



# GREENBOOK

*adapting settlements for the future*



## Gamagara Local Municipality Adaptation Action Plan

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## List of Acronyms and Abbreviations

CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFFE	Department of Forestry, Fisheries and the Environment
DHS	Department of Human Settlements
DRR	Disaster risk reduction
GLM	Gamagara Local Municipality
HDA	Housing Development Agency
IPCC	Intergovernmental Panel on Climate Change
LRT	Let's Respond Toolkit
PHDA	Priority Housing Development Area
PHS	Priority Human Settlement
PHSHDA	Priority Human Settlement and Housing Development Area
SPLUMA	Spatial Planning and Land Use Management Act, 2013 (Act No.16 of 2013)

## Glossary of Terms

Adaptation actions	A range of planning and design actions that can be taken by local government to adapt to the impacts of climate change, reduce exposure to hazards, and exploit opportunities for sustainable development (CSIR, 2019).
Adaptation planning	The process of using the basis of spatial planning to shape built-up and natural areas to be resilient to the impacts of climate change, to realise co-benefits for long-term sustainable development, and to address the root causes of vulnerability and exposure to risk. Adaptation planning assumes climate change as an important factor while addressing developmental concerns, such as the complexity of rapidly growing urban areas, and considers the uncertainty associated with the impacts of climate change in such areas – thereby contributing to the transformational adaptation of urban spaces. Adaptation planning also provides opportunities to climate proof urban infrastructure, reduce vulnerability and exploit opportunities for sustainable development (National Treasury, 2018; Pieterse, 2020).
Adaptive capacity	“The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2022, p. 2899).
Climate change adaptation	“In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects” (IPCC, 2022, p. 2898).
Climate change mitigation	“A human intervention to reduce emissions, or enhance the sinks, of greenhouse gases (GHGs)” (IPCC, 2022, p. 2915). The goal of climate change mitigation is to achieve a reduction of emissions that will limit global warming to between 1.5°C and 2°C above preindustrial levels (Behsudi, A, 2021).
Climate hazards	Climate hazards are a sub-set of natural hazards and a grouping of hydrological, climatological, and meteorological hazards. This includes the spatial extent and frequency of, among others, floods, fires, and extreme weather events such as extreme rainfall and extreme heat. Sometimes referred to as hydrometeorological hazards. The potential occurrence of a climate hazard may cause loss of life, injury, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (IPCC, 2022). Climate hazards can increase in intensity and frequency with climate change (Pieterse et al., 2023).
Climate risk	Risk implies the potential for adverse consequences resulting from the interaction of vulnerability, exposure, and a hazard. Relevant adverse consequences include those on “lives and livelihoods, health and well-being, economic and sociocultural assets, infrastructure and ecosystems” (IPCC, 2022, p. 144). In the IPCC’s 6th Assessment Report, it is confirmed that risks

may result from “dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system” (IPCC, 2022, p. 132).

Coping capacity	“The ability of people, institutions, organizations and systems, using available skills, values, beliefs, resources and opportunities, to address, manage, and overcome adverse conditions in the short to Medium term (5- 10 years)” (IPCC, 2022, p. 2904).
Disaster risk reduction	“Denotes both a policy goal or objective, as well as the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard or vulnerability; and improving resilience” (IPCC, 2022, p. 2906).
Exposure	Exposure implies the physical exposure of elements to a climate hazard. It is defined as the “presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected [by climate hazards]” (IPCC, 2022, p. 2908).
Mainstreaming	The process of integrating climate change adaptation strategies and measures into existing planning instruments and processes as opposed to developing dedicated adaptation policies and plans (Pieterse et al., 2021).
Resilience	“The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation” (IPCC, 2022, pp. 2920–2921).
Sensitivity	“The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)” (IPCC, 2022, p. 2922).
Vulnerability	Vulnerability is defined as the “propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including, sensitivity or susceptibility to harm and lack of capacity to cope and adapt” (IPCC, 2022, p. 2927). Vulnerability refers to the characteristics or attributes of exposed elements, i.e., elements that are exposed to potential climate-related hazards. Vulnerability is a function of sensitivity and (coping or adaptive) capacity (Pieterse et al., 2023).

# 1. Introduction

Climate change impacts vary widely from region to region in South Africa, and are reflected by floods, droughts, heatwaves, and coastal erosion among others. These impacts directly threaten life, economic well-being, property, infrastructure, and ecosystems as well as the ability of local government to provide public services. It is local government's responsibility and duty to provide leadership in planning and preparing to manage these risks for the sake of the well-being, safety, and security of individuals within their jurisdiction (SABS, 2023). The purpose of this document is to strengthen the capability of local government to prepare for climate change threats and associated risks.

The Climate Change Adaptation Plan and its accompanying Risk Profile report have been specifically drafted for the Gamagara Local Municipality (GLM) with the aim of strengthening its strategic response to climate change. These documents derive their insights from the GreenBook ([www.greenbook.co.za](http://www.greenbook.co.za)), a freely accessible online planning support system. The GreenBook is a unique and invaluable resource, providing quantitative scientific evidence to assist local governments in comprehending their climate risks. It plays a pivotal role in guiding the adaptation of settlements to withstand the impacts of both current and future climate challenges.

Designed as an information-rich tool, the GreenBook caters to South African local governments, offering insights into risks and vulnerabilities associated with population growth, climate change, exposure to hazards, and the vulnerability of critical resources. Moreover, the GreenBook not only diagnoses these challenges but also provides practical adaptation measures. These measures are essential for cities, towns, and settlements, empowering local government to mitigate the impacts of climate hazards on communities, the environment, the economy, and municipal assets and infrastructure, while aligning with broader developmental goals (refer to [Green Book I Adapting settlements for the future](#)).

The Climate Risk Profile and the Climate Change Adaptation Plan serve distinct yet interlinked purposes and strategic objectives. They aim to:

1. Drive and advance the local climate change response agenda.
2. Provide a foundational framework for strategy and planning within the Local Municipality, with a specific focus on Priority Human Settlements or Priority Housing Development Areas (PHSDAs).
3. Systematically identify and prioritise risks and vulnerabilities.
4. Pinpoint and prioritise targeted interventions and responses.
5. Facilitate the integration of climate change response, particularly adaptation, into mainstream policies and practices.

In essence, these documents are instrumental in equipping Gamagara Local Municipality with a comprehensive strategy to navigate the complexities of climate change, reduce vulnerability and exposure, and champion sustainable development.

The Adaptation Action Plan briefly outlines the policies constituting the framework for adaptation in South Africa. It then goes on to describe generic adaptation principles, approaches, pathways, and various categories of actions. Subsequently, the plan suggests a specific adaptation strategy for Gamagara LM by aligning it with adaptation goals, programmes, and actions designed to address priority risks. Finally, the document concludes with recommendations aimed at facilitating the integration of the proposed actions into broader initiatives, ensuring their effective mainstreaming.

## 2. Policy Framework

South Africa's institutional policy and legislative framework makes provision for climate change adaptation at all levels of government, with local governments increasingly identified as the primary drivers of climate change adaptation. For instance, there exists various national policy and legislative mechanisms that promote, necessitate, guide and/or regulate climate change adaptation at the local level. These include the Disaster Management Amendment Act of 2015, the Spatial Planning and Land Use Management Act, i.e., Act No. 16 of 2013 (SPLUMA), the Climate Change Bill (B9 of 2022), the 2011 National Climate Change Response White Paper, as well as the 2019 National Climate Change Adaptation Strategy.

While the Disaster Management Amendment Act requires each organ of state, as well as provincial and local government to identify measures for, as well as indicate plans to invest in, disaster risk reduction (DRR) and climate change adaptation; SPLUMA identifies the principles of (1) spatial resilience – which involves accommodating “flexibility in spatial plans, policies and land use management systems, to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks” (Republic of South Africa., 2013, p. 20) – some of which may be induced by the impacts of climate change, and (2) spatial sustainability, which sets out requirements for municipal planning functions such as spatial planning and land use management to be carried out in ways that consider protecting vital ecosystem features such as agricultural land, i.e., from both anthropogenic and natural threats, including the impacts of climate change, as well as in ways that consider current and future costs of providing infrastructure and social services in certain areas (e.g., uninformed municipal investments may lead to an increase in the exposure of people and valuable assets to extreme climate hazards) amongst the key principles intended to guide municipal planning and development. The Climate Change Bill (DEA, 2018) sets out requirements for every District Intergovernmental Forum to serve as a Municipal Forum on climate change that coordinates climate response actions and activities in its respective municipality, while also requiring every municipality to report on their climate change response needs and draft resultant climate risk assessments, as well as climate change response and -implementation plans.

Moreover, the National Climate Change Response White Paper identifies local governments as critical role players that can contribute towards effective climate change adaptation through their various functions, including human settlement planning; urban development; municipal infrastructure and services provision; water and energy demand management; and local disaster response, amongst others. The National Climate Change Adaptation Strategy (DEA, 2019) outlines several actions that applicable at local government level, including the development and implementation of adaptation strategies and vulnerability reduction programmes for communities and individuals that are most at risk to the impacts of climate change; the development of municipal early warning systems; as well as the integration of climate change adaptation into municipal development plans and relevant sector plans.

In response to the national call to advance spatial transformation and consolidation in human settlement development, the National Department of Human Settlements (DHS) has identified and gazetted a total of 136 Priority Human Settlements and Housing Development Areas (PHSHDAs). The PHSHDAs were declared to ensure that housing delivery is used to restructure and revitalise towns and cities, strengthen the livelihood prospects of households, and overcome apartheid spatial patterns by fostering integrated urban forms (DHS, 2020). PHSHDAs were designated using national criteria which includes an area or settlement's potential to support sustainable environmental management (which plays a critical role in mitigating the negative impacts of climate change, particularly through nature-based adaptation



solutions), as well as its potential to accommodate the integration of land uses and amenities, i.e., in addition to other criteria.

The DHS has identified two key objectives for PSHDAs, including (1) targeting and prioritising areas for integrated housing and human settlements development to ensure the delivery of housing for a diverse range of income groups within an integrated mixed-use development, as well as (2) transforming spatial patterns which have historically exacerbated social inequality and economic inefficiency (PLM, 2021). As part of the second objective, this initiative aims to develop post-apartheid cities and city patterns that ensure urban access, as well as achieve a balance between spatial equity, economic competitiveness and environment sustainability (PLM, 2021). As the impacts of climate change become more severe, the latter outcome (i.e., ensuring and maintaining environmental sustainability) will become increasingly important.

Furthermore, as part of the implementation approach for housing and human settlement development in PSHDAs, the DHS has identified the provision and maintenance of ecological infrastructure to support development in priority areas as a key avenue for integrating climate considerations and mainstreaming climate responses, including climate change adaptation (See Figure 2).

### 3. Adaptation Principles, Approach, Programmes & Actions

Climate change mitigation and adaptation refer to the two primary strategies aimed at addressing the adverse effects of climate change, i.e., by either delaying, reducing, redistributing, or avoiding the impacts. Although disaster risk reduction and climate change mitigation form part of the overall climate change response agenda, the focus of this plan is on adaptation.

Climate change adaptation aims to reduce climate-related risks by adjusting a system to the actual or anticipated climate and seeking “to moderate or avoid harm [and] exploit beneficial opportunities” (IPCC, 2022, p. 2898) that may derive from unavoidable impacts of climate change such as extreme hazards. The climate change adaptation agenda is concerned with adapting species, people, places, assets, and systems, to the impacts of actual or anticipated climate-related risks and implements various measures or actions to achieve this (Behsudi, 2021; C40, 2020).

This section of the report outlines adaptation principles, drawing from the recommendations by the South African Bureau of Standards. It also presents a structured approach to selecting adaptation options, categorises adaptation actions, and explains the concept of an adaptation pathway.

#### 3.1. Adaptation principles

The Bureau for Standards recently proposed the following principles that apply to local government when adapting to climate change (SABS, 2023):

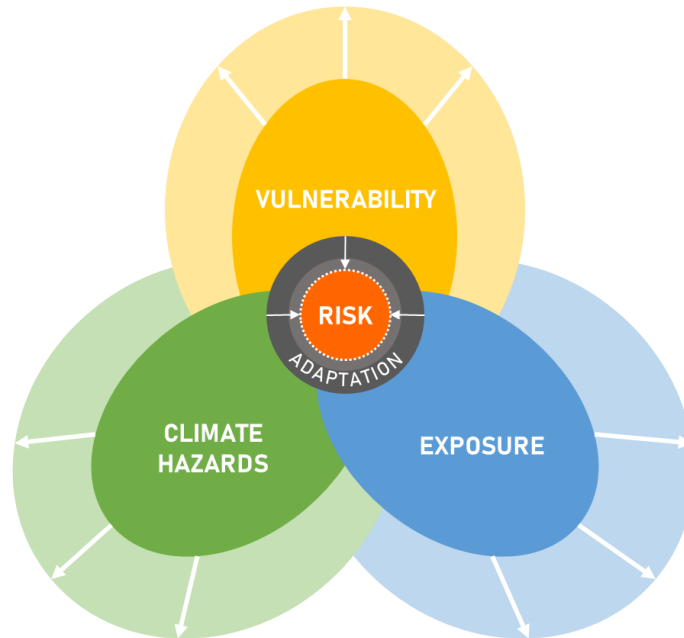
- i. **Accountability:** Local governments not only acknowledge but also assume responsibility for their climate change adaptation efforts. They willingly subject themselves to appropriate scrutiny and accept the duty to respond to this scrutiny.
- ii. **Continual learning and improvement:** Recognising the uncertainties in knowledge and the dynamic nature of drivers of change, available knowledge and evidence, and the contextual factors, continual learning and improvement are essential for effective climate change adaptation.

- iii. **Mainstreaming and embedding:** The effectiveness of climate change adaptation is maximised when integrated into local government operations, encompassing policies, plans, procedures, risk management, and implementation strategies.
- iv. **Flexibility:** Embrace a flexible approach that considers technical, social, administrative, political, legal, environmental, and economic circumstances. This allows for the accommodation of a diverse range of data availabilities and technical and institutional capacities to meet goals and objectives.
- v. **Practicality:** Set practical and achievable goals and objectives. Impractical targets may hinder the successful realisation of climate change adaptation benefits. Focus on easily measurable indicators/metrics with available underlying data and compare them across scales to avoid imposing additional burdens.
- vi. **Prioritisation:** During the identification of adaptation plans and measures, prioritise areas based on the relative characteristics of climate change impacts (magnitude, likelihood, and urgency). Consider the capacities of stakeholders and the local government and community's ability to act.
- vii. **Proportionality:** Undertake actions that are most effective under the current circumstances, including economic, social, cultural, and political contexts, capabilities, knowledge, and evidence base. Aspire for continual improvement in identifying and assessing adaptation measures.
- viii. **Relevance:** Facilitate assessments that provide decision-makers and practitioners with meaningful information for adaptation planning, considering appropriate spatial scales and relevant time durations.
- ix. **Transparency:** Ensure that reports and communications on climate change adaptation are openly, comprehensively, and understandably presented, providing accessible information for all interested parties (SABS, 2023).

These principles should be considered when formulating adaptation goals, programmes, and measures.

### 3.2. Adaptation approach

The approach that was followed to develop this adaptation plan revolves around comprehending the climate-related risks and implementing adaptive measures in response to these risks. Climate-related risk encompasses the potential for adverse consequences arising from the interplay of vulnerability, exposure, and the occurrence of climate hazards (IPCC, 2022). The components of risk are dynamic, with the occurrence of climate hazards influenced by both natural climate variability and anthropogenic climate change. The exposure of individuals, the built environment, and the natural surroundings to climate hazards is driven by both planned and unplanned development and growth. Vulnerability is the inherent characteristics that make systems sensitive to the effects and impacts of climate hazards.



*Figure 1 – The interplay between climate hazards, vulnerability and exposure that determines risk (based on IPCC, 2014 and IPCC, 2021)*

The inherent uncertainty in future climate trends underscores the necessity for a flexible response and the formulation of adaptable, medium to long-term adaptation strategies.

The approach followed in this plan involves the following steps:

- i. Gain an understanding of climate risk in a specific geographic area.
- ii. Identify priority climate hazards/zones based on the risk profile.
- iii. Establish adaptation goals to mitigate the risk associated with priority hazards/zones.
- iv. Develop adaptation programmes with measures/actions to achieve these goals.
- v. Integrate climate considerations into other sector plans/instruments/strategies.

Refer to Table 1 for a more detailed description of this approach.

*Table 1: The adaptation approach*

Understand climate risk for a specific geographic area	A climate risk profile assesses risk by determining – in a specific geographic area and at a specific scale – the likelihood of a hazard to occur, the inherent vulnerability of various systems, and exposure of these systems to specific climate hazards. To be able to develop an appropriate adaptation plan, it is important to understand what contributes to risk and vulnerability.
Identify priority climate-related risks/zones	Identify the climate hazards and impacts that pose the greatest risk at present and in the future within a geographic area. If possible, also identify climate risk zones that need to be prioritised for intervention.

Establish adaptation goals	Identify adaptation goals to address priority risks/zones that speak to policy goals.
Develop adaptation programmes and actions	<p>Develop adaptation programmes that speak to the identified adaptation goals and identify appropriate adaptation actions under each of the programmes that are mutually supportive. Adaptation actions should:</p> <ul style="list-style-type: none"> <li>• Be specific to a climate hazard/vulnerability/exposure.</li> <li>• Suggest a target or an indicator to measure progress.</li> <li>• Be assignable to a primary implementer.</li> <li>• Consider co-benefits and other possible implications.</li> <li>• Include mitigation as far as it builds resilience or reduces exposure and vulnerability.</li> </ul>
Mainstream climate considerations into planning	Integrate evidence of climate risk, adaptation goals, programmes, and actions into existing instruments and processes. The aim is to ensure that climate change considerations are an integral part of all that local government is doing.

The primary aim of an adaptation plan is to address both current and anticipated future risks and vulnerabilities while also leveraging opportunities for long-term transformation and sustainable development.

### 3.3. Adaptation programmes and actions

An adaptation programme is a structured and systematic set of actions, initiatives, and interventions aimed at local governments adapt to the impacts of climate change. It involves the practical implementation of specific goals identified in the plan.

Broadly, adaptation actions include anticipatory and reactive measures. Anticipatory adaptation involves proactive measures taken in preparation for anticipated climate change impacts, while reactive adaptation entails responding to climate change effects as they are experienced. Furthermore, it facilitates the integration and prioritisation of climate change adaptation and resilience measures into various planning mechanisms and processes (CSIR, 2019).

A spectrum of adaptation actions is at the disposal of local municipalities to enhance resilience and mitigate risks posed by changing climatic patterns and extreme weather events. Some of the categories of actions include:

- Infrastructure development, encompassing the construction of, for example, seawalls, levees, and storm surge barriers to protect against rising sea levels and extreme weather events. These engineered solutions provide immediate protection and buy time for longer-term adaptation efforts but are mostly very expensive to build.
- Green infrastructure initiatives offer sustainable and nature-based solutions. Municipalities can implement urban green spaces, green roofs, and permeable pavements to absorb excess water, reduce flooding, and mitigate the urban heat island effect. Such approaches not only enhance climate resilience but also contribute to improved air quality and overall urban liveability.

- Environmental protection such as restoring ecosystems like mangroves, dunes, and wetlands, not only provides natural buffers but also supports biodiversity.
- Integrated urban planning is essential to create climate-resilient municipalities. Land-use regulations should be adapted to consider climate risks, prioritising construction practices that enhance resilience. Elevating structures above projected flood- and sea levels and using climate-resilient materials in building design can minimise the impacts of flooding and storm damage.
- Early warning systems and emergency preparedness plans are critical tools to ensure swift responses to extreme weather events, minimising the impact on vulnerable communities.
- Innovative water management strategies are essential for municipalities facing changing precipitation patterns and increasing water scarcity. Diversifying water sources, implementing water efficiency measures, and investing in advanced stormwater management systems contribute to water security and sustainable resource use.
- Engagement and education are pivotal components of successful adaptation strategies. Empowering officials, and residents, to understand and respond to climate risks through awareness campaigns, education programmes, and participatory planning initiatives can enhance local adaptive capacity (CSIR, 2019).

Local governments must embrace a combination of structural, natural, and community-based approaches to build resilience and adaptive capacity, protect vulnerable communities, while ensuring long-term sustainability in the face of evolving climate challenges.

## 4. Summary of Climate Risk Profile

A Climate Risk Profile Report was prepared by the team, designed to complement this Plan. The comprehensive Climate Risk Profile serves as an essential resource for understanding the risks associated with climate change in Gamagara Local Municipality. Presented to representatives of the Municipality during a series of nationwide stakeholder engagements in late 2023, these workshops served as forums to not only validate the risks outlined in the report but also to confirm the adaptation goals proposed.

This section of the Plan summarises the climate risk profile for Gamagara Local Municipality, drawing from the GreenBook Risk Profile Tool at <https://riskprofiles.greenbook.co.za/>. Consult the accompanying Climate Risk Profile Report for more detailed information.

### 4.1. Climate projections, vulnerabilities and impacts

The main climate projections for the Gamagara LM points to hotter and drier conditions. Future projections show increases in annual average temperature up to 3.54 °C. Rainfall predictions show future change in annual rainfall expected to range between 13.53 and 21.21 mm. This indicates a slight increase in annual precipitation. Future predictions show an increase in the number of very hot days by between 26 to 60 days per year, as well as an increase in heatwave days of between 25 to 28 days. Gamagara LM is expected to experience extreme growth pressure in the towns of Kathu, Dibeng and Olifantshoek. The LM has the lowest socio-economic vulnerability in the Northern Cape and is ranked 8th out of the 26 municipalities in the province. The water supply vulnerability is expected to increase in the future due to reduced rainfall and runoff generation, as well as population growth. The climate change risks as indicated were validated by the stakeholders of Gamagara LM during a stakeholder engagement.

## 4.2. Priority climate-related hazards

For Gamagara LM, and thus for Kathu PSHDA, the biggest risks are increases in temperature with the risk of heat extremes increasing by as much as 28 days by 2050. Severe and persistent heat can place significant stress on the ecology and livestock and have implications for both human comfort and health. Warmer temperatures can disrupt growing seasons and affect crop yields. Some crops may fail to grow, while others may see reduced productivity. This can lead to food security issues and higher food prices. Higher temperatures can increase the risk of wildfires, threatening vegetation, homes, and infrastructure. The PSHDA's populous areas rely on a combination of surface water and groundwater. For the settlements that are dependent on groundwater, either entirely or partially, the combination of decreasing groundwater recharge potential and increasing population growth pressure will affect settlement water supply as water supplies decrease and demand increases.

## 5. Adaptation Goals, Programmes and Actions

The section outlines the adaptation plan using goals and measures designed to help Gamagara LM to adapt to the impacts of climate change. Based on the assessment of the potential risks and vulnerabilities posed by climate change, this plan was developed as a proactive strategy to mitigate these risks and enhance resilience. All settlements in the LM are expected to experience extreme population growth pressure in the future, which means an increase in the exposure of people to heat stress. High population growth pressure will also lead to increased competition for resources – which affects the adaptive capacity of the PSHDA and its inhabitants, thus making it more difficult for people to adapt to, respond to and recover from climate hazards and impacts.

### 5.1. Adaptation goals

Drawing upon the assessment of the current and projected climate-related risks and vulnerabilities outlined in the preceding section, the following adaptation goals for Gamagara LM were identified, prioritising those risks with the highest potential impact. These goals were validated by stakeholders during the nationwide engagements:

- Goal 1: To prioritise the health and safety of communities in the face of a changing climate.
- Goal 2: To ensure water security in the face of climate change.
- Goal 3: To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events.
- Goal 4: To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.

The adaptation programmes below identify the overarching programmes and their actions, necessary to achieve each one of the goals. Specific timeframes and responsibilities are allocated in the subsequent implementation framework.

## 5.2. Adaptation programme: Goal 1

Goal 1: To prioritise the health and safety of communities in the face of a changing climate

### Programme 1.1: Heatwave Preparedness and Response

The programme aims to enhance community resilience to extreme heat events by implementing a range of proactive measures. This programme focuses on identifying vulnerable populations, raising public awareness, providing refuge during heatwaves, and mitigating heat through urban greening.

#### Actions:

- i. Conduct heat vulnerability assessments to identify high-risk areas and vulnerable populations, such as the elderly, children, and outdoor workers.
- ii. Develop heatwave early warning systems and public awareness campaigns to educate residents on heat-related risks and protective measures.
- iii. Establish cooling centres in community facilities, such as libraries and recreation centres, to provide refuge during heatwaves.
- iv. Train healthcare workers, emergency responders, and community volunteers on heat illness prevention, recognition, and treatment.
- v. Implement urban greening initiatives, such as planting trees and creating green spaces, to mitigate the urban heat island effect and provide natural cooling.

### Programme 1.2: Community Health and Well-being Promotion

This programme aims to enhance the overall health and well-being of the community by addressing the direct and indirect health impacts of climate change. By improving access to healthcare, building local capacity, and promoting healthy lifestyles, the programme seeks to create a more resilient and supportive community environment.

#### Actions:

- i. Provide access to affordable healthcare services and preventive care programs to address climate-related health impacts, such as heat-related illnesses, respiratory diseases, and vector-borne diseases.
- ii. Establish community emergency response teams and train residents in first aid, disaster preparedness, evacuation procedures, and health promotion to build local capacity and resilience in the face of climate-related hazards.
- iii. Develop mental health and psychosocial support programs to address the psychological impacts of climate change, such as anxiety, stress, and trauma.
- iv. Strengthen social support networks and community resilience through peer support groups, neighbourhood associations, and faith-based organisations.
- v. Promote healthy lifestyle behaviours, such as physical activity, nutrition, and stress management, through community-based education and outreach initiatives.
- vi. Enhance access to clean water, sanitation, and hygiene facilities to prevent waterborne diseases and ensure basic hygiene practices during extreme weather events.

### Programme 1.3: Infrastructure Resilience and Emergency Preparedness

This programme focuses on assessing and enhancing the resilience of critical infrastructure to withstand climate-related hazards and extreme weather events. By retrofitting existing structures and leveraging local resources, the programme aims to ensure the safety and functionality of essential services.

**Actions:**

- i. Assess the vulnerability of critical infrastructure, such as healthcare facilities, schools, and water supply systems, to climate-related hazards and extreme weather events.
- ii. Identify opportunities to enhance the resilience of existing infrastructure using low-cost, resource-efficient measures, such as retrofitting buildings with locally sourced materials, improving drainage systems using community labour, and repurposing underutilised spaces for emergency shelters.
- iii. Seek partnerships with local businesses, NGOs, and community groups to leverage additional resources and expertise for infrastructure upgrades.

### 5.3. Adaptation programme: goal 2

Goal 2: To ensure water security in the face of climate change.

**Programme 2.1: Groundwater Management and Protection**

This programme aims to sustainably manage and protect groundwater resources by conducting comprehensive assessments, implementing monitoring networks, and developing recharge projects. By regulating extraction and establishing protection zones, the programme seeks to ensure the long-term viability and quality of groundwater supplies for the municipality.

**Actions:**

- i. Conduct hydrogeological assessments to understand groundwater recharge potential and identify sustainable yield limits for aquifers in the municipality.
- ii. Develop groundwater monitoring networks using low-cost monitoring wells and community-based water quality testing kits to assess groundwater levels and quality.
- iii. Implement aquifer recharge projects, such as managed aquifer recharge and infiltration basins, to enhance groundwater replenishment during periods of low rainfall.
- iv. Regulate groundwater extraction through permit systems and licensing schemes to prevent overexploitation of aquifers and ensure equitable distribution of groundwater resources.
- v. Establish groundwater protection zones around critical recharge areas and vulnerable aquifers, implementing land use regulations to prevent contamination and pollution.

**Programme 2.2: Sustainable Water Management and Conservation**

This programme focuses on promoting water conservation through education, the distribution of water-saving devices, and community-based initiatives. By reducing water losses and enhancing water use efficiency, the programme aims to ensure sustainable water consumption and availability for all users.

**Actions:**

- i. Implement water conservation education campaigns targeting residents, schools, and businesses to raise awareness about the importance of water conservation practices.
- ii. Provide low-cost water-saving devices, such as faucet aerators and low-flow showerheads, to households and businesses to reduce water consumption.
- iii. Develop community-based rainwater harvesting initiatives to capture and store rainwater for non-potable uses, such as irrigation and toilet flushing.
- iv. Conduct leak detection surveys and repair programs to minimise water losses in distribution networks, prioritising areas with high leakage rates.



- v. Conduct regular leak detection surveys and repair activities to minimise water losses in distribution networks.
- vi. Establish water metering and monitoring systems to track water usage and identify opportunities for efficiency improvements.

#### Programme 2.3: Integrated Water Resource Management

This programme seeks to integrate various water management strategies to optimize the use and distribution of both surface water and groundwater resources. By promoting collaborative governance, upgrading infrastructure, and engaging the community, the programme aims to enhance water supply reliability and resilience to climate change.

##### Actions:

- i. Conduct integrated water resource assessments to evaluate the availability and demand for surface water and groundwater resources in the municipality.
- ii. Develop water allocation plans that prioritise sustainable water use practices and equitable distribution of water resources among different sectors and users.
- iii. Promote multi-stakeholder partnerships and collaborative governance approaches to facilitate coordinated decision-making and collective action for water management.
- iv. Invest in water infrastructure upgrades and resilience measures, such as storage reservoirs, and distribution networks, to enhance water supply reliability and resilience to climate change impacts.
- v. Facilitate community engagement and participation in water governance processes through public consultations, stakeholder workshops, and citizen science initiatives.

### 5.4. Adaptation programme: goal 3

Goal 3: To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events

#### Programme 3.1: Climate Resilient Infrastructure and Urban Planning

This programme aims to enhance the resilience of critical infrastructure and urban areas to climate-related hazards. By conducting vulnerability assessments, implementing low-cost retrofitting measures, updating urban planning processes, and establishing community-based early warning systems, the programme seeks to mitigate risks and improve the ability of urban areas to withstand extreme weather events.

##### Actions:

- i. Conduct low-cost vulnerability assessments of critical infrastructure using existing data and community input to identify areas at risk from extreme weather events and climate-related hazards.
- ii. Implement simple retrofitting and resilience measures for existing infrastructure, such as clearing drainage systems, reinforcing buildings with locally sourced materials, and promoting green spaces to mitigate heat island effects.
- iii. Incorporate climate resilience considerations into existing urban planning processes by updating zoning regulations and building codes with minimal cost adjustments.

- iv. Establish community-based early warning systems and emergency response protocols for extreme weather events, utilizing local networks and volunteers to disseminate information and coordinate responses.

### Programme 3.2: Sustainable Land Use and Natural Resource Management

This programme focuses on promoting sustainable land use and managing natural resources to enhance ecosystem resilience and support local communities. Through community-led reforestation, soil conservation projects, sustainable agriculture practices, and the establishment of conservation areas, the programme aims to reduce erosion, improve soil health, preserve biodiversity, and enhance ecosystem services.

#### Actions:

- i. Promote community-led reforestation and soil conservation projects using volunteer labour and locally available resources to enhance ecosystem resilience and reduce erosion.
- ii. Provide training and support for small-scale farmers on sustainable agriculture practices and water-efficient irrigation techniques, emphasising low-cost solutions that improve soil health and crop yields.
- iii. Advocate for the protection of natural habitats and green spaces through community-driven conservation efforts and awareness campaigns, leveraging existing volunteer networks and partnerships.
- iv. Establish community-managed conservation areas and urban green spaces to preserve biodiversity and ecosystem services, utilising vacant lots and public lands for community gardening and recreation.

### Programme 3.3: Community Engagement and Capacity Building

This programme aims to empower communities to build resilience and adapt to climate change. By facilitating participatory risk assessments, developing community resilience plans, providing capacity-building workshops, and fostering partnerships, the programme seeks to enhance local adaptive capacity, improve disaster preparedness, and leverage resources for effective climate adaptation initiatives.

#### Actions:

- i. Facilitate participatory risk assessments and vulnerability mapping exercises with community members and local organizations to identify priority areas for adaptation and resilience-building.
- ii. Develop community resilience plans and adaptation strategies in collaboration with local stakeholders, including residents, community organisations, and indigenous groups, to address specific climate risks and enhance adaptive capacity.
- iii. Provide capacity-building workshops and training sessions for residents, community leaders, and government officials on climate change adaptation, disaster preparedness, and emergency response, to empower communities to take proactive measures to reduce vulnerability and build resilience.
- iv. Foster partnerships and collaboration between government agencies, non-profit organisations, academic institutions, and private sector actors to leverage resources, expertise, and networks for climate adaptation initiatives at the local level.

## 5.5. Adaptation programme: goal 4

**Goal 4:** To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.

### Programme 4.1: Rural Economic Diversification and Innovation

This programme aims to stimulate rural economies by promoting innovation and entrepreneurship in green industries. By establishing rural innovation hubs, supporting local businesses, organizing community forums, and facilitating market access, the programme seeks to create sustainable economic opportunities, reduce dependency on traditional livelihoods, and enhance resilience through diversification.

#### Actions:

- i. Establish rural innovation hubs or incubators to support the development of local businesses and startups focused on renewable energy, sustainable agriculture, eco-tourism, and other green industries.
- ii. Use existing community resources and volunteer networks to establish low-cost innovation hubs or entrepreneurship centres in community spaces.
- iii. Organise community forums, pitch competitions, and local markets to showcase and support grassroots entrepreneurship and small-scale enterprises.
- iv. Facilitate knowledge-sharing and skills development through peer-to-peer learning, mentorship programs, and online training platforms.
- v. Facilitate access to markets, networks, and supply chains for rural producers and entrepreneurs through partnerships with wholesalers, retailers, and online platforms.

### Programme 4.2: Capacity Building and Skills Development

This programme focuses on enhancing the skills and capacities of rural residents to adapt to changing economic and environmental conditions. Through collaboration with NGOs, vocational training centers, and local industries, the programme offers cost-effective training in sustainable practices and technologies, creates job placement opportunities, and leverages digital platforms to provide accessible learning, thereby empowering individuals and improving livelihoods.

#### Actions:

- i. Collaborate with local NGOs, community colleges, and vocational training centres to offer cost-effective training programs and workshops on sustainable farming practices, renewable energy technologies and green building techniques that are tailored to the needs of rural residents.
- ii. Leverage digital technology and mobile learning platforms to provide accessible and affordable training opportunities to reach a broader audience.
- iii. Partner with local industries and employers to create job placement programs, apprenticeships, and internship opportunities for youth and unemployed individuals seeking entry into the workforce.

### Programme 4.3: Infrastructure Development and Access to Services

This programme aims to improve rural infrastructure and access to essential services using low-cost, labour-intensive methods. By implementing community-driven infrastructure projects, exploring innovative financing mechanisms, and partnering with various stakeholders, the programme seeks to

enhance the quality of life in rural areas, support economic activities, and build resilience to climate impacts.

**Actions:**

- i. Implement low-cost infrastructure improvements, such as road repairs, community water points, and renewable energy installations, using labour-intensive methods and locally available materials.
- ii. Explore innovative financing mechanisms, including crowd-funding campaigns, community savings groups, and microfinance initiatives, to fund infrastructure projects and service upgrades.
- iii. Seek partnerships with government agencies, development organisations, and private sector stakeholders to leverage resources and reduce financial burdens.

**Programme 4.4: Natural Resource Management and Environmental Conservation**

This programme promotes sustainable management of natural resources and environmental conservation. By engaging local schools, youth groups, and community organizations in environmental education and hands-on conservation activities, and providing technical assistance to farmers, the programme aims to preserve biodiversity, improve ecosystem services, and encourage sustainable agricultural practices, contributing to long-term environmental resilience.

**Actions:**

- i. Foster partnerships with local schools, youth groups, and environmental organisations to promote environmental education, awareness, and stewardship within the community.
- ii. Engage local volunteers and community groups in hands-on conservation activities, such as tree planting, habitat restoration, and waste management initiatives, leveraging community labour and resources.
- iii. Provide technical assistance, training, and incentives for farmers to adopt sustainable agricultural practices, such as agroforestry, organic farming, soil conservation, and water-efficient irrigation methods.

## 6. Implementation Framework

The implementation framework summarises the adaptation plan and indicate responsibilities, timeframes, and priorities.

### 6.1. Implementation framework: Goal 1

Goal 1: To prioritise the health and safety of communities in the face of a changing climate

Adaptation programme 1.1: Heatwave Preparedness and Response				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Conduct heat vulnerability assessments.</p> <p>In this action heat vulnerability assessments to identify high-risk areas and vulnerable populations, such as the elderly, children, and outdoor workers will be conducted.</p>	<p>Temperature increases Increased heat stress Increase in heat waves</p>	<p>Environmental Department and Community Services Department in collaboration with local community</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>ii. Develop heatwave early warning systems and public awareness campaigns.</p> <p>In this action heatwave early warning systems and public awareness campaigns to educate residents on heat-related risks and protective measures will be developed.</p>	<p>Temperature increases Increased heat stress Increase in heat waves</p>	<p>John Taolo Gaetsewe Disaster Management Centre in collaboration with local community</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>iii. Establish cooling centres in community facilities.</p> <p>In this action cooling centres will be established in community facilities, such as libraries and recreation centres, to provide refuge during heatwaves.</p>	<p>Temperature increases Increased heat stress Increase in heat waves</p>	<p>Community Services Department</p>	<p>Short term (&lt; 5 years)</p>	<p>Medium</p>
<p>iv. Train healthcare workers, emergency responders, and community volunteers</p> <p>In this action healthcare workers, emergency responders, and community</p>	<p>Temperature increases Increased heat stress Increase in heat waves</p>	<p>Department of Health in collaboration with John Taolo Gaetsewe District Disaster Management Centre</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>

volunteers will be trained on heat illness prevention, recognition, and treatment.				
iv. Implement urban greening initiatives.  In this action urban greening initiatives, such as planting trees and creating green spaces, to mitigate the urban heat island effect and provide natural cooling will be implemented.	Temperature increases Increased heat stress Increase in heat waves	Development and Town Planning Department	Medium term (5-10 years)	Medium

Adaptation programme 1.2: Community Health and Well-being Promotion				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Provide access to affordable healthcare services and preventive care programs.  In this action access to affordable healthcare services and preventive care programs to address climate-related health impacts, such as heat-related illnesses, respiratory diseases, and vector-borne diseases will be provided.	Temperature increases Increased heat stress Increase in heat related illnesses	John Taolo Gaetsewe District Environmental Health Department in collaboration with local health clinics and community organisations	Short term (< 5 years)	High
ii. Establish community emergency response teams and train residents.  In this action community emergency response teams will be established, and residents will be trained in first aid, disaster preparedness, evacuation procedures. and health promotion to build local capacity and resilience in the face of climate-related hazards.	Increased heat stress Temperature increases Remoteness, access to available services	John Taolo Gaetsewe District Disaster Management Centre in collaboration with local community leaders and organisations	Short term (< 5 years)	High
iii. Develop mental health and psychosocial support programs.  In this action mental health and psychosocial support programs will be	Temperature increases Increased heat stress Increase in heat related illnesses	John Taolo Gaetsewe District Environmental Health Department in collaboration with local health clinics and	Medium term (5-10 years)	High

developed to address the psychological impacts of climate change, such as anxiety, stress, and trauma.		community organisations		
iv. Strengthen social support networks and community resilience.  In this action social support networks and community resilience will be strengthened through peer support groups, neighbourhood associations, and faith-based organisations.	Temperature increases Increased heat stress Increase in heat related illnesses	Development and Town Planning in collaboration with NGOs	Medium term (5-10 years)	Medium
v. Promote healthy lifestyle behaviours  In this action healthy lifestyle behaviours, such as physical activity, nutrition, and stress management, through community-based education and outreach initiatives will be promoted.	Temperature increases Increased heat stress Increase in heat related illnesses	Community Services Department in collaboration with local health clinics and community organisations	Short term (< 5 years)	High
vi. Enhance access to clean water, sanitation and hygiene facilities.  In this action access to clean water, sanitation, and hygiene facilities to prevent waterborne diseases and ensure basic hygiene practices during extreme weather events will be enhanced.	Temperature increases Increased heat stress Increase in heat related illnesses	Technical Services Department and development and town planning	Short term (< 5 years)	High

Adaptation programme 1.3: Infrastructure Resilience and Emergency Preparedness				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Assess the vulnerability of critical infrastructure.  In this action the vulnerability of critical infrastructure, such as healthcare facilities, schools, and water supply systems, to	Temperature increases	Technical Services Department	Short term (< 5 years)	High

climate-related hazards and extreme weather events will be assessed.				
<p>ii. Enhance the resilience of existing municipal infrastructure.</p> <p>In this action opportunities to enhance the resilience of existing infrastructure using low-cost, resource-efficient measures, such as retrofitting buildings with locally sourced materials, improving drainage systems using community labour, and repurposing underutilised spaces for emergency shelters will be identified.</p>	Increased heat stress Temperature increases	Technical Services Department in collaboration with local businesses, NGOs and community groups	Medium term (5-10 years)	High
<p>iii. Develop partnerships.</p> <p>In this action efforts will be made to seek partnerships with local businesses, NGOs, and community groups to leverage additional resources and expertise for infrastructure upgrades.</p>	Temperature increases	Municipal Manager and Technical Services Department and development and town planning department		

## 6.2. Implementation framework: Goal 2

Goal 2: To ensure water security in the face of climate change.

Adaptation programme 2.1: Groundwater Management and Protection				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Conduct hydrogeological assessments.</p> <p>In this action a hydrogeological assessment will be conducted to understand groundwater recharge potential and identify sustainable yield limits for aquifers in the municipality.</p>	Water supply vulnerability Water security	Technical Services in collaboration with groundwater experts e.g. geohydrologist	Short term (< 5 years) (< 5 years)	High



<p>ii. Develop groundwater monitoring networks.</p> <p>In this action groundwater monitoring networks using low-cost monitoring wells and community-based water quality testing kits to assess groundwater levels and quality will be developed.</p>	<p>Water supply vulnerability Water security</p>	<p>Technical Services in collaboration with community</p>	<p>Short term (&lt; 5 years) (&lt; 5 years)</p>	<p>High</p>
<p>iii. Implement aquifer recharge projects.</p> <p>In this action aquifer recharge projects, such as managed aquifer recharge and infiltration basins, to enhance groundwater replenishment during periods of low rainfall will be implemented.</p>	<p>Water supply vulnerability Water security</p>	<p>Technical Services</p>	<p>Medium term (5-10 years)</p>	<p>Medium</p>
<p>iv. Regulate groundwater extraction.</p> <p>In this action groundwater extraction will be regulated through permit systems and licensing schemes to prevent overexploitation of aquifers and ensure equitable distribution of groundwater resources.</p>	<p>Water supply vulnerability Water security</p>	<p>Technical Services</p>	<p>Short term (&lt; 5 years) (&lt; 5 years)</p>	<p>High</p>
<p>v. Establish groundwater protection zones.</p> <p>In this action groundwater protection zones will be established around critical recharge areas and vulnerable aquifers, implementing land use regulations to prevent contamination and pollution.</p>	<p>Water supply vulnerability Water security</p>	<p>Technical Services</p>	<p>Medium term (5-10 years)</p>	<p>High</p>

Adaptation programme 2.2: Sustainable Water Management and Conservation.				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Implement water conservation education campaigns.</p>	<p>Water security Water supply vulnerability</p>	<p>Community Services Department in</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>

In this action water conservation education campaigns targeting residents, schools, and businesses to raise awareness about the importance of water conservation practices will be implemented.		collaboration with community		
ii. Provide low-cost water saving devices.  In this action low-cost water-saving devices, such as faucet aerators and low-flow showerheads will be provided to households and businesses to reduce water consumption. The municipality can partner with local hardware stores or suppliers to offer aerators and low flow showerheads at subsidised prices.	Water supply vulnerability Water security	Technical Services in collaboration with local hardware stores and suppliers	Short term (< 5 years)	High
iii. Develop community-based rainwater harvesting initiatives.  In this action community-based rainwater harvesting initiatives will be developed to capture and store rainwater for non-potable uses, such as irrigation and toilet flushing.	Water supply vulnerability Water security	Community Services Department and technical services in collaboration with community	Short term (< 5 years)	High
iv. Conduct leak detection surveys and repair programs.  In this action leak detection surveys and repair programs will be conducted to minimise water losses in distribution networks, prioritising areas with high leakage rates.	Water supply vulnerability Water security	Technical Services Department	Short term (< 5 years)	High
v. Establish water metering and monitoring systems.  In this action water metering and monitoring systems will be established to track water usage and identify opportunities for efficiency improvements.	Water supply vulnerability Water security	Technical services	Short term (< 5 years)	High

Adaptation programme 2.3: Integrate Water Resource Management				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Conduct integrated water resource assessments.</p> <p>In this action integrated water resource assessments will be conducted to evaluate the availability and demand for surface water and groundwater resources in the municipality.</p>	<p>Water security Water supply vulnerability</p>	<p>Technical Services Department</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>ii. Develop water allocation plans.</p> <p>In this action water allocation plans will be developed that prioritise sustainable water use practices and equitable distribution of water resources among different sectors and users.</p>	<p>Water supply vulnerability Water security</p>	<p>Technical Services and Development and Town Planning Department</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>iii. Promote multi-stakeholder partnerships.</p> <p>In this action stakeholder partnerships among various stakeholders involved in water resource management, including government agencies, local authorities, community groups, NGOs, private sector, and research institutions will be formed to engage stakeholders in joint problem solving to develop and implement water management strategies.</p>	<p>Water supply vulnerability Water security</p>	<p>Technical Services Department and Municipal manager in collaboration with NGO's, community groups, private sector, and research institutions</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>iv. Invest in water infrastructure upgrades.</p> <p>In this action the municipality should invest in water infrastructure upgrades and resilience measures, such as storage reservoirs, and distribution networks, to</p>	<p>Water supply vulnerability Water security</p>	<p>Technical Services Department</p>	<p>Medium term (5-10 years)</p>	<p>Medium</p>

enhance water supply reliability and resilience to climate change impacts.				
v. Facilitate community engagement.  In this action the municipality will facilitate community engagement and participation in water governance processes (i.e. implementation of policies related to the use and management of water resources) through public consultations, stakeholder workshops, and citizen science initiatives.	Water supply vulnerability Water security	Technical services	Short term (< 5 years)	High

### 6.3. Implementation framework: Goal 3

Goal 3: To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events.

Adaptation programme 3.1: Climate Resilient Infrastructure and Urban Planning				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Conduct vulnerability assessments.  In this action the municipality will conduct low-cost vulnerability assessments of critical infrastructure using existing data and community input to identify areas at risk from extreme weather events and climate-related hazards.	Fire Flood Increase in temperature.	Technical Services Department	Short term (< 5 years)	High
ii. Implement retrofitting measures.  In this action the municipality will implement simple retrofitting and resilience measures for existing infrastructure, such as clearing drainage systems, reinforcing buildings with locally sourced materials, and promoting green spaces to mitigate heat island effects.	Increased temperature Fire risk	Municipal Works Department	Short term (< 5 years)	Medium

<p>iii. Updating zoning regulations.</p> <p>In this action the municipality will incorporate climate resilience considerations into existing urban planning processes by updating zoning regulations and building codes with minimal cost adjustments.</p>	<p>Increase in heat waves. Wildfire risk</p>	<p>Development and Town Planning Department</p>	<p>Medium</p>	<p>High</p>
<p>iv. Establish early warning systems.</p> <p>In this action community-based early warning systems and emergency response protocols will be established for extreme weather events, utilising local networks and volunteers to disseminate information and coordinate responses.</p>	<p>Increased heat stress Wildfire risk</p>	<p>John Taolo Gaetsewe District Disaster Management Department in collaboration with community</p>	<p>Short</p>	<p>High</p>

Adaptation programme 3.2: Sustainable Land Use and Natural Resource Management				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Promote soil conservation projects.</p> <p>In this action the municipality will promote community-led soil conservation and reforestation projects using volunteer labour and locally available resources to enhance ecosystem resilience and reduce erosion.</p>	<p>Wildfire risk</p>	<p>Community Development Department in collaboration with community</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>ii. Provide training for farmers.</p> <p>In this action training and support will be provided for small-scale farmers on sustainable agriculture practices and water-efficient irrigation techniques, emphasizing low-cost solutions that improve soil health and crop yields. This can be done through</p>	<p>Increase in temperature. Reduced crop yield Food security</p>	<p>Municipality in collaboration with agricultural extension services, community organisations, educational institutions and local farmers</p>	<p>Short term (&lt; 5 years)</p>	<p>Medium</p>

identifying existing resources such as community organisations and educational institutions, using the local knowledge and experience of local farmers who are already practicing sustainable agriculture				
iii. Advocate for habitat protection.  In this action the municipality will advocate for the protection of natural habitats and green spaces through community-driven conservation efforts and awareness campaigns, leveraging existing volunteer networks and partnerships.	Increase in temperature. Wildfire risk		Short term (< 5 years)	High
iv. Establish community-managed green spaces.  In this action community-managed conservation areas and urban green spaces will be established to preserve biodiversity and ecosystem services, utilizing vacant lots and public lands for community gardening and recreation.	Increase in temperature. Wildfire risk	Development and Town planning in collaboration with community	Medium term (5-10 years)	Medium

Adaptation programme 3.3: Community Engagement and Capacity Building				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Facilitate Risk Assessments  In this action participatory risk assessments and vulnerability mapping exercises with community members and local organizations will be facilitated to identify priority areas for adaptation and resilience-building.	Wildfire risk Increase in temperature. Increase in heat stress	Community Development Department in collaboration with community	Short term (< 5 years)	High

<p>ii. Develop resilience plans.</p> <p>In this action community resilience plans and adaptation strategies will be developed in collaboration with local stakeholders, including residents, community organisations, and indigenous groups, to address specific climate risks and enhance adaptive capacity.</p>	<p>Increase in temperature. Reduced crop yield Food security Wildfire risk</p>	<p>Municipality in collaboration with community</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>iii. Provide capacity building workshops.</p> <p>In this action capacity-building workshops and training sessions will be provided for residents, community leaders, and government officials on climate change adaptation, disaster preparedness, and emergency response, to empower communities to take proactive measures to reduce vulnerability and build resilience.</p>	<p>Increase in temperature. Wildfire risk Increase in heat stress Reduced crop yield Food security</p>	<p>Community Development Department</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>iv. Foster partnerships</p> <p>In this action the municipality will foster partnerships and collaboration between government agencies, non-profit organizations, academic institutions, and private sector actors to leverage resources, expertise, and networks for climate adaptation initiatives at the local level.</p>	<p>Increase in temperature. Wildfire risk Increase in heat stress Reduced crop yield Food security</p>	<p>Development and Town planning in collaboration with community</p>	<p>Medium term (5-10 years)</p>	<p>Medium</p>

### 6.4. Implementation framework: Goal 4

Goal 4: To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.

Adaptation programme 4.1: Rural Economic Diversification and Innovation				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Establish rural innovation hubs.</p> <p>In this action rural innovation hubs or incubators to support the development of local businesses and startups focused on renewable energy, sustainable agriculture, eco-tourism, and other green industries will be established</p>	Economic vulnerability Change in crop production.	Local Economic Development Department in collaboration with local community centres and NGOs	Short term (< 5 years)	Medium
<p>ii. Use community resources for innovation centres.</p> <p>In this action existing community resources and volunteer networks will be used to establish low-cost innovation hubs or entrepreneurship centres in community spaces.</p>	Economic vulnerability	Development and town planning in collaboration with local community centres and NGOs	Short term (< 5 years)	High
<p>iii. Organise community forums and markets.</p> <p>In this action the municipality will organise community forums, pitch competitions, and local markets will be organised to showcase and support grassroots entrepreneurship and small-scale enterprises.</p>	Economic vulnerability	Local economic development department in collaboration with local business associations and community leaders	Short term (< 5 years)	High
<p>iv. Facilitate access to markets and networks.</p> <p>In this action the municipality will facilitate access to markets, networks, and supply chains for rural producers and</p>	Economic vulnerability	Local economic development department in collaboration with Trade Associations and Online Platforms	Medium term (5-10 years)	High



entrepreneurs through partnerships with wholesalers, retailers, and online platforms.				
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Adaptation programme 4.2: Capacity Building and Skills Development				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Offer training programs and workshops.</p> <p>In this action municipality will collaborate with local NGOs, community colleges, and vocational training centres to offer cost-effective training programs and workshops on sustainable farming practices, renewable energy technologies and green building techniques that are tailored to the needs of rural residents.</p>	<p>Economic vulnerability Change in crop production. Increased risk to livestock Increase in temperature</p>	<p>Development and town planning department in collaboration with NGOs and vocational training centres</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>ii. Leverage digital technology for learning.</p> <p>In this action the municipality will facilitate knowledge-sharing and skills development through peer-to-peer learning, mentorship programs, and online training platforms.</p>	<p>Economic vulnerability Socio-economic vulnerability</p>	<p>Local Economic Development department and development and town planning department in collaboration with IT department and online platforms</p>	<p>Short term (&lt; 5 years)</p>	<p>High</p>
<p>iii. Create job placement programs.</p> <p>In this action with municipality will partner with local industries and employers to create job placement programs, apprenticeships, and internship opportunities for youth and unemployed individuals seeking entry into the workforce.</p>	<p>Economic vulnerability Socio-economic vulnerability</p>	<p>Local Economic Development department and Development and town planning department in collaboration with local industries and employers</p>	<p>Medium term (5-10 years)</p>	<p>High</p>

Adaptation programme 4.3: Infrastructure Development and access to services				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Implement low-cost infrastructure improvements.</p> <p>In this action the municipality will implement low-cost infrastructure improvements, such as road repairs, community water points, and renewable energy installations, using labour-intensive methods and locally available materials.</p>	Economic vulnerability Increased isolation of rural communities	Technical services department in collaboration with community development department and NGOs	Medium term (5-10 years)	High
<p>ii. Explore innovative financing mechanisms.</p> <p>In this action the municipality will explore innovative financing mechanisms, including crowd-funding campaigns, community savings groups, and microfinance initiatives, to fund infrastructure projects and service upgrades.</p>	Economic vulnerability	Municipal Finance Department in collaboration with local savings groups and financial institutions	Medium term (5-10 years)	High
<p>iii. Seek partnerships for resource leveraging.</p> <p>In this action the municipality will seek partnerships with government agencies, development organizations, and private sector stakeholders to leverage resources and reduce financial burdens.</p>	Economic vulnerability	Corporative service in collaboration with Government agencies and private sector stakeholders	Medium term (5-10 years)	High

Adaptation programme 4.4: Natural Resource Management and Environmental Conservation				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
<p>i. Promote environmental education and stewardship.</p>	Economic vulnerability	Development and town planning department, in collaboration with	Medium term (5-10 years)	High

<p>In this action the municipality will foster partnerships with local schools, youth groups, and environmental organisations to promote environmental education, awareness, and stewardship within the community.</p>		<p>schools, youth groups and NGOs</p>		
<p>ii. Engage community in conservation activities.</p> <p>In this action the municipality will engage local volunteers and community groups in hands-on conservation activities, such as tree planting, habitat restoration, and waste management initiatives, leveraging community labour and resources.</p>	<p>Economic vulnerability</p>	<p>Development and town planning in collaboration with community groups and NGOs</p>	<p>Medium term (5-10 years)</p>	<p>High</p>
<p>iii. Provide technical assistance for sustainable farming.</p> <p>In this action the municipality will provide technical assistance, training, and incentives for farmers to adopt sustainable agricultural practices, such as agroforestry, organic farming, soil conservation, and water-efficient irrigation methods will be provided.</p>	<p>Economic vulnerability Change in fruit production</p>	<p>Development and town planning department in collaboration with agricultural extension services and NGOs</p>	<p>Medium term (5-10 years)</p>	<p>High</p>

## 7. Implications for the PSHDA

When taking into consideration the vision for the Kathu PSHDA which is as follows: “*The Kathu PSHDA seeks to achieve an integrated and sustainable human settlement beyond the advent of mining which would create opportunities for all who reside here through sustained economic growth and quality basic services*”, the following recommendations can be made:

- In the planning and development of the Kathu PSHDA, planners should ensure that new developments promote health and safety by incorporating green spaces, pedestrian-friendly infrastructure, and access to healthcare facilities.
- Significant increases in temperature and increases in heatwaves are predicted for the municipality. Measures should be implemented to mitigate the impact of climate change on health, such as heat-resilient design, effective waste management systems, and disease prevention programmes.
- The projected decrease in rainfall and increase in population makes the Kathu PSHDA vulnerable to water shortages in future. Water-sensitive urban design principles should be integrated into neighbourhood planning to maximise water efficiency and reduce reliance on centralised water supply systems.
- Rainwater harvesting, greywater recycling, and sustainable landscaping practices should be promoted to conserve water and enhance resilience to droughts and water shortages.
- Settlements should be designed to withstand climate-related hazards, such as floods and storms, through resilient infrastructure, floodplain management, and disaster risk reduction measures.
- Nature-based solutions such as green infrastructure and wetland restoration, to buffer communities from the impacts of extreme weather events and enhance ecosystem services should be incorporated in planning and design.
- Economic diversification and entrepreneurship should be fostered within the Kathu PSHDA by supporting small-scale businesses, promoting local food systems, and creating job opportunities in renewable energy and green technologies.

## 8. Recommendations for Mainstreaming

Mainstreaming is the process of integrating climate change considerations into existing sectoral plans, other instruments and decision-making processes across various sectors and levels of governance. It involves recognising that climate change impacts and risks cut across multiple sectors and require a holistic approach to address effectively.

Mainstreaming climate change involves several key elements:

- **Policy integration:** Embedding evidence of climate change, as well as climate change adaptation and mitigation considerations into sectoral policies and strategies, such as those related to disaster risk management, energy, water resources, transportation, and urban planning. This ensures that climate change is not treated as a standalone issue but is instead integrated into broader development agendas.
- **Institutional integration:** Incorporating climate change responsibilities and expertise within departments. This may involve establishing a dedicated but decentralised climate change unit, as well as fostering collaboration and coordination among departments and relevant external stakeholders.

Incorporating climate response outcomes in the KPIs of all relevant departments, will ensure that progress towards climate goals can be tracked and measured.

- **Capacity building:** Enhancing the knowledge, skills, and capacities of politicians, decision-makers, and practitioners to understand and address climate change effectively. This includes providing training, technical assistance, and access to relevant information and tools, such as the GreenBook. By improving their understanding of climate change and the need for adaptation, these groups can better integrate climate considerations into their work.
- **Budgeting and financing:** Allocating resources and funding to support climate change adaptation and mitigation activities within existing budgets and financing mechanisms. This may involve reallocating funds from other priorities, leveraging external sources of finance, or integrating climate considerations into budget planning processes.
- **Establishing networks and partnerships:** Establishing networks or partnerships with civil society organisations, research councils, the private sector, different spheres of government, and other relevant entities could bolster climate adaptation efforts.
- **Monitoring and evaluation:** Establishing systems for monitoring and evaluating the effectiveness of mainstreaming efforts and tracking progress towards climate-related goals and targets. This helps ensure accountability and facilitates learning and adaptation over time.

Climate change mainstreaming is essential for building resilience and promoting sustainable development in the face of climate change. By integrating climate considerations into decision-making processes and actions across sectors, mainstreaming helps minimise future risks, maximise opportunities for adaptation and mitigation, and enhance overall resilience to climate change impacts.

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