	
Rubus fruticosus	European Blackberry	2	
Eucalyptus gum spps:-see gum spps			
Ulex europaeus	European Gorse	1	
Albizia procera	False Lebbeck	1	
Pennisetumvillosum	Feathertop	1	
Convolvulus arvensis	Field Bindweed/ Wild Morning-glory	1	
	Firethorn spps:- see Himalayan/ Yellow Firethorn		
Lilium formosanum	Formosa/St Joseph's/ Trumpet lily	3	
Penisetum setaceum	Fountain Grass	1	*none*
Arundo donax	Giant reed/ Spanish reed	1	*none*
Mimosa pigra	Giant Sensitive plant	3	
	Ginger Lilies:- See Kahili/Red/White/Yellow ginger		
Acacia pycnantha	Golden Wattle	1	
Passiflora Subpeltata	Granadina	1	
Acacia deecurrens	Green Wattle	2	
Eucalyptus paniculata	Grey Ironbark	2	
Populus X canescens	Grey poplar/ Matchwood poplar	2	*none*
	Guava spps:-see Brazillian/ Durban/Guava/Strawberry guava		
Psidium guajava	Guava	2	
	Gum spps:-see karri/red river/Rose/Saligna/ Spider/ Sugar Black/Grey/ Red ironbark		
	Hakea spps:-see sweet/Rock/Silky hakea		
Harrisia martinii	Harrisia cactus/Moon cactus	1	
Pyracantha crenulata	Himalayan firethorn	3	*1b*
Lepidium draba	Hoary Cardaria/ Pepper-cress/White top	1	
Gledistia tracanthos	Honey locust/ Sweet locust	2	*none*
Prosopis glandulosa	Honey mesquite	2	
Casuarina equisetifolia	Horsetail tree	2	
Opuntia imbricate	Imbricate prickly pear	1	
Opuntia imbricate	Imbricate prickly pear/Cactus	1	

Litsea glutinosa	Indian Laurel	1	
Canna indica	Indian shot	1	
Passiflora suberosa	Indigo berry/Devil's Pumpkin	1	
Cestrum laevigatum	Inkberry	1	
Ageratum conyzoides	Invading Ageratum/Ageratum	1	
Jacaranda mimosifolia	Jacaranda	3	
Syzygium cumini	Jambolan	3	
Ligustrum japonicum	Japanese wax-leaved privet	3	
Sorghum halepense	Johnson grass/Aleppo Grass	2	*Protected*
Opuntia aurantiaca	Jointed cactus	1	
HedychiumGardnerianum	Kahili ginger lily	1	
Acacia paradoxa	Kangaroo wattle	1	
Salvinia molesta	Kariba weed	1	
Eculyptus diversicolor	Karri	2	
Pueraraia lobata	Kudzu vine	1	
Lantana camara	Lantana,Tickberry/Cherry pie	1	*1b*
Xanthium strumarium	Large cocklebur	1	*none*
Opuntia humifusa	Large flowered/creeping prickly pear	1	
Opuntia spenulifera	Large round-leavedprickly pear/Saucepan	1	
Datura ferox	Large thorn Apple	1	
Albizia lebbeck	Lebbeck tree	1	
Orobanche minor	Lesser broomrape/ Clover broomrape	1	
Leucaena leococephala	Leucaena	2	*none*
Pinus taeda	Loblolly pine	2	
Opuntia exaltata	Long spine cactus	1	
Pinus roxburghii	Longifolia pine/ Chir pine	2	
Acacia longifolia	Long leaved-wattle	1	
Eriobotrya japonica	Loquat	3	
Cuscuta suaveolens	Lucerne dodder	1	
Anredera cordifolia	Madeira vine/Bridal wreath	1	
Myoporum tenuifolium, montanum	Manatoka	3	

Populus X canescens	Matchwood poplar/Grey poplar	2	
Caesalpinia decapetala	Mauritius thorn	1	
	Mesquite spps:-see Honey/ Velvet mesquite		
Ageratumhoutonianum	Mexican Ageratum	1	
	Mexican poppy spps:- see Yellow-flowwered/ White-flowered		
	Mexican poppy		
Tithonia diversifolia	Mexican Sunflower	1	
Opuntia ficus-indica	Mission Prickly pear, Sweet Prickly pear	1	
Ageratina riparia	Mistflower	1	
Montanoa hibiscifolia	Montanoa, tree daisy	1	
Pinus radiata	Monterey pine/ Radiata pine	2	
Cytisusmonspessulanus	Montpellier broom	1	
Harrisia martini	Moon cactus/Harrisia cactus	1	
Ipomoea alba	Moonflower	1	
Ipomoea purpurea	Morning Glory(annual)	3	*1b*
Ipomoea indica	Morning Glory(perennial)	1	
Araujia sericifera	Moth catcher	1	*none*
Nassella trichotoma	Nassella tussock	1	
Metrosiderosexcelsa	New Zeland Christmas tree	3	
Atriplexnummularia	Old man saltbush	2	
Nerium oleander	Oleander	1	
Cestrum aurantiacum	Orange cestrum or Yellow cestrum	1	
	Orchid tree spps:- see Orchid/Butterfly orchid		
Bauhinia variegata	Orchid tree	3	
Cordaderia jubata	Pampas grass	1	*none*
Cortaderia selloana	Pampas grass	1	*none*
Chromolaena odorata	Paraffin bush/Chromolaena/Triffid weed	1	
Myrophyllum aquaticum	Parrot's feather	1	
Parthenium hyperophorus	Parthenium/Demoina weed/Feverfew	1	
Echium plantagineum	Patterson's curse	1	
Pinus patula	Patula pine	2	

Senna didymobotrya	Peanut butter cassia	3	
Acacia podalyriifolia	Pearl acacia	3	*none*
Acacia elata	Pepper tree wattle	3	
Lepidium draba	Pepper-cress/Hoary cardaria/White top	1	
Pereskia acuelata	Pereskia/Barbados gooseberry	1	
Melia azedarach	Persianlilac, Syringa	3	
Opuntia stricta	Pest pear of Australlia	1	
Pontenderia cordata	Pickerel weed	3	
	Pine spps:- see Aleppo/ Canary/Chir/Cluster/Lobloly/Longifolia/ Monterey/Radiata/ Patula pine		
Tamarix ramosissima	Pink tamarisk	3	
Eugenia uniflora	Pitanga/Surinam cherry	1	
Campuloclinium macrocephalum	Pom Pom weed	1	*none*
	Poplar spps:- see Grey/ White/ Match wood poplar		
Acacia saligna	Port Jackson willow	2	
Solanum seaforthianum	Potato creeper	1	*none*
	Privet spps:- see Chinese wax-leaved/Japanese wax-leaved/ Californian/Chinese/ Common privet		
	Prickly pear/Cactus spps:- see cactus		
Lythrum salicaria	Purple Loosestrife	1	
Cereus jamacaru	Queen of the night	1	*none*
Pinus radiate	Radiata pine/ Monterey pine	2	
Senna bicapsularis	Rambling cassia	3	*none*
Acacia Cyclops	Red eye	2	
Hedychium connineum	Red ginger lily	1	
Eucalyptus Sideroxylon	Red ironbark/ Black ironbark	2	
Eucalyptus camaldulensis	Red River gum	2	*none*
Sesbania punicea	Red sesbania	1	*?*
Tithonia rotundifolia	Red susnflower	1	*none*
Azolla filiculoides	Red Water fern/ Azolla	1	
Rivina humilis	Rivina/Bloodberry	1	

Hakea gibbosa	Rock hakea	1	
Syzygium jambos	Rose apple	3	
Eucalyptus grandis	Rose Gum/ Saligna gum	2	
Opuntia fulgida	Rosea cactus	1	
Eucalyptus grandis	Saligna gum/Rose Gum	2	
Opuntius spinuliferia	Saucepan cactus/ Largeround-leaved	1	
Cytisus scoparius	Scotch broom	1	
Cirsium vulgare	Scotch thistle/Spear thistle	1	
Acacia implexa	Screw-pod wattle	1	
Hakea sericea	Silky hakea	1	
Acacia dealbata	Silver Wattle	2	*none*
Solanum elaeagnifolium	Silver- leaf bitter apple	1	
Cotoneaster pannosus	Silver-leaf cotoneaster	3	
Thelechitonia/Wedelia trilobata	Singerpore Daisy	1	
Agave sisalana	Sisal hemp/Sisal	2	
Agave sisalana	Sisal/Sisal hemp	2	
Pinus elliotti	Slash pine	2	
Opuntia lindheimeri	Small round –leaved prickly pear	1	
Spartium junceum	Spanish broom	1	
Arundo donax	Spanish reed, Giant reed	1	
Cirsium vulgare	Spear thistle, Scotch thistle	1	
Eucalyptus lehmannii	Spider gum	2	
Myriophyllum spicatum	Spiked water-milfoil	1	
Xanthium spinosum	Spiny Cocklebur	1	
Atriplex lindleyi	Sponge-fruit Saltbush	3	
Hypericum perforatum	St. John's Wort/Tipton weed	2	
Lilium formosanum	St. Joseph's/Trumpet/Formosa Lily	3	
Paraserianthes lophanta	Stink Bean/Australian Albizia	1	
Psidium cattleianum	Strawberry Guava	3	
Eucalyptus cladocalyx	Sugar Gum	2	
	Sunflower spps:- Mexican/ Red Sunflower		

Eugenia uniflora	Surinam Cherry/Pitanga	1	
Hakea drupacea	Sweet hakea	1	
Gledistia triacanthos	Sweet locust/Honey Locust	2	
Pittosporum undulatum	Sweet pittosporum/Australian Cheesewood	1	
Opuntia ficus-indica	Sweet Prickly pear/ Mision Prickly pear	1	*none*
Rosa rubiginosa	Sweetbriar/Eglantine	1	
Nephrolepis exaltata	Sword fern	3	
Melia Azedarach	Syringa/Persian lilac	3	*none*
	Tamarisk spps:- see Chinese/Pink tamarisk		
	Thorn apple spps:-see common/Downey/Large thorn apple		
Lantana camara	Tickberry/Cherry pie/Lantana	1	
Hypericum perforatum	Tipton weed/St John's wort	2	
Tipuana tipu	Tipu tree	3	*none*
Toona ciliate	Toon tree	3	
Echinopsis spachiana	Torch cactus	1	
Montanoa hibiscifolia	Tree daisy/Montanoa	1	
Ailanthus altissima	Tree-of-heaven	3	*none*
Chromolaena odorata	Triffid weed/Chromolaena/Paraffin bush	1	
Triplaris Americana	Triplaris/Ant tree	1	
Lilium formosanum	Trumpet/St.Joseph's/Formosa lily	3	
Prosopis velutina	Velvet mesquite	2	
Eichhornia crassipes	Water hyacinth	1	
Pistia stratiotes	Water lettuce	1	
Rorippa narstutium-aquaticum	Watercress	2	
	Wattle spps:- seeBailey's/Black green/Golden/Kangaroo/Long-leaved/Pepper tree/Red/Screw-pod/ Silver wattle/ Pearl acacia		
Rhus succedanea	Wax tree	1	
Salix babylonica	Weeping willow	2	*none*

Hedychium coronarium	White Ginger lily	1	
Morus alba	White Mulberry/Common Mulberry	3	
Populus alba	White poplar	2	
Lepidium draba	White top/Hoary cardaria/Pepper-cress	1	
Nassella tenuissima	White tussock	1	
Argemone ochroleuca	White-flowered Mexican poppy	1	*none*
Convolvulus arvensis	Wild morning glory/Field bindweed	1	
Nicotiana glauca	Wild tobacco	1	
Solanum sisymbriifolium	Wild tomato/Dense –thorned bitter apple	1	
	Willow spps:-see Brittle/ crack/Weeping willow		
Plectranthus comosus	Woolly plecthranthus/Abyssinian coleus	3	
Temoca stans	Yellow bells	1	*none*
Cestrum aurantiacum	Yellow cestrum or Orange cestrum	1	
Pyracantha angustifolia	Yellow firethorn	3	
Hedychium flavescens	Yellow Ginger lily	1	
Thevetia peruviana	Yellow oleander	1	
Argemone mexicana	Yellow –flowered Mexican poppy	1	

Appendix 3: Waste Hierarchy

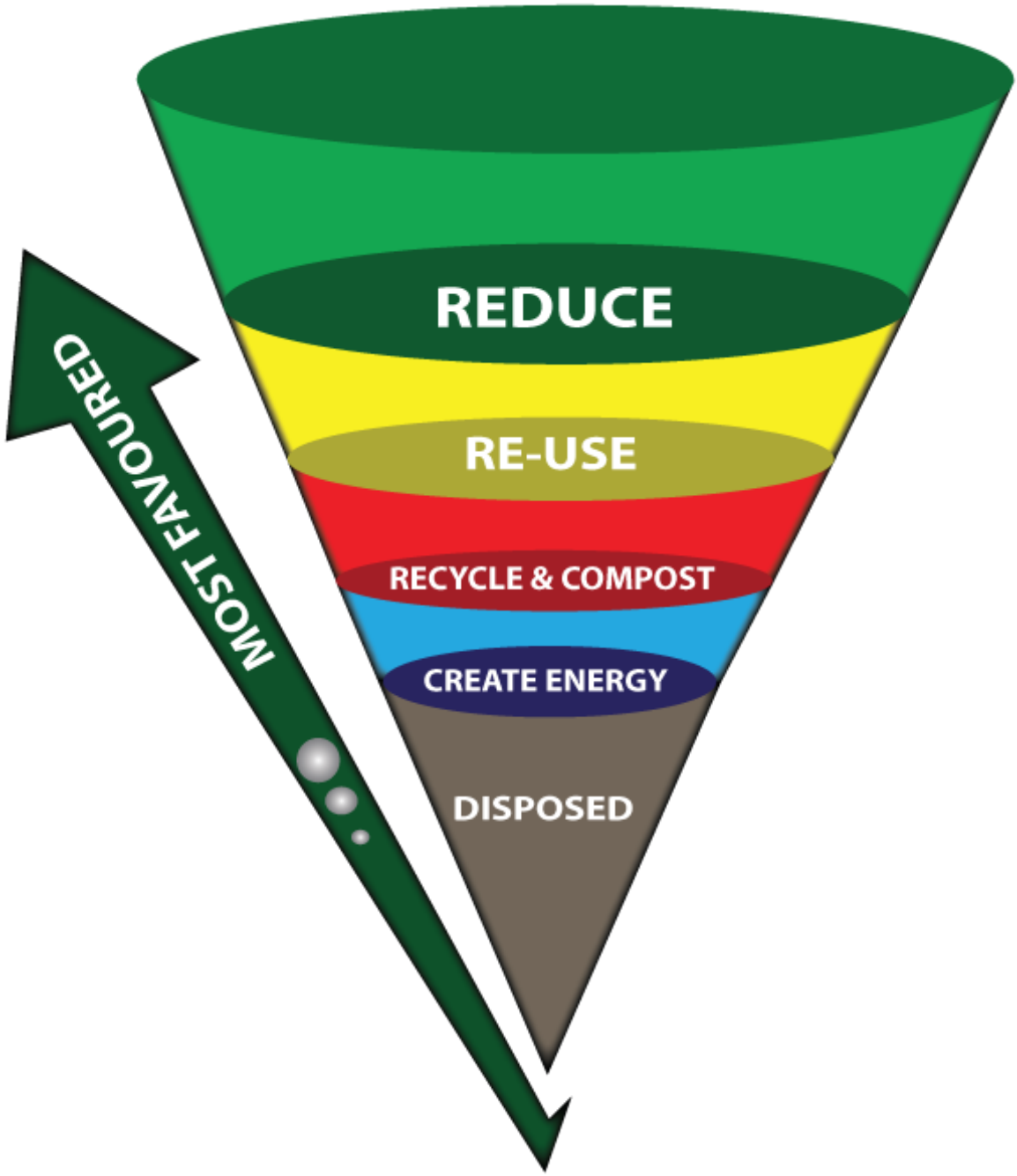

Figure 1: Waste Hierarchy (www.environment.gov.za)

Appendix 4: Climate Change Strategy reflected in SEMP

B6: Climate Change Risk Assessment and Adaptation Strategy				
Strategic Outcomes	Reduce Msunduzi's Carbon footprint	**Strategic Objectives**	To plan for and facilitate a shift from the use of non-renewable to renewable resources. To accentuate the importance of energy and its role in development and the negative effects that energy production may have on the environment.	
Issues Addressed	Risk of climate change and potential impacts to ecosystem service delivery	**Responsible Organisation/s**	Msunduzi – Development Services, Environmental Branch	
Tasks		**Timing**	**Potential Partners**	**Estimated Cost**
Identify potential risks to Msunduzi as a result of climate change.		Long term	eThekwini Municipality and Msunduzi Innovation and Development Institute (MIDI)	In-house
Develop adaptation strategies to address climate change risks.		Long term		In-house
Implement and review strategies.		Long term		Dependant on strategies identified
Total				Still to be determined
Key Performance Indicator:	Climate change risks identified and strategies in place to address risks	**Target**	Reduced climate change risk	

Appendix 5

DAEA&RD2: Identify areas of grazing importance and implement strategies to support sustainable land use practices				
Strategic Outcomes	Improved, sustainable agricultural production	**Strategic Objectives**	To manage inappropriate land use to limit land degradation and loss of agricultural potential To conserve and promote sustainable use of natural resources	
Issues Addressed	Inappropriate land use results in land degradation; the loss of agriculturally productive land and natural resources; and, the loss of ecosystem goods and services and associated biodiversity; which results in a decline in social and economic conditions.	**Responsible Organisation/s**	Department of Agriculture; DAEA&RD	
Tasks		**Timing**	**Potential Partners**	**Estimated Cost**
Identify existing carrying capacity data such as the Bioresource unit / group to provide broad level carrying capacity figures.		Short term	Institute of Natural Resources	R 5 000.00
Refine the assessment of carrying capacity by using information available on rainfall, veld type and veld condition.		Short term		R15 000.00
Undertake field verification.		Short term		R 15 000.00
Prepare Reporting		Short term		R 5 000.00
Total				R40 000.00
Key Performance Indicator:	Areas of high grazing potential mapped	**Target**	Increased agricultural production and reduced land degradation	

References

BBOP. (nd). *Biodiversity Offsets.* [Retrieved on the 10th April 2015 from: http://bbop.forest-trends.org/pages/biodiversity_offsets].

Brown, T. C., Bergstrp, J. C., & Loomis, J. B. (2007). *Defining, valuing, and providing ecosystem goods and services*. Nat. Resources J., 47, 329.

Department of Environmental Affairs. (2011). *National Climate Change Response White Paper.*

Goodward, J. & Kelly, A. (2010). *Bottom Line on Offsets*. World Resources Institute.

Integrated Development Plan (IDP) review for 2013/14 – 2016/17.

Intergovernmental Panel on Climate Change (IPCC). (2007). Fourth Assessment Report.

Magee, N., Curtis, J., & Wendler, G. (1999). The urban heat island effect at Fairbanks, Alaska. *Theoretical and Applied Climatology*, 64(1-2), 39-47.

McGinley, M. (2014). *Species Diversity.* [Retrieved on the 20th April 2015 from: http://www.eoearth.org/view/article/156211/].

National Environmental Management: Biodiversity Act (Act no. 10 of 2004). Department of Environmental Affairs, Pretoria.

National Waste Management Strategy. (2011). Department of Environmental Affairs, Pretoria.

SANBI. 2014. *Grazing and Burning Guidelines: Managing Grasslands for Biodiversity and Livestock Production*. Compiled by Lechmere-Oertel, R.G. South African National Biodiversity Institute, Pretoria.

Singh, K. & Bartholomew, R. C. L. (2014). *Climate Change Policy for the Msunduzi Municipality*. Pietermaritzburg.

SRK Consulting. (2010). *SRK Consulting: Msunduzi Strategic Environmental Assessment*. Prepared on behalf of KZN DAEA, National DAEA and Msunduzi Municipality.

SRK Consulting. (2010). *SRK Consulting: Msunduzi Environmental Management Framework.* Prepared on behalf of KZN DAEA, National DAEA and Msunduzi Municipality.

SRK Consulting. (2010). *SRK Consulting: Msunduzi Strategic Environmental Management Plan*. Prepared on behalf of KZN DAEA, National DAEA and Msunduzi Municipality.

Sutherland, S., Airey, L., Langley, N., Levieux, C., Muir, A., Seholoholo, M., & Van Der Spuy, G.F. (1997). *Tree Management Policy: Guidelines and Procedures.*

The Potsdam Institute for Climate Impact Research and Climate Analytics. (2012). *Turn Down the Heat: Why a 4°C Warmer World must be Avoided*. Washington DC. [Retrieved on the 15th of August 2015 from:

http://www.worldbank.org/content/dam/Worldbank/document/Full_Report_Vol_2_Turn_Down_the_Heat_%20Climate_Extremes_Regional_Impacts_Case_for_Resilience_Print%20version_FINAL.pdf].

Wood, W. A., & Kellogg, S. T. (Eds.). (1988). *Biomass.* Academic Press.