



# GREENBOOK

*adapting settlements for the future*



## Overberg District Municipality Adaptation Plan

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# Table of Contents

Table of Contents .....	iii
List of Figures .....	iv
List of Tables .....	iv
List of Acronyms and Abbreviations .....	v
Glossary of Terms .....	vi
1. Introduction .....	1
1.1. Policy Framework .....	2
1.2. Outline of the Climate Change Adaptation Plan .....	3
2. Adaptation Planning Framework .....	4
2.1. Adaptation principles .....	4
2.2. Adaptation approach .....	5
2.3. Adaptation programmes and actions .....	6
2.4. Stakeholder engagement process .....	7
3. Summary of Climate Risk Profile .....	8
3.1. Climate projections, vulnerabilities and impacts .....	8
3.1.1 Climate projections .....	9
3.1.2 Municipal and settlement vulnerabilities .....	10
3.1.3 Changing biomes .....	10
3.2 Priority climate-related hazards .....	11
3.2.1 Increasing temperatures .....	11
3.2.2 Drought and water security .....	13
3.2.3 Flooding .....	13
3.2.4 Coastal risk .....	14
3.2.5 Wildfires .....	14
4. Adaptation Goals, Programmes and Actions .....	14
4.1 Adaptation priorities identified elsewhere .....	14
4.2. Adaptation goals .....	17
4.2.1. Adaptation programme: Goal 1: Ensure water security for human consumption and Irrigation under a changing climate .....	17
4.2.2. Adaptation programme: Goal 2: To protect and rehabilitate ecological infrastructure to be able to support climate change response .....	20
4.2.3. Adaptation programme: Goal 3: Increase adaptative capacity of the growing population .....	21
5. Implementation Framework .....	24

5.1.	Goal 1: Ensure water security for .....	24
5.2.	Goal 2: To protect and rehabilitate ecological infrastructure to be able to support climate change response.....	29
5.3.	Goal 3: Increase adaptative capacity of the growing population.....	32
6.	Recommendations for Mainstreaming .....	38
7.	Bibliography .....	40

## List of Figures

Figure 1: Outline of the Climate Change Adaptation Plan. ....	3
Figure 2: The interplay between hazards, vulnerability and exposure that determines risk (based in IPCC, 2014 and IPCC, 2021) .....	5
Figure 3: Biomes in the Overberg DM today (left) and predicted (right) using a high-risk scenario (Source: SANParks 2011).....	11

## List of Tables

Table 1: The adaptation approach.....	6
Table 2: Highest priority ranked Climate Response Measures as established in ODM (2017, Annex 3).....	15

## List of Acronyms and Abbreviations

<b>CSIR</b>	Council for Scientific and Industrial Research
<b>CSIRO</b>	Commonwealth Scientific and Industrial Research Organisation
<b>DFFE</b>	Department of Forestry, Fisheries and the Environment
<b>DM</b>	District Municipality
<b>DRR</b>	Disaster risk reduction
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>LRT</b>	Let's Respond Toolkit
<b>ODM</b>	Overberg District Municipality
<b>SPLUMA</b>	Spatial Planning and Land Use Management Act, 2013 (Act No.16 of 2013)

## Glossary of Terms

<b>Adaptation actions</b>	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, 2023).
<b>Adaptation planning</b>	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).
<b>Adaptive capacity</b>	“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).
<b>Climate change adaptation</b>	“In human systems, the process of adjustment to <b>actual</b> or <b>expected</b> climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to <b>actual</b> climate and its effects; human intervention may facilitate adjustment to expected climate and its effects” (IPCC, 2022, p. 2898).
<b>Climate change mitigation</b>	“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).
<b>Climate hazards</b>	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).

<b>Climate risk</b>	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, [as well as] infrastructure and ecosystems” (IPCC, 2022, p. 144). In the IPCC’s 6 <sup>th</sup> 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).
<b>Coping capacity</b>	“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” (IPCC, 2022, p. 2904).
<b>Disaster risk reduction</b>	“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).
<b>Exposure</b>	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).
<b>Mainstreaming</b>	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).
<b>Resilience</b>	“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).
<b>Sensitivity</b>	“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).
<b>Vulnerability</b>	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 Overberg District Municipality, 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 | Adapting settlements for the future](#)).

The Climate Risk Profile report 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 District Municipality.
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 the Overberg District Municipality with a comprehensive strategy to navigate the complexities of climate change, reduce vulnerability and exposure, and champion sustainable development.

The Adaptation Plan briefly outlines the policies constituting the framework for adaptation planning and implementation 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 Overberg District Municipality by aligning it with adaptation goals, programmes, and actions designed to address priority risks, as well as an implementation framework, designed to identify appropriate actors and enable the implementation of the strategy. Finally, the document concludes with recommendations aimed at

facilitating the integration of the proposed actions into broader initiatives, ensuring their effective mainstreaming.

## 1.1. 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, i.e. Act 16 of 2015, the Spatial Planning and Land Use Management Act (SPLUMA), i.e., Act No. 16 of 2013, the Climate Change Bill, i.e., 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** sets out climate change response requirements for all organs of state across all levels of government, as well as the institutional arrangements necessary to meet those requirements. Amongst them is the requirement 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, as well as the requirement for every metropolitan and district 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** outlines several actions that are 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 addition to the national Adaptation Strategy, the Western Cape Province and the Overberg DM have been developing policies which tackle climate Change response on a level relevant for local and sectoral decision makers. These include the **Status Quo Review of Climate Change and the Agriculture Sector of the**

**Western Cape Province** (WC 2016) which describes in detail the direct and indirect climate impacts for the AFF sector in the Western Cape, the **Overberg DM Climate Change Response Framework**, which aims to “give a strategic overview of climate change responses that is relevant for the Overberg region” (ODM 2017), and the **Western Cape Climate Response Strategy – Vision 2050** (WC 2023).

## 1.2. Outline of the Climate Change Adaptation Plan

Figure 1 below outlines the structure of the report, and includes a description of the development process, and components, of the Climate Change Adaptation Plan for the Overberg District Municipality. The first chapter introduces the District’s Climate Change Adaptation Plan and provides an overview of the national policy context for climate change adaptation planning and implementation, as well as an outline of the structure of the Adaptation Plan. Chapter 2 outlines the adaptation planning framework that forms the basis for the District’s Climate Change Adaptation Plan, and consists of adaptation principles, an adaptation approach, as well as adaptation goals, programmes and actions. Chapter 3 provides a summary of the District Municipality’s Climate Risk Profile report, which includes an overview of the climate projections, vulnerabilities and impacts identified for the District Municipality, as well as the key climate-related risks that need to be prioritised when undertaking climate change response. Chapter 4 outlines the adaptations goals, programmes and actions identified for the District Municipality, as informed by the key climate-related hazards facing the district. Chapter 5 provides a framework for the implementation of the adaptation programmes and actions identified for the Overberg District Municipality and considers the local government functions and actors (including nongovernmental actors) responsible for the implementation of the identified actions, as well as the costs and level of priority associated with each adaptation action. Chapter 6 provides recommendations on how the District Municipality can mainstream the identified programmes and actions into existing municipal processes and instruments, with the aim to ensure that climate change considerations are an integral part of all that local government is doing.

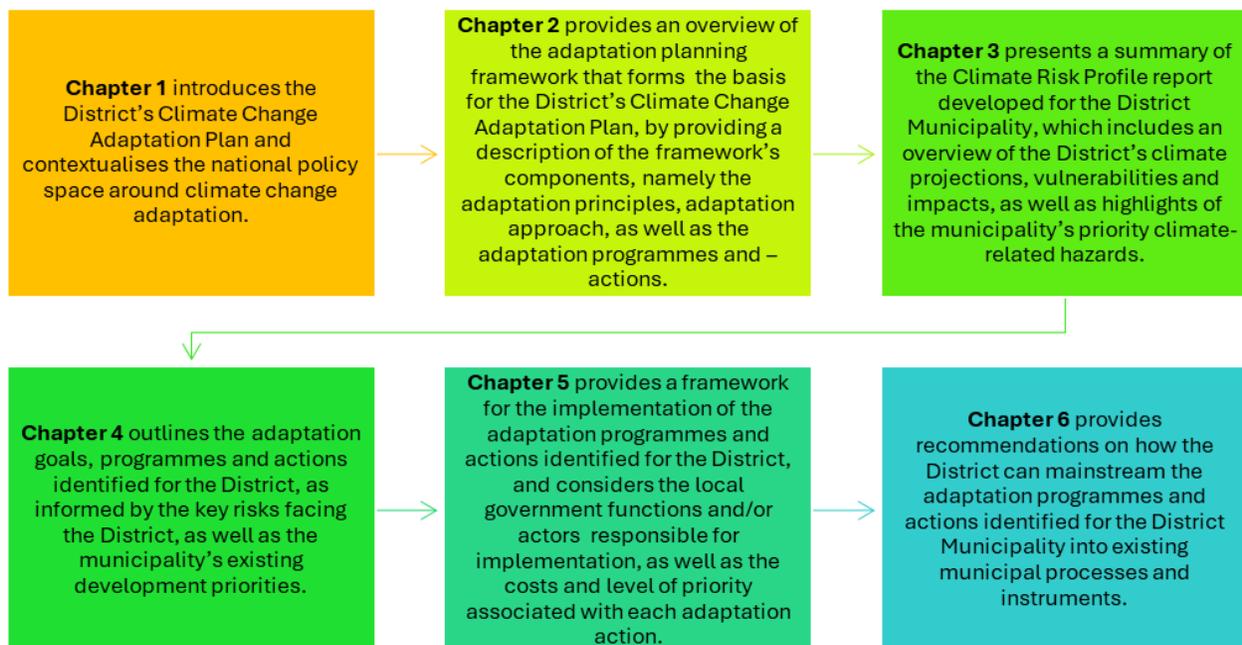


Figure 1: Outline of the Climate Change Adaptation Plan.

## 2. Adaptation Planning Framework

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.

### 2.1. Adaptation principles

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

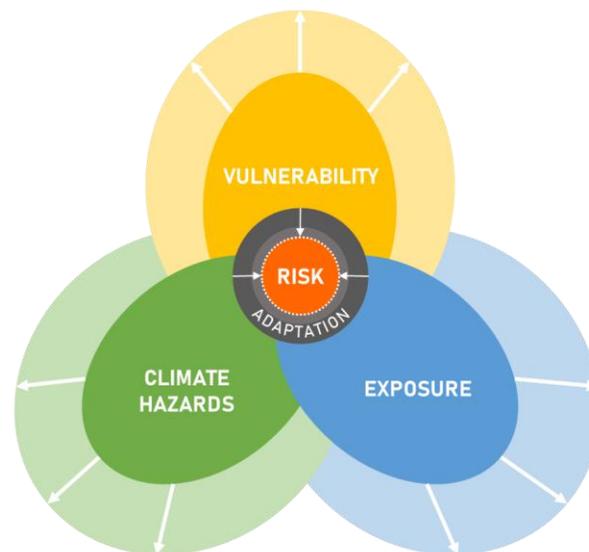
- i. **Accountability:** Local governments not only acknowledge but also assume responsibility for their climate change adaptation efforts. They willingly subject themselves to appropriate scrutiny and accept the duty to respond to this scrutiny.
- ii. **Continual learning and improvement:** Recognising 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 (also referred to as ‘actions’).

## 2.2. 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 2: The interplay between hazards, vulnerability and exposure that determines risk (based in 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*

<b>Understand climate risk for a specific geographic area</b>	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.
<b>Identify priority climate-related risks/zones</b>	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.
<b>Establish adaptation goals</b>	Identify adaptation goals to address priority risks/zones that speak to policy goals.
<b>Develop adaptation programmes and actions</b>	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: <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>
<b>Mainstream climate considerations into planning</b>	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.

### 2.3. Adaptation programmes and actions

An adaptation programme is a structured and systematic set of actions, initiatives, and interventions aimed at local governments to adapt their localities 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 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.

## 2.4. Stakeholder engagement process

To construct a Climate Change Adaptation Plan resonating with the specific requirements of the Overberg District Municipality, while appropriately addressing its significant risks – a stakeholder engagement component was factored into the adaptation planning process, which gave district municipal officials and practitioners a platform to provide meaningful input on both the Risk Profile report and Adaptation Plan. The first stakeholder engagement focused on the Climate Risk Profile report of the District Municipality, with the aim of validating the climate-related risks identified for the district (as flagged in the Risk Profile report), while securing the district's confirmation of the adaptation goals proposed in response to the identified risks.

The first engagement with Overberg District Municipality took place on 18 April 2024. During this engagement there was representation from the Overberg District Municipality, the Western Cape Province, the Department of Forestry, Fisheries, and the Environment's Local Government Support Programme, Cape Agulhas Local Municipality, Overstrand Local Municipality, and Theewaterskloof Local Municipality. All stakeholders including from the province, the district, and the local municipalities were provided with an opportunity to supply written comments on the Climate Risk Profile Report. Further written comments were received from the Western Cape Province Department of Environmental Affairs and Development Planning, noted, and addressed in the final report.

The second engagement took place after a draft Climate Change Adaptation Plan was developed. This engagement with Overberg District Municipality took place on 7 June 2024. During the engagement there was representation from provincial and local government officials from the Environmental Management function. As part of this engagement, each climate change adaptation programme identified under each goal, as well as each of the actions associated with the adaptation programmes, were intensely workshopped with the district and relevant local municipal officials and stakeholders, in an effort to gather comprehensive input that would help the project team finalise the document. Municipal officials and practitioners from various sectors – particularly those sectors that are either most vulnerable to climate change impacts, or those that are well-positioned to respond to climate change, particularly through adaptation, were invited to participate and provide input in an effort to fulfil section 7.1 (a) of the Climate Change Bill, and to achieve a holistic response to climate change. All engagements took place virtually.

The stakeholder engagement process offered a platform to interact with District stakeholders, thus, promoting a more profound comprehension of the District Municipality's context. Feedback gleaned from these engagement procedures has been deliberated upon and woven into the final draft Climate Change Adaptation Plan.

### 3. Summary of Climate Risk Profile

A Climate Risk Profile Report was prepared by the team, designed to complement this Plan. The Climate Risk Profile report serves as an essential resource for understanding the risks associated with climate change in Overberg District Municipality, with a particular focus on settlements. It is important to note that the Climate Risk Profile report only covers climate change, the occurrence of specific climate hazards, settlement vulnerability, and high-level overviews of the impacts of climate change on water vulnerability and the agriculture, forestry, and fisheries sector. The information is drawn from the GreenBook and does not include additional studies. Where relevant and possible, additional information as received from stakeholders during engagements, were integrated into the Climate Risk Profile. The specific focus of the Climate Risk Profile therefore has implications and limitation for the development of the Adaptation Plan. The Adaptation Plan can be supplemented and expanded on where certain priorities cannot be fully addressed.

This section of the Plan summarises the climate risk profile for Overberg District Municipality, drawing from the GreenBook Risk Profile Tool (available at: <https://riskprofiles.greenbook.co.za/>). Please consult the accompanying Climate Risk Profile Report for more detailed information.

#### 3.1. Climate projections, vulnerabilities and impacts

The following climate, vulnerability, and impact trends were identified in the Overberg District Municipal Risk Profile Report and through engagement with stakeholders (See Section 2.4). Additional to the Risk Profile

Report, district stakeholder identified observed changes in biomes which are driven by climatic changes and could lead to further changes in wildfire risk profiles. Additionally, district stakeholders highlighted the importance of the agricultural sector in the district and the need to offer insights on the possible impact of climate change on the agricultural sector. The climate change trends described below have been cross-referenced with the outputs of the Department of Agriculture (DoA) SmartAgri study on climate change trends and projections for the Western Cape, conducted by the Climate Systems Analysis Group (DoA, 2022). The methodology used in the SmartAgri study and the GreenBook differs from each other, however, overall projected trends are similar. Please consult the SmartAgri study for a more insights on seasonal projections, and historical observations. Below are the results from the GreenBook.

### 3.1.1 Climate projections

Historical climate records and climate projections show that the climate in the Overberg DM is changing. Between 1961-1990 the average annual temperature for most of the Theewaterskloof LM, Overstrand and the northern part of the Swellendam LM was about 16°C, with the eastern parts of the DM with an average of 18°C slightly warmer and the Villiersdorp-Genadendal area and the northern Swellendam LM with 14°C slightly cooler. Assuming a “worst-case” climate future, i.e. RCP8.5, for most of the district average annual temperatures are expected to be about 1.5°C higher for most of the district, with an average temperature increase of 2°C possible for the northern area of the Swellendam LM, the central area of Overstrand and the western part of Theewaterskloof.

Modelled average annual rainfall in most of the DM until 1990 ranged between 400-800mm, more rain of 800-1000mm in the mountainous areas and 300-400mm in some of the inland areas. Most of the rainfall occurs over the winter months and shoulder seasons between April and August. Assuming an RCP8.5 scenario, only a slight decrease of <100mm is expected for most of the Overberg district until 2050, with a tendency of a slight increase of annual rainfall (<100mm) towards the east and a potential decrease of up to 200mm towards the west. Apart from an overall decrease in rainfall over the region, projections also suggest that rainfall patterns could shift, with the rainfall season starting later and lasting into spring and early summer. It is important to note that there are significant uncertainties regarding rainfall projections.

As for projected changes in the annual average number of extreme rainfall days throughout the district over the period 2021-2050 under the RCP 8.5 scenario, a slight decrease by 1 to 3 days of annual extreme rainfall is expected for most of Overstrand LM and the western part of Theewaterskloof. Given projected decreases average rainfall, and in extreme rainfall events, typically the types of rainfall events that induce large amounts of run-off and thereby drive streamflow, it is possible that the occurrence of multi-year droughts will increase into the future.

Climate scenarios are not clear on the development of coastal storms in the future. While some scenarios predict a decrease in wind speeds (and storms) for South Africa’s west and southwest coasts, most scenarios, regionally and globally, predict an increase of coastal storm frequency and intensity. Coastal storms lead to coastal flooding due to wave run-up and storm surges; the impact of waves can lead to erosion of coastline and coastal property. A continued rise of global sea level, leading to permanent flooding of coastal areas, is undisputed, although the rate of rise might vary regionally.

### 3.1.2 Municipal and settlement vulnerabilities

The Overberg has always been considered as the breadbasket of the Cape and is largely given to grain farming, mainly wheat. Another important food farmed in the Overberg is fruit, with Grabouw being the second largest supplier of fruit in South Africa. Nestled in the Overberg, one can find the Kogelberg Biosphere Reserve (recognised and registered with UNESCO) populated with a large diversity of flowering plants not found anywhere else in the fynbos biome. The landscape is dominated by gently to moderately undulating hills enclosed by mountains and the ocean (COGTA 2020).

All four local municipalities in the Overberg have a very low socio-economic vulnerability, in national comparison. Socio-economic vulnerability index reflects on the vulnerability of households, and includes indicators for income, education, health, access to basic services, and safety. Environmental vulnerability is relatively high across the district and is largely driven by the high density of ecological areas and strategic water source areas, as well as measured human impact on the environment through degraded natural areas and urban encroachment.

In 2019, the economic sectors that contributed the most to employment in the Overberg DM were the trade sector with 25.9%. The finance sector with 18.7% employed the second highest number of people relative to the rest of the sectors. Agriculture, forestry and fisheries contribute 10.4%.

The 2022 Census shows that the district has already reached the projected population numbers for the medium growth scenario. The district's total population is expected to grow by 101% under the high growth scenario between 2011 and 2050. Especially in the Overstrand, the explosive population growth by 165% will put an enormous pressure on infrastructure, service delivery and the natural environment and resources. Settlements with the highest growth pressure here are Hermanus, Gans Bay, Hawston and Stanford.

The Overstrand LM's economy depends to a high degree on tourism and natural resources on its 160km long coast, and its coastal settlements are under high to extreme development pressure. In contrast, Cape Agulhas LM's coastline is more than 130 km long, with its few coastal settlements depending on tourism and fisheries. Swellendam LM's coastline is about 10 km long and harbours only few scattered residential or holiday properties.

Each of the 44 settlements in the district displays its own individual vulnerability profile. For instance, in Theewaterskloof LM, Grabouw faces the highest growth pressure, while Greyton faces the highest regional connectivity vulnerability, as well as very high environmental vulnerability. In Overstrand, Hawston has the highest socio-economic vulnerability while Van Dyks Bay has the highest economic vulnerability. In Cape Agulhas, Napier has both the greatest growth pressure and socio-economic vulnerability, while it is well connected and serviced.

### 3.1.3 Changing biomes

The predicted changes in climate conditions not only impact human settlements, economy and health, they also impact the natural environment. Currently, most of the Overberg DM falls within the fynbos biome (Figure 3). Fynbos is dependent on a winter rainfall regime, but predictions foresee an increasing influence of summer rainfall in parts of the province (ODM 2017), leading the fynbos biome to retreat towards the west. The area of the Swellendam LM and the eastern and coastal area of the Cape Agulhas LM might see a transition from Fynbos to Succulent Karoo vegetation. The Central area of the Swellendam LM might see an increase of Albany

Thicket, and its northern area an increase of dwarf shrub dominated Nama-Karoo and even desert (SANParks 2011). These biomes are generally less fire-prone than the fynbos vegetation they are replacing.

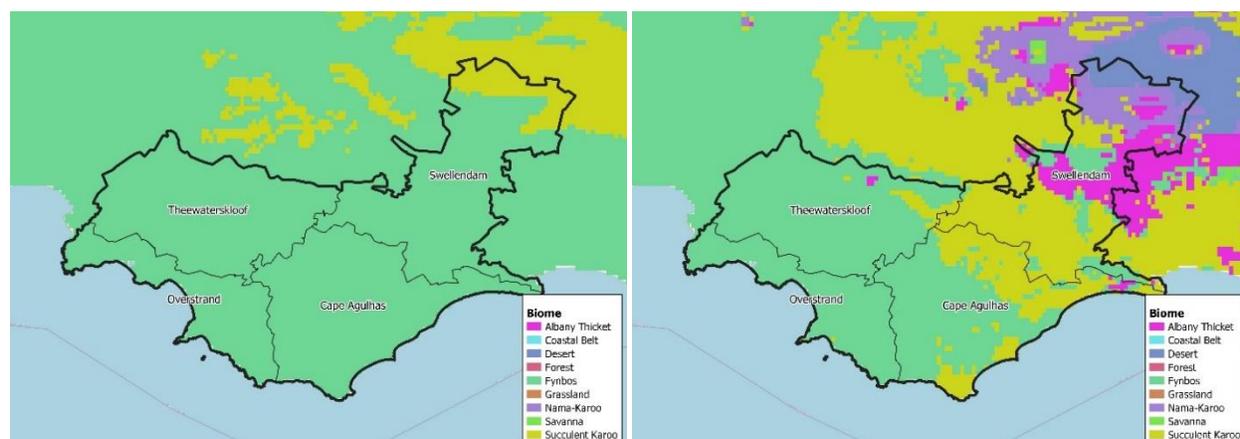


Figure 3: Biomes in the Overberg DM today (left) and predicted (right) using a high-risk scenario (Source: SANParks 2011)

## 3.2 Priority climate-related hazards

In its Climate Change Response Framework, the Overberg DM identified the key climate hazards threatening the district as “an increase in extreme weather events, such as intense rainfall, sea storm surges, increased wind speeds, drought and flood events” (ODM 2017), which are aligned with the hazards described in this section and verified during stakeholder engagements.

### 3.2.1 Increasing temperatures

Increasing temperatures in the Overberg DM are manifesting as increased annual average temperatures, increased annual minimum and maximum temperatures, an increase of heatwave days and an increase in very hot days. However, for most of the DM, only a slight increase in heatwave days (<4 days) is expected for 2050, ranging to 6 heatwave days per year in the northern parts of the DM. Overberg’s coastal zone is expected to be least affected by rising temperatures.

The Western Cape has seen substantial droughts in the last decades. It is expected that during the period 2015–2044 relative to the 1986–2005 baseline period, under the low mitigation “business as usual” emissions scenario (RCP 8.5) the tendency for droughts could further increase, particularly for the Swellendam LM. On a settlement level, Theewaterskloof and Overstrand settlements are at moderate risk of increase in drought tendencies while most Cape Agulhas and Swellendam settlements are at high risk of drought tendencies. Further, the predicted likely increase in temperatures might lead to an increase in evaporation which might put fruit yards and crops under stress.

In all four LMs the production of deciduous fruit plays an important role in their AFF sector GVA. Agriculture is generally highly exposed to, and often highly sensitive to climate variability and climate change, leading to significant impacts and potential disruption. However, the level of resilience depends on economic and social factors at the local scale.

The Review of Climate Change and Agriculture in the Western Cape Province (WC 2016) summarises the direct impacts of the expected warmer climate on agriculture in the Western Cape as follows:

- In the Western Cape, the agricultural system has proven its general resilience, and it is already well adapted to existing climate variability.
- For winter grains, expectations are that flexible adaptation approaches, the use of rotational production systems, the increasing shift to Conservation Agriculture, combined with the fertilising effects of rising atmospheric CO<sub>2</sub>, could provide enough resilience to warming of up to ~+2 °C. Opportunities for increased grain production would arise in currently marginal areas if rainfall increases there.
- The biggest threats of climate change to field crops are likely to lie in changes to the species, distribution and intensity of pests, diseases and weeds. The potential threat applies equally to drying or wetting scenarios.
- Irrigated horticultural crops are well studied and temperature thresholds known, with total rainfall being important only in relation to dam filling. Apart from apples, horticultural crops are not likely to become limited by moderate warming. Seasonal shifts in rainfall, temperature and humidity give rise to production and quality problems, including pressure from pests, diseases and weeds. These cannot currently be predicted with much certainty. Temperature extremes (heat waves) will have negative impacts, but gentle warming could make drying of fruit and vegetables more feasible in some areas. There are likely to be winning and losing production regions, and possibly new areas suitable for horticultural production. Technologies are likely to be available to deal with many arising issues.
- Dryland horticultural crops will experience range shifts in suitable production areas, with warmer and drier areas contracting and new areas becoming suitable which are currently too cool or wet. Responses will depend primarily on rainfall trends which are still very uncertain.
- Undercover protected crop cultivation will have to deal with increased cooling costs and risks associated with cooling failure, changing pressure of pests and diseases, and storm damage. Opportunities could open up in currently colder parts of the province, in areas where water resources may increase.
- Extensive livestock production (cattle, sheep, goats, ostriches) will be primarily impacted by rangeland vegetation changes (fodder), changes in pests and diseases, and availability of water. However, dairy cattle are at greater risk of experiencing heat stress with reduced milk production and fertility. Choice of breed is the primary adaptation already being used.
- Intensive livestock production (feedlot cattle, pigs, chickens) is likely to be adversely affected by heat stress in warmer regions, feed scarcity and high costs, and diseases. More resilient heat- and drought-tolerant indigenous breeds are available but currently used more by smallholder and subsistence farmers.

Additionally, the increase in atmospheric CO<sub>2</sub> concentrations is expected to affect plant growth, too.

Indirect climate impacts on the Overberg DM can be summarised as follows (WC 2016):

- Generic risks include floods, droughts, hail, frost and fires, and damage to agricultural infrastructure. In addition, rising input prices and volatile market prices are already squeezing margins, and these could be further affected by local and global impacts of climate change.
- Adverse impacts on the smallholder and emerging sector and the employment offered could heighten levels of poverty, drive urbanisation, and increase food insecurity.
- The well-being of agricultural workers is likely to be affected by increasing heat stress, diseases associated with floods and poor water quality, and physical danger associated with storms, floods and fires. Poor nutritional status and other health threats (stunting, obesity, HIV/AIDS) render rural workers less resilient to the demands of agricultural labour.

- On a production level, agriculture in the Western Cape shows fairly high levels of adaptive capacity, with only a few commodities likely to come under threat with a moderate warming (until mid-century). However, resilience may be declining because of multiple stresses interacting with climate, a higher frequency of events with insufficient time for recovery, and generally more difficult conditions in some of the more marginal regions.
- Under climate change, agriculture continues to show growth potential if current institutional, legal and other barriers to adaptation can be removed. A continued focus on partnerships and collaboration at all levels, and between the public and private sector, would set the sector on a new growth path. At a global level, the sector's major competitors in Mediterranean-climate regions are projected to face a bleaker future climatically than the Western Cape; this could present opportunities for increasing market share in commodities such as wine, olives and fresh fruit (WC 2016).

### 3.2.2 Drought and water security

Settlements in the Swellendam LM are 100% surface water dependent, Overstrand and Cape Agulhas LMs are about 37% groundwater dependent, while in the Theewaterskloof, settlements derive 18.4% of their water from groundwater and the remainder from surface. There are several strategic groundwater areas in the district including the Southwestern Cape Ranges and the Overberg Region strategic groundwater areas. Over large areas of Theewaterskloof, Overstrand and Cape Agulhas the groundwater recharge potential is expected to increase in the future, only the northern ranges of the Swellendam LM might see a – partly significant – decrease in recharge potential. However, extreme rainfall events and droughts can negatively impact surface water quality, while rising sea levels can cause seawater to leak into groundwater aquifers.

Given the high development pressure on the settlements in Overstrand, the highest risk of groundwater depletion towards 2050 exists here. The usage of other water sources, i.e. surface water, and the projected slight increase of rainfall might mitigate the pressure of the growing population on water resources, provided pollution control is in place. In the other LMs of the district, groundwater depletion risk is low to very low, or insignificant in Swellendam LM which is 100% surface water dependent. In all four LMs of the Overberg DM, the water demand is lower than the current water supply. Overstrand LM will see a continued, partly extreme, population increase in the future which could lead to an increase in water supply vulnerability, particular when combined with drying trends. Water supply vulnerabilities could be more severe during the dry season, particularly considering projected shifts in rainfall patterns that suggest the that the rainy season could start later into the winter months.

### 3.2.3 Flooding

During the last 10-20 years, flooding events have occurred in the Overberg DM almost every year. The total financial damage from floods in the Western Cape over this period was estimated to be R4.9billion, and a significant proportion of this damage occurred in the Overberg (ODM 2017). Most of the Overberg DM will experience no significant change in the number of extreme rainfall days. Over Theewaterskloof and Overstrand, the trend is leaning towards slight decreases while over Swellendam and Cape Agulhas, the trend is leaning towards slight increase in the number of extreme rainfall days.

Given the tentative decrease in extreme rainfall days, most settlements in Overberg will see a very low to low increase in rainfall-related flood likelihood, apart from the settlements of Suurbrak (Swellendam LM) and Elim (Cape Agulhas LM) which are expected to see a “moderate” increase in flooding. Overall, there is a high

frequency of observed flood events in the district, and therefore flooding will remain a priority risk which needs to be mitigated.

### 3.2.4 Coastal risk

In addition to the exposure to all other climate hazards described in this section, low-lying coastal areas are also at risk of flooding and erosion during sea storms, due to surges, wave run-up and rising sea levels. Further, low-lying estuarine areas are exposed to compound flooding during storms, as high rainfalls in the catchment, leading to high flow rates, combine with wave and surge impacts from the ocean side. There is likelihood of the frequency and intensity of sea storms to increase over the region in the future. Consequently, damages to coastal infrastructure and coastal property are likely to increase, exacerbated by the extreme development growth rate in the Overberg, especially in the Overstrand LM.

In awareness of the threat to coastal areas and in response to the requirements of the Integrated Coastal Management Act (ICM Act, Act 24 of 2018), in 2015, the district developed Coastal Management Lines to effectively prevent future coastal development in risk-prone areas (WC 2015). A residual risk for coastal flooding and erosion remains however for infrastructure already in place in risk-prone areas.

### 3.2.5 Wildfires

Currently, most of the Overberg DM is located in the fynbos biome. Consequently, all settlements apart from Cape Agulhas and Struisbaai, have a high fire risk in the wildland-urban interface (the boundary or interface between developed land and fire-prone vegetation) of the settlements, as the natural fynbos vegetation is fire-prone, and the DM has seen several destructive fires in the recent past (ODM 2017). Invasion of Fynbos by invasive woody alien vegetation leads to an increase in fuel loads, which leads to more intense and devastating fires. The fire risk, being very high as is, is not expected to increase by 2050 for most settlements, at least not as a result of the predicted climate conditions. An increase in fire risk might result however, from the rapidly growing population, especially in the Overstrand LM, if expansion of developments into the rural-urban interface is not controlled. Fire risk might decrease in the eastern part of the DM, should the natural vegetation undergo the changes which are predicted for the region (see above).

## 4. Adaptation Goals, Programmes and Actions

### 4.1 Adaptation priorities identified elsewhere

The section outlines the adaptation plan using goals and measures designed to help Overberg DM 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.

As mentioned above, extensive work has been done on Climate Response in the Western Cape province and the Overberg DM already, as documented in the Overberg Climate Response Framework (ODM 2017), the Status Quo Review of Climate Change and the Agriculture Sector of the Western Cape Province (WC 2016), and the Western Cape Climate Change Response Strategy: Vision 2050 (WC 2023). This project cannot be conducted without the context of those previous activities. Therefore, before expanding on the adaptation goals identified with government stakeholders in the context of this project, a brief summary of the previous projects needs to be provided.

The Western Cape Climate Change Response Strategy (WC 2023) formulates its Vision for 2050 as follows:

*“Our Vision is to be a net zero emissions and climate resilient province by 2050, built on an equitable and inclusive economy and society that thrives despite the shocks and stresses posed by climate change.”*

Local and district municipal officials, as well as external stakeholders engaged for the Overberg District Climate Change Response Framework development (ODM 2017) identified more than 60 response measures across a wide range of climate change impact aspects and ranked them according to their respective perceived priority. Table 2 lists the 13 highest-ranked response measures and the respective response areas the measures are contributing to. These are addressing fire hazard, water security and flood risk, among other aspects, such as climate mitigation through better waste management and recycling.

*Table 2: Highest priority ranked Climate Response Measures as established in ODM (2017, Annex 3)*

No	Response area	Response measure	Priority	
			medium	high
1	Fire management	Maintain fire breaks and improve fire awareness [this will decrease the impact from fires (CC adaptation)]	0	12
2	Fire management	General alien clearing; Clearing of fire-prone alien plant species; alien control plans [this will decrease the impact from fires, as well as improving water availability (CC adaptation)]	0	11
3	Waste management opportunities	Recycling (municipal & household level) [this will decrease resource use and GHG emissions (CC mitigation)]	0	11
4	Environmental rehabilitation	Rehabilitation of water catchment areas	0	10
5	Risk & vulnerability mapping	Map areas that are at high risk from fires, flooding, extreme winds, sea level rise / sea storm surge [this will increase disaster preparedness (CC adaptation)]	0	10
6	Risk & vulnerability mapping	Assess informal settlements for climate vulnerability [this will improve disaster planning and preparedness (CC adaptation)]	0	10
7	Agriculture responses	Implement dryland and conservation agriculture; soil-moisture and soil carbon conservation practices [this decreases water demand and improves drought resilience (CC adaptation), and increases soil carbon and carbon sequestration (CC mitigation)]	0	10

8	Environmental planning, conservation and management	Enhance best practice town and land use planning (e.g. avoid building close to riverbanks, enforce buffer zones) – utilise the principles of SPLUMA and the direction of LUPA [this will reduce climate vulnerability, as well as leading to low-carbon developments, which contributes to CC mitigation]	4	9
9	Environmental planning, conservation and management	Standard environmental approval linked to agricultural use needs to take the impact of climate change into account [this will prevent the development of climate-inappropriate agriculture, as well as improve water demand planning (CC adaptation)]	2	8
10	Replace / retrofit / upgrade infrastructure	Increase the capacity of storm water systems [this will allow these systems to handle increased rainfall intensity and flooding (CC adaptation)]	1	8
11	Water management	Develop/ implement catchment management strategies (cross-reference to environmental rehabilitation responses)	1	8
12	Climate finance	Apply for international funding – overarching response can potentially be pulled out as a generic option for funding (Opportunity to use climate change funding to address infrastructure and other related issues / needs)	0	8
13	Environmental planning, conservation and management	Regulate groundwater abstraction [this will prevent over-abstraction of groundwater and improve water security (CC adaptation)]	0	8

The Western Cape Climate Response Strategy (WC 2023, p. 9) further sets the following Response Priorities:

- Improve Disaster Risk Management Systems by improving early warning systems
- Make Disaster Risk Management Plans more climate resilient by having plans in place to prepare for, and for dealing with extreme heat and flooding events
- Capacitate people living in informal settlements to become resilient through innovative responses to climate risks such as innovative informal settlement management and reduction of air pollution
- Ensure that spatial planning and development planning reduces risks to people, infrastructure and assets through integration of climate change considerations by aligning transport planning with climate resilient spatial development planning, integrating climate change into spatial and development planning processes, capacitating local government in respect of climate resilient planning, and using spatial performance indicators to inform progress reporting and land use decision-making.

- Ensure new-build projects take climate risks into consideration, both in terms of the placement of infrastructure and communities, and in terms of building in resilience and building back better to suit a changing climate through reporting on the resource efficiency of buildings
- Develop a coastal risk assessment, policy and regulatory framework that includes a coastal vulnerability and risk assessment, coastal risk policy that details the roles of coastal management lines and active retreat, as well as the legal framework for the implementation of coastal management lines
- Reduce coastal risks through development management, coastal defence reinforcement, and deployment of natural defences, with a focus on priority coastal defence or retreat projects and the reduction of estuarine risk through climate resilient estuarine management plans

## 4.2. Adaptation goals

During the previous phase of this project, i.e. the development of Overberg district's Climate Risk Profile report, the following adaptation goals for the DM were set and discussed with Overberg's provincial and local government stakeholders on 18 April 2024:

- **Goal 1: To ensure water security for human consumption and irrigation under a changing climate**
- **Goal 2: To protect and rehabilitate ecological infrastructure to be able to support climate change response**
- **Goal 3: To increase the adaptive capacity of human settlements to climate change and extreme events**

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.

### 4.2.1. Adaptation programme: Goal 1: Ensure water security for human consumption and Irrigation under a changing climate

Water for human and agricultural use is the most important natural asset. As described above, the water supply in the Overberg DM currently is covered by a mix of surface and groundwater resources, and supply currently exceeds demand. Climate projections are unclear on whether total rainfall amounts are increasing or not, but there is a tendency of increasing extreme rainfall events, leading to flooding and potential pollution of surface water sources by stormwater run-off, but also, if managed smartly, providing an option to refill municipal water storage systems. Furthermore, rising sea-levels might lead to an infiltration of coastal water – near groundwater aquifers, thus polluting groundwater resources. Another factor potentially contributing to future water shortage, is the rapidly growing population, specifically in the Overstrand LM, putting additional strain on currently available water resources.

#### **Programme 1.1: Protect, Maintain and Improve Water Services Infrastructure**

The programme aims to increase the resilience of water services to climate change and expected increased water demand, by improving infrastructure reliability, reducing downtime, and minimising service interruptions, thereby addressing water reticulation losses and ensuring sustainable water supply for municipalities. The following actions would contribute to this programme:

- **Regular maintenance and inspection:** Implement regular maintenance schedules for water infrastructure, including pipelines, treatment plants, reservoirs, and pumping stations. Conduct routine inspections to identify and address potential issues before they escalate into larger problems and to reduce water losses through leakages. All water provision infrastructure should be maintained to ensure that it will be able to deal with extreme events such as flooding and drought and remain in functioning condition.
- **Prioritise repairs and upgrades based on the condition and criticality of infrastructure components:** This includes the installation of technology that can detect leaks in water supply reticulation and send notifications and alarms to relevant personnel; as well as retrofitting existing infrastructure to withstand extreme weather events, such as floods, storms, and droughts.
- **Infrastructure upgrading and expansion anticipating future growth:** Invest in upgrading infrastructure to improve reliability, efficiency, and resilience to climate change impacts and increased water demands in the near future.
- **Climate-resilient design:** Incorporate climate-resilient design principles into new infrastructure projects to future-proof against climate risks, particularly extreme rainfall and droughts.
- **Continual water demand side management** to increase preparedness for dry periods (incl. replication of successful water conservation programmes)

#### **Programme 1.2: Diversification of water sources**

The 2015-17 drought in the Western Cape has shown that reliance on municipal dams as main source for water can lead to extreme shortage in water supply. Reliance on groundwater, sourced through public or private boreholes is less vulnerable to droughts, but for many aquifers, the recharge time is unknown, therefore there is a risk of depleting these groundwater resources as well. As such, this programme aims to explore alternative water resources that can be tapped by the municipality and/or individual households. The suggested activities include:

- **Harvesting of rainwater from building roofs:** Divert gutters into above- or underground tanks and cisterns. This will reduce stormwater runoff into public stormwater systems, while also providing water for gardens & parks and other household uses (e.g. toilet flushing).
- **Seawater desalination:** Having the advantage of bordering the ocean, investigate water desalination options which can run on non-fossil energy, e.g. using wave power to create the pressure needed for desalination or using solar/wind to generate the necessary energy for desalination
- Investigate options of **wastewater treatment and recirculation** as blue water.

#### **Programme 1.3: More effective water usage**

Wasteful water usage is still a problem, even if sensitivity of the wider public generally increased during the last drought. This programme suggests activities the municipalities in Overberg can take to promote a more effective water usage on public, industrial and municipal/public level:

- **Re-using greywater** from kitchen and bathroom sinks, showers and baths: Divert greywater into above ground tanks or underground cisterns, providing water for gardens & parks and some household usage (e.g. toilet flushing). Combined grey- and rainwater systems are thinkable. Greywater is

available all year round while rainwater is only provided in the rainy season, so a combination of both can alleviate pressure on fresh water sources especially in the dry months.

- Build new buildings **by default with separate grey and blue water systems** (as is done in parts of Namibia, for example).
- **Make use of smart metering and steep block tariff schemes** ('more you use the more you pay per unit') for water to increase/incentivise water saving efforts
- **Investigate alternative water storage options** (e.g. underground) / dam expansion where appropriate. Underground storage minimises losses through evaporation. This will increase water security and drought resilience
- **Improve stormwater retention systems** to use flooding events to store water against future drought periods. This will contribute to flood attenuation as well as increased drought resilience

#### **Programme 1.4: Protect surface water sources**

The quantity of available surface water to cover the household, industrial and agricultural water demand is an important factor for future water security, the other important factor is water quality. Dam water quality can be impacted by land use activities in the catchment of the rivers feeding the dams. Main sources of pollution are agriculture (run off of fertilisers and pesticides) and insufficient stormwater management and sewage overflows during extreme rainfall events. Another risk to dams is loss of storage volumes by silting up by river sediments, especially during extreme events. This programme aims to manage stormwater, create buffer zones around wetlands and dams, prevent run-off from agriculture and industrial area into storm water systems and freshwater dams. The suggested activities to protect surface water sources are as follows:

- **Protect, restore and increase ecological infrastructure** to slow, spread and sink storm and floodwater run-off (e.g. on-farm furrows and swales)
- **Promote farming practises** that prevent surface run-off and soil erosion, e.g. contour farming and in-between crops to avoid fallow, erosion-prone soils
- **Construction of hard infrastructure** where appropriate, e.g. gabions to protect freshwater from storm- and flood-water intrusion. This will also allow more water infiltration into soil and groundwater, as well as decrease flood impacts.
- **Standard environmental approval** linked to agricultural use needs to take the impact of climate change into account. This will prevent the development of climate-inappropriate agriculture, as well as improve water demand planning.
- **Plan for increased river sediment loads** during extreme rainfall events and its effect on dam infrastructure and storage capacity (e.g. riverbank stabilisation to prevent erosion leading to sediment build-up in water storage structures). This will prevent the loss of water storage capacity, which will improve drought resilience.
- **Expand urban green infrastructure** to improve water infiltration, flood attenuation and thus reduce polluted run-off. This will also contribute to carbon sequestration and decreased urban heat island effect while also improving air quality.
- **Increased storm water system maintenance:** this will improve/increase the capacity of storm water systems. This will also allow these systems to handle increased rainfall intensity and flooding.
-

#### 4.2.2. Adaptation programme: Goal 2: To protect and rehabilitate ecological infrastructure to be able to support climate change response

As noted earlier, the district's natural environment is a valuable asset to its economy and plays an important role in buffering and mitigating the impacts of climate change, such as extreme rainfall events and temperature extremes. However, it is under severe pressure due to rapid urbanisation and land-use change, leaving the district's natural environment and resources, as well as biodiversity, very vulnerable and reducing the provision of valuable ecosystem services. It is thus necessary to protect and restore these natural environments in order to maintain their key functions. Furthermore, as indicated in section 3.1.3, the changing climate is expected to lead to a shift in biome boundaries in the eastern part of the DM, with the Fynbos biome being replaced by succulent Karoo, Nama Karoo, Albany thicket and potentially, desert vegetation.

##### **Programme 2.1: Preserving and restoring wetlands and riparian buffer zones**

The programme aims to preserve, restore and re-create the buffer function of wetlands and water bodies to absorb stormwater and purify water. Furthermore, wetlands are endangered hotspots of biodiversity and teal carbon sinks, thus directly acting towards climate mitigation. The following actions towards restoring and protecting them are suggested:

- **Inventory of water bodies and wetlands** in the DM: Assess the location and condition of rivers, streams and standing water bodies regarding their ecological condition
- **Identify interventions needed** to improve ecosystem health and to enhance/maintain ecosystem service delivery such as stormwater retention and purification, nursery function for species etc.
- If needed, **prioritise waterbodies and wetlands** for intervention.
- **Implement monitoring** of ecosystem condition and functioning over time.

##### **Programme 2.2: Maintain biodiversity through facilitation of climate transition of ecosystems and biomes**

The potential shift of biomes in the east of the district towards biomes more adapted to summer or all-year-round rainfall and lower rainfalls in general will lead to the local extinction of fynbos species, to be replaced by species of better adapted ecosystems and biomes. For the in-migration of species to take place, ecological migration corridors need to be in place. Suggested activities in this regard are:

- **Analysis of land cover and ecosystem maps** regarding location and connectivity between valuable ecosystem islands
- **Establish a connectivity goal** for allowing effective species migration along climate and land use gradients
- **Identify and take actions to achieve this goal**, e.g. de-intensifying of agriculture, purchase of land for conservation, change/remove fencing, targeted introduction of key species

- **Include urban spaces into corridor planning** and improve natural infrastructure accordingly. This will have the added benefits of air quality improvement, urban heat regulation, stormwater control, carbon sequestration and mental well-being of population.

### **Programme 2.3: Alien invasive vegetation control**

Invasive alien vegetation is a threat to natural ecosystems as it can replace indigenous biodiversity. This can lead to a loss of ecosystem functioning and service provision, such as stormwater retention and purification, and soil stabilisation, and will reduce the natural environments appeal for eco-tourism. Further, specifically woody alien species such as pines and eucalypts are increasing the loss of water and are a severe fire hazard. Floating aliens can block watercourses and suffocate indigenous fauna and flora. This programme therefore proposes the following actions to control the expansion and damage caused by alien invasive vegetation:

- **Targeted alien clearing and alien control plan development:** This would prevent conversion of naturally highly ecosystems into monotonous dense stands. Clearing of alien acacia, pina and eucalypts will reduce fire risk, as well as improving water availability
- **Develop/ implement catchment management strategies** to reduce invasion of aquatic alien vegetation such as water hyacinth
- **Control invasion of alien fauna** to prevent threat of indigenous fauna and flora
- **Promote beneficiation of extracted alien biomass**, such as use alien woody biomass for energy generation: this will decrease IAPs with associated improvements in water-related issues (CC adaptation) and decrease energy generation from fossil fuels; use of leather of invasive fish (e.g. carp) for clothing and bags; use of water hyacinth for furniture and homeware. This might create new markets for marginalised communities in the DM.
- **Consider public or private stewardships for sensitive environments**, e.g. wetlands and river sections to give the public or industry “ownership” and responsibility for conservation and maintenance.

### **4.2.3. Adaptation programme: Goal 3: Increase adaptative capacity of the growing population**

Climate change will affect the environment, settlements and population at all scales. While a large responsibility to take action lies with government, the other members of the public need to take action as well. However, frequently lack of awareness of options, or the mere lack of existence of options for better adaptive capacity leave populations or economies vulnerable to the primary or secondary effects of climate change. These shortcomings should be addressed on different levels.

### **Programme 3.1: Develop more resilient settlements and communities**

Largely within the responsibility of local government is the identification of climate risks (as done in WC 2016, 2023, ODM 2017 and the GreenBook) and the implementation of response measures for settlements, including rural and informal settlements.

The following actions would contribute to this programme:

- **Conduct local-scale assessment of climate hazards and risks, as well as the inherent vulnerability of the location assessed:** This action involves conducting a spatially explicit and detailed vulnerability assessment to identify the populations and locations most at risk to climate change impacts: This assessment would help identify and prioritise communities that are particularly vulnerable to climate change, due to factors such as their geographic location, reliance on natural resources, or lack of access to information and resources.
- **Develop land use planning and zoning regulations that consider climate change impacts:** This action involves developing and implementing land use planning and zoning regulations that consider the potential impacts of climate change, including flooding. Land use planning can help reduce vulnerability to climate change, for example by preventing development in flood-prone areas or protecting areas that provide crucial ecosystem services. The Coastal Management Lines developed for the district are another valuable spatial planning tool for climate-proofing the district's coastal areas.
- **Develop early warning systems:** This action involves developing and implementing an early warning system (EWS) to help communities prepare for and respond to climate change risks. EWSs need to have three components, firstly, a weather and/or environmental observation and forecasting component, secondly, a component that analyses these data and extracts and packages information that can lead to hazardous extreme events and thirdly, an information distribution component. The 3rd component can be I.T. based but the district should also consider mouth-to-mouth snowball information system chains to reach technologically impaired communities and environments. Early warning systems can give communities the time they need to take preventive measures or evacuate, potentially saving lives and reducing economic loss. This could be particularly useful in the face of extreme weather events like droughts, hailstorms, and floods, which are predicted to become more common due to climate change.
- **Facilitate improved cellular communication networks.** This will decrease reliance on landline phone infrastructure networks which may be heavily impacted during disaster events
- **Establish partnerships:** This action involves establishing partnerships with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience

### **Programme 3.2: Climate-wise buildings and infrastructure**

While spatial and development plans can be used to keep people and infrastructure out of hazardous areas, such as zones at risk of flooding, other climate hazards can affect a municipality uniformly, e.g. extreme heat or cold, or can hit at any place. It is therefore important to use the built environment and infrastructure to reduce the potential impact of climate hazards. Suggestions for creating climate-wise buildings and infrastructure are as follows:

- **Develop building and construction guidelines for better protection against climate events:** These could include building insulation against cold and heat, greywater and rainwater harvesting and re-use, protection against flood impact (e.g. building on stilts or locate main switchboards higher above ground level), measures for fire-proofing, especially for buildings on the urban-wildland interface.

- Develop municipal support structures for **Small Scale Embedded Generation (SSEG)** / mini-grids – feed-in tariffs in place, such as applicable bylaws, incentives etc., to create independence from the public grid which might fail during extreme events. This will also reduce reliance on fossil fuels (climate mitigation)
- **Implement rainwater collection systems for low-cost housing.** This will reduce pressure on public water sources and can help with storm water retention and reduce flooding in already vulnerable communities.
- **Design and construct traffic infrastructure** in expectance of more likely and extreme rainfall events.
- **Climate-proof and/or relocate critical service infrastructure** such as sewage treatment works, electricity substations, hospitals, police stations, retirement centres, etc.
- **Inspect local social facilities and recommend / demand improvements** from personnel in charge to reduce risks, e.g. to fire and flood events.

### **Programme 3.3: Education of the public**

Climate adaptation starts at a household level and at personal behaviour. The general public therefore plays an important role in adapting to a new climate future. This programme aims to raise more awareness on how climate change will affect the public and which measures each person can take to prepare for a more extreme climate, how individual habits and resource use (e.g. water) can impact the wellbeing of the community and how to protect themselves. Further, a changing climate can also provide opportunities for new economies. The goal should be to promote a culture of valuing natural resources, by providing incentives/disincentives for responsible water and electricity usage, protection of water bodies, etc. The activities proposed for education and guiding the general public are as follows:

- **Lead by example!:** Climate-proof public buildings and infrastructure.
- **Increase public awareness** on the impacts of climate change and benefits of best practice environmental management through flyers, posters, info boards, short videos etc. This will assist with building an accountable and responsible community, as well as increasing community resilience.
- **Conduct (interactive?) roadshows** targeting the most vulnerable groups. Visit the district's care centres, as well as primary and secondary schools to inform the elderly and children in an age-appropriate format about climate risks and steps they can take to protect themselves, e.g. from veldfires, flooding or heatwaves (amongst others), and to use scarce natural resources responsibly.
- **Create a green information hub** for collection of all data and info to avoid duplication, provide coordination, etc.; information could also be used to identify gaps and act as an evidence base to raise funds. Find ways to engage private sector in this process, including households, and local farmers.

## 5. Implementation Framework

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

### 5.1. Goal 1: Ensure water security for human consumption and Irrigation under a changing climate

Adaptation programme 1.1: Protect, Maintain and Improve Water Services Infrastructure				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
i. <b>Regular maintenance and inspection:</b> Implement regular maintenance schedules for water infrastructure, including pipelines, treatment plants, reservoirs, and pumping stations.	Drought  Flooding  Water supply vulnerability	Overberg DM: Water and Sanitation, as well as Technical/Engineering Services functions; with guidance from Environmental Management function	Continuous	High priority
ii. <b>Prioritise repairs and upgrades</b> based on the condition and criticality of infrastructure components: This includes the installation of technology that can detect leaks in water supply reticulation and send notifications and alarms to relevant personnel. Retrofit existing infrastructure to withstand extreme weather events, such as floods, storms, and droughts.	Drought  Flooding  Water supply vulnerability	Overberg DM: Water and Sanitation, as well as Technical/Engineering Services functions; with guidance from Environmental Management function	Medium to long term	High priority
iii. <b>Infrastructure upgrading and expansion anticipating future growth:</b> Invest in upgrading infrastructure to improve	Drought  Flooding	Overberg DM: Water and Sanitation, Spatial Planning, as well as	Long term	High priority

reliability, efficiency, and resilience to climate change impacts and increased water demands in the near future.	Water supply vulnerability Population growth	Technical/Engineering Services functions; with guidance from Environmental Management function		
iv. <b>Climate-resilient design:</b> Incorporate climate-resilient design principles into new infrastructure projects to future-proof against climate risks, particularly extreme rainfall and droughts.	Drought Flooding Coastal flooding Water supply vulnerability Population growth	Overberg DM: Water and Sanitation, Environmental Management, Spatial Planning, Building Regulations, as well as Engineering/Technical Services functions	Long term	Medium priority
v. <b>Continual water demand side management</b> to increase preparedness for dry periods (incl. replication of successful water conservation programmes)	Drought Water supply vulnerability	Overberg DM: Water and Sanitation, as well as Community Services functions; with guidance from Environmental Management function	Short term (continuous)	High priority

Adaptation programme 1.2: Diversification of water sources				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
i. <b>Harvesting of rainwater from building roofs:</b> Divert gutters into above- or underground tanks and cisterns. This will reduce stormwater run off into public stormwater systems, while also providing	Flooding Drought (storage) Water supply vulnerability	Overberg DM: Water and Sanitation, Land Use Management, Building Regulations, Roads and Stormwater, as well as	Medium to long term	High priority

water for gardens & parks and some household usage (e.g. toilet flushing)		Environmental Management functions		
ii. <b>Seawater desalination:</b> Having the advantage of bordering the ocean, investigate water desalination options which can run on non-fossil energy e.g. using wave power to create the pressure needed for desalination or using solar/wind to generate the necessary energy for desalination	Flooding Drought Water supply vulnerability	Overberg DM: Water and Sanitation, Spatial Planning, Environmental Management, as well as Engineering/Technical Services functions	Long term	Medium priority
iii. <b>Investigate options of wastewater treatment and recirculation</b> as blue water.	Drought Water supply vulnerability	Overberg DM: Water and Sanitation, Spatial Planning, Environmental Management, as well as Engineering/Technical Services functions	Medium to long term	High priority

Adaptation programme 1.3: More effective water usage				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
i. <b>Re-using greywater from kitchen and bathroom sinks, showers and baths:</b> Divert greywater into above ground tanks or underground cisterns, providing water for gardens & parks and some household usage (e.g. toilet flushing). Combined grey- and rainwater systems are thinkable. Greywater is available all year round while rainwater is only provided in the rainy	Drought Water supply vulnerability	Overberg DM: Water and Sanitation, as well as Community Services functions, with guidance from Environmental Management function  Private sector	Medium to long term	High priority

season, so a combination of both can alleviate pressure on fresh water sources especially in the dry months.		Households		
ii. <b>Build new buildings by default with separate grey and blue water systems</b> (as is done in parts of Namibia, for example).	Drought Water supply vulnerability	Overberg DM: Water and Sanitation, Environmental Management, Housing/Human Settlements, Town Planning (Development Application Approval), as well as Building Regulations function	Medium to long term	High priority
iii. <b>Make use of smart metering and steep block tariff schemes</b> ('more you use the more you pay per unit') for water to increase/incentivise water saving efforts	Water supply vulnerability	Overberg DM: Water and Sanitation function	Short term	High priority
iv. <b>Investigate alternative water storage options</b> (e.g. underground) / dam expansion where appropriate. Underground storage minimises losses through evaporation. This will increase water security and drought resilience	Drought Water supply vulnerability	Overberg DM: Water and Sanitation, Environmental Management, Spatial Planning, as well as Building Regulations function	Medium to long term	Medium priority
v. <b>Improve stormwater retention systems</b> to use flooding events to store water against future drought periods. This will contribute to flood attenuation as well as increased drought resilience	Flooding Drought Water supply vulnerability	Overberg DM: Water and Sanitation, as well as Roads and Stormwater functions; with guidance from Environmental Management function	Medium to long term	High priority

#### Adaptation programme 1.4: Protect surface water sources

Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
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<p><i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i></p>	<p><i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i></p>	<p><i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i></p>	<p><i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i></p>	<p><i>Does this action have a high, medium, or low priority level for implementation?</i></p>
<p>i. <b>Protect, restore and increase ecological infrastructure</b> to slow, spread and sink storm and floodwater run-off (e.g. on-farm furrows and swales)</p>	<p>Flooding Environmental vulnerability</p>	<p>Overberg DM: Environmental Management and Spatial Planning functions</p>	<p>Medium to long term (continuous)</p>	<p>High priority</p>
<p>ii. <b>Promote farming practises that prevent surface run-off and soil erosion</b>, e.g. contour farming and in-between crops to avoid fallow, erosion-prone soils</p>	<p>Flooding Environmental vulnerability</p>	<p>Overberg DM: Environmental Management and Agricultural Management/Support and/or LED functions</p>	<p>Medium term</p>	<p>High priority</p>
<p>iii. <b>Construction of hard infrastructure</b> where appropriate e.g. gabions to protect freshwater from storm- and flood-water intrusion. This will also allow more water infiltration into soil and groundwater, as well as decrease flood impacts.</p>	<p>Flooding Environmental vulnerability Water supply vulnerability</p>	<p>Overberg DM: Water and Sanitation, Roads and Stormwater, as well as Environmental Management functions</p>	<p>Medium to long term</p>	<p>High priority</p>
<p>iv. <b>Standard environmental approval</b> linked to agricultural use needs to take the impact of climate change into account. This will prevent the development of climate-inappropriate agriculture, as well as improve water demand planning.</p>	<p>Flooding Environmental Vulnerability Water supply vulnerability</p>	<p>Overberg DM: Environmental Management and Agricultural Management/Support and/or LED functions</p>	<p>Medium term</p>	<p>Medium priority</p>
<p>v. <b>Plan for increased river sediment loads during extreme rainfall events</b> and its effect on dam infrastructure and storage capacity (e.g. riverbank stabilisation to prevent erosion leading to sediment build-up in water storage structures). This will prevent the loss of water storage capacity, which will improve drought resilience.</p>	<p>Flooding Environmental Vulnerability Water supply vulnerability</p>	<p>Overberg DM: Environmental Management, as well as Water and Sanitation functions</p>	<p>Long term</p>	<p>Medium priority</p>

vi. <b>Expand urban green infrastructure</b> to improve water infiltration, flood attenuation and thus reduce polluted runoff. This will also contribute to carbon sequestration and decreased urban heat island effect while also improving air quality.	Flooding Drought Heat extremes Environmental vulnerability Water supply vulnerability	Overberg DM: Environmental Management, Land Use Management, Roads and Stormwater, as well Parks and Recreation functions	Medium term	High priority
vii. <b>Increased storm water system maintenance:</b> this will improve Increase the capacity of storm water systems. This will allow these systems to handle increased rainfall intensity and flooding.	Flooding Environmental vulnerability Water supply vulnerability	Overberg DM: Water and Sanitation and/or Roads and Stormwater functions, with guidance from Environmental Management function	Short term (continuous)	High priority

## 5.2. Goal 2: To protect and rehabilitate ecological infrastructure to be able to support climate change response

Adaptation programme 2.1: Preserving and restoring wetlands and riparian buffer zones				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
i. <b>Inventory of water bodies and wetlands in the DM:</b> Assess the location and condition of rivers, streams and standing water bodies regarding their ecological condition	Environmental vulnerability	Overberg DM: Environmental Management, as well as Water and Sanitation functions	Short term	High priority
ii. <b>Identify interventions needed</b> to improve ecosystem health and to enhance/maintain ecosystem service	Flooding Heat extremes	Overberg DM: Environmental Management, Spatial	Short term	High priority

delivery such as stormwater retention and purification, nursery function for species etc.	Environmental vulnerability	Planning, as well as Water and Sanitation functions		
iii. If needed, <b>prioritise waterbodies and wetlands</b> for intervention.	Flooding Environmental vulnerability	Overberg DM: Environmental Management, Roads and Stormwater, as well as Water and Sanitation functions	Medium term	High priority
iv. <b>Implement monitoring</b> of ecosystem condition and functioning over time	Environmental vulnerability	Overberg DM: Environmental Management function	Continuous	High priority

Adaptation programme 2.2: Maintain biodiversity through facilitation of climate transition of ecosystems and biomes				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
i. <b>Analysis of land cover and ecosystem maps</b> regarding location and connectivity between valuable ecosystem islands	Environmental vulnerability	Overberg DM: Environmental Management and Spatial Planning functions	Short term	High priority
ii. <b>Establish a connectivity goal</b> for allowing effective species migration along climate and land use gradients	Environmental vulnerability	Overberg DM: Environmental Management function	Short to medium term	Medium priority
iii. <b>Identify and take actions to achieve this goal</b> , e.g. de-intensifying of agriculture, purchase of land for conservation, change/remove fencing, targeted introduction of key species	Environmental vulnerability	Overberg DM: Environmental Management function	Long term	Medium priority

iv. <b>Include urban spaces into corridor planning</b> and improve natural infrastructure accordingly. This will have the added benefits of air quality improvement, urban heat regulation, stormwater control, carbon sequestration and mental well-being of population	Flooding  Heat Extremes  Socioeconomic vulnerability: Air quality  Environmental Vulnerability	Overberg DM: Environmental Management, Spatial Planning, Land Use Management, as well as Parks and Recreation functions	Long term	High priority
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Adaptation programme 2.3: Alien invasive vegetation control				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
i. <b>Targeted alien clearing and alien control plan development:</b> This would prevent conversion of naturally highly ecosystems into monotonous dense stands. Clearing of alien acacia, pina and eucalypts will reduce fire risk, as well as improving water availability	Wildfires  Environmental vulnerability  Water supply vulnerability	Overberg DM: Environmental Management function	Medium to long term	High priority
ii. <b>Develop/ implement catchment management strategies</b> to reduce invasion of aquatic alien vegetation such as water hyacinth	Environmental vulnerability  Water supply vulnerability	Overberg DM: Environmental Management function	Medium to long term	High priority
iii. <b>Control invasion of alien fauna</b> to prevent threat of indigenous fauna and flora	Environmental vulnerability	Overberg DM: Environmental Management function	Medium to long term	High priority
iv. <b>Promote beneficiation of extracted alien biomass</b> , such as use alien woody biomass for energy generation: this will	Economic vulnerability  Environmental vulnerability	Overberg DM: Environmental	Medium term	Medium priority

decrease IAPs with associated improvements in water-related issues (CC adaptation) and decrease energy generation from fossil fuels; use of leather of invasive fish (e.g. carp) for clothing and bags; use of water hyacinth for furniture and homeware. This might create new markets for marginalised communities in the DM		Management and LED functions		
<b>v. Consider public or private stewardships for sensitive environments</b> , e.g. wetlands and river sections to give the public or industry “ownership” and responsibility for conservation and maintenance	Environmental vulnerability	Overberg DM: Environmental Management function	Medium term	High priority

### 5.3. Goal 3: Increase adaptative capacity of the growing population

Adaptation programme 3.1: Develop more resilient settlements and communities				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
<b>i. Conduct local-scale assessment of climate hazard risks</b> , as well as inherent vulnerability of the location assessed: Conducting a spatially explicit and detailed vulnerability assessment to identify the populations and locations most at risk of climate change impacts: This assessment would help identify and prioritise	Flooding  Coastal flooding  Heat extremes  Wildfires	Overberg DM: Environmental Management, Spatial Planning and Disaster Management functions	Short term	High priority

<p>communities that are particularly vulnerable to climate change, due to factors such as their geographic location, reliance on natural resources, or lack of access to information and resources</p>	<p>Environmental vulnerability</p> <p>Physical vulnerability</p> <p>Economic and socioeconomic vulnerability</p>			
<p>ii. <b>Develop land use planning and zoning regulations:</b> Developing and implementing land use planning and zoning regulations that consider the potential impacts of climate change, including flooding. Land use planning can help reduce vulnerability to climate change, for example by preventing development in flood-prone areas or protecting areas that provide crucial ecosystem services. The Coastal Management Lines developed for the district are another valuable spatial planning tool for the district's coastal areas</p>	<p>Flooding</p> <p>Coastal flooding</p> <p>Heat extremes</p> <p>Wildfires</p> <p>Environmental vulnerability</p> <p>Physical vulnerability</p>	<p>Overberg DM: Spatial Planning and Environmental Management functions</p>	<p>Medium term</p>	<p>High priority</p>
<p>iii. <b>Develop early warning systems:</b> Developing and implementing an early warning system (EWS) to help communities prepare for and respond to climate change risks. EWSs need to have three components, firstly, a weather and/or environmental observation and forecasting component, secondly, a component that analyses these data and extracts and packages information that can lead to hazardous extreme events and thirdly, an information distribution component. The 3rd component can be IT based but should also consider mouth-to-mouth snowball-system information chains to reach technologically impaired communities and environments. Early</p>	<p>Flooding</p> <p>Coastal flooding</p> <p>Heat extremes</p> <p>Wildfires</p>	<p>Overberg DM: Environmental Management, Spatial Planning and Disaster Management functions</p>	<p>Medium term</p>	<p>High priority</p>

warning systems can give communities the time they need to take preventive measures or evacuate, potentially saving lives and reducing economic loss. This could be particularly useful in the face of extreme weather events like droughts, hailstorms, and floods that are predicted to become more common due to climate change				
iv. <b>Facilitate improved cellular communication networks.</b> This will decrease reliance on landline phone infrastructure networks which may be heavily impacted during disaster events	<p>Flooding</p> <p>Coastal flooding</p> <p>Heat extremes</p> <p>Wildfires</p>	Overberg DM: Environmental Management, Spatial Planning, Disaster Management, as well as Community Services/Communication functions	Medium term	High priority
v. <b>Establish partnerships:</b> Establishing partnerships with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience	<p>Flooding</p> <p>Coastal flooding</p> <p>Heat extremes</p> <p>Wildfires</p> <p>Environmental vulnerability</p> <p>Physical vulnerability</p> <p>Economic and socioeconomic vulnerability</p>	Overberg DM: Environmental Management and Disaster Management functions, as well as Corporate Services department	Short to medium term (continuous)	High priority

Adaptation programme 3.2: Climate-wise buildings and infrastructure				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level

<p><i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i></p>	<p><i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i></p>	<p><i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i></p>	<p><i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i></p>	<p><i>Does this action have a high, medium, or low priority level for implementation?</i></p>
<p>i. <b>Develop building and construction guidelines for better protection against climate events:</b> these could include building insulation against cold and heat, greywater and rainwater harvesting and re-use, protection against flood impact (e.g. building on stilts or locate main switchboards higher above ground level), measures for fire-proofing, especially for buildings on the urban-wildland interface</p>	<p>Heat extremes Flooding Coastal flooding Wildfire Physical vulnerability</p>	<p>Overberg DM: Environmental Management, Spatial Planning, Disaster Management, Land Use Management, Building Regulations, as well as Engineering/Technical Services functions</p>	<p>Medium term</p>	<p>High priority</p>
<p>ii. <b>Develop municipal support structures for Small Scale Embedded Generation (SSEG) / mini-grids – feed-in tariffs in place, applicable bylaws, Incentives etc.</b> to create independence from the public grid which might fail during extreme events, and which will reduce reliance on fossil fuels (climate mitigation)</p>	<p>Likelihood of flagged climate hazards to occur  Economic and socioeconomic vulnerability: energy independence</p>	<p>Overberg DM: Environmental Management, Spatial Planning, as well as Engineering/Technical Services functions</p>	<p>Medium to long term</p>	<p>High priority</p>
<p>iii. <b>Implement rainwater collection systems also for low-cost housing.</b> This will reduce pressure on public water sources and can help in storm water retention and reduce flooding in already vulnerable communities</p>	<p>Flooding  Physical vulnerability</p>	<p>Overberg DM: Environmental Management, Spatial Planning, Land Use Management, Building Regulations, Housing, as well as Engineering/Technical Services functions</p>	<p>Medium to long term</p>	<p>High priority</p>
<p>iv. <b>Design and construct traffic infrastructure</b> in expectance of more likely and extreme rainfall events</p>				

<b>v. Climate proof and/or relocate critical service infrastructure</b> such as sewage treatment works, electricity substations, hospitals, police stations, retirement centres etc	Flooding Coastal flooding Wildfire Physical vulnerability	Overberg DM: Environmental Management, Spatial Planning, Land Use Management, as well as Engineering/Technical Services functions	Long term	High priority
<b>vi. Inspect local social facilities and recommend / demand improvements</b> from personnel in charge to reduce risks, e.g. to fire and flooding	Heat extremes Flooding Coastal flooding Wildfire Physical vulnerability Socioeconomic vulnerability	Overberg DM: Environmental Management, Spatial Planning, Disaster Management and Community Services functions	Medium term	High priority

<b>Adaptation programme 3.3: Education of the public</b>				
<b>Adaptation Actions</b>	<b>Key risk or vulnerability addressed</b>	<b>Responsible entity</b>	<b>Timeframe</b>	<b>Priority level</b>
<i>Shorten the action identified under the programme section above starting with a verb (action) (e.g. design, plan for, implement, identify, protect, maintain, etc.). Description of what is meant by and included in this action.</i>	<i>What are the key climate risks, vulnerabilities, or impacts that this action addresses? See Climate Risk Profile Report</i>	<i>Who should take primary responsibility for the action within the current DM structure? Are there other important actors that should be included?</i>	<i>Will the action be implemented over the short term (&lt;5 years), medium term (5-10 years) or long term (10+ years)?</i>	<i>Does this action have a high, medium, or low priority level for implementation?</i>
<b>i. Lead by example!:</b> Climate-proof public buildings and infrastructure	Heat extremes Flooding Coastal flooding Wildfire	Overberg DM: Environmental Management, Spatial Planning, Land Use Management, Building Regulations, as well as	Long term	High priority

	Physical vulnerability	Engineering/Technical Services functions		
ii. <b>Increase public awareness</b> on the impacts of climate change and benefits of best practice environmental management through flyers, posters, info boards, short videos etc. This will assist with building an accountable and responsible community, as well as increasing community resilience	Heat extremes Flooding Coastal flooding Wildfire	Overberg DM: Environmental Management, Disaster Management and Community Services/Communications functions	Short term	High priority
iii. <b>Conduct (interactive?) roadshows</b> targeting the most vulnerable groups. Visit the district's care centres, primary and secondary schools to inform the elderly and children in an age-appropriate format about climate risks and steps they can take to protect themselves, e.g. from veldfires, flooding or heatwaves and others, and to use scarce natural resources responsibly	Heat extremes Flooding Coastal flooding Wildfire	Overberg DM: Environmental Management, Disaster Management and Community Services/Communications functions	Short term	High priority
iv. <b>Create a green information hub</b> for collection of all data and info to avoid duplication, provide coordination etc.; identify gaps; raise funds. Find ways to engage private sector in this process, including households, and local farmers	Heat extremes Flooding Coastal flooding Wildfire Environmental vulnerability Physical vulnerability Economic and socioeconomic vulnerability	Overberg DM: Environmental Management, Spatial Planning, and Disaster Management functions	Short term	High priority

## 6. 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 supports and enables the implementation of climate adaptation measures.

Mainstreaming climate change involves several key elements, and recommendations are made in terms of each of these:

- **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. Various funding mechanisms are available to support climate change response initiatives, including national and international grants, public-private partnerships, and municipal budgets.
- **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.
- **Additional recommendations** for the district are outlined below:
  - The Overberg district could have priority climate risks represented in municipal risk register, i.e., Local Municipal Strategic Risk Register;
  - The district could also use the risk register to bring the issue under the attention of management and councillors;
  - The district could also undertake capacity building around climate change response activities across departments/sectors;

- Lastly, the district could benefit from DFFE's training around accessing external funding to support the municipality's climate activities. It is recommended that the district contact its dedicated DFFE Local Government Support Control Environment Officer for more information.

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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