KwaDukuza Climate Change Response Strategy

KwaDukuza Local Municipality

May 2013

KwaDukuza Climate Change Response Strategy

KwaDukuza Local Municipality

May 2013

14 Chief Albert Luthuli Street, KwaDukuza, 4450

Mott MacDonald, Unit 7, Rydall Vale Park, Douglas Saunders Drive, La Lucia Ridge Office Park, La Lucia, Durban 4051, South Africa
Postal address: Postnet Suite 165, Postnet La Lucia, Private Bag X02, Glenashley 4022, South Africa
t +27 (0)31 566 4368 f +27 (0) 86 573 3708, W www.mottmac.com

Mott MacDonald

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
01	5 April 2013	J. Dunham T. Ellis J. Brislin K. Kueng	P. Govender	D. Viner	Draft for Comment
02	15 May 2013	J. Dunham T. Ellis J. Brislin K. Kueng	D. Donkin	A. Heather	Second draft with public comments incorporated

Mott MacDonald, Unit 7, Rydall Vale Park, Douglas Saunders Drive, La Lucia Ridge Office Park, La Lucia, Durban 4051, South Africa
Postal address: Postnet Suite 165, Postnet La Lucia, Private Bag X02, Glenashley 4022, South Africa
t +27 (0)31 566 4368 f +2

Content

DOCUMENT LIMITATIONS

This Climate Change related Document has been provided by Mott MacDonald South Africa (Pty) Ltd ("Mott MacDonald") subject to the following limitations:

1. This document is issued for the party which commissioned it and for specific purposes connected with the above-captioned project only. It should not be relied upon by any other party or used for any other purpose.

2. We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

3. This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

4. This Document has been prepared for the specific purpose outlined in Mott MacDonald's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

5. The scope and the period of Mott MacDonald's Services are as described in Mott MacDonald's inception report and are subject to restrictions and limitations. Mott MacDonald performed a limited assessment of the possible conditions or circumstances that may exist at or within the study area referenced in this Document. If a service (as outlined in Section 1) is not expressly indicated it cannot be assumed that it has been provided in the document. If a sector is not addressed under the four key themes (twelve sectors) identified in consultation with the client, it cannot be assumed that any determination has been made by Mott MacDonald in regards to it.

6. Conditions may exist which were undetectable given the limited nature of the defined requirements with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to parts of the study area which have not been revealed by the investigation and which have not therefore been taken into account in this Document. Accordingly, additional studies and actions may be required.

7. In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Mott MacDonald's opinions are based on information that existed at the time of the production of this Document. It is understood that the Services provided allowed Mott MacDonald to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site.

8. The study is limited to the study area and is based on information and data that was supplied by third parties, and including any presiding laws, by-laws, guidelines or regulations at the time of the study that could be reasonably obtained by the project team.

9. Any assessments made in this Document are based on the conditions indicated from published sources as referenced in the footnotes and the investigation described. No warranty is included - either express or implied - that the actual conditions will conform exactly to the assessments contained in this Document.

MOTT MACDONALD SOUTH AFRICA (PTY) LTD

1. Introduction

1.1 Project Background

During COP17-CMP7 held in Durban in 2011, the KwaDukuza Municipality declared its commitment to climate change action. The Municipality's Integrated Development Plan (IDP) of 2012/17 acknowledges that the municipal area will face risks associated with climate change and intends to plan better for the future in a precautionary manner. Climate change risks are regarded as key factors to consider in the long term, sustainable management of the Municipality's operations.

The Municipality has also recently partnered with the International Council for Local Environmental Initiatives (ICLEI) - Local Governments for Sustainability - Africa on a project running from 2012-2015. It is the intention of this document to achieve alignment between the key strategies and processes arising, in order to avoid any unnecessary duplication and wasted resources.

Mott MacDonald South Africa (MMSA) was appointed by the KwaDukuza Municipality[1] to evaluate climate change management risks to the Municipality and develop a Climate Change Response Strategy (CCRS) of climate change mitigation and climate change adaptation response options.

In line with the Municipality's forward thinking and risk-averse approach to climate change, this project considers climate change impacts up to the intermediate future around the 2050 time horizon and beyond to the more distant 2100 time horizon. It is also understood that the results and findings of this strategy will strongly inform the KwaDukuza and ICLEI-Africa partnership and its associated projects going forward.

1.2 Project Objectives

The aim of the project is to develop a robust climate change strategy that identifies and outlines recommendations for response to specific climate change management issues for vulnerable sectors[2] in the KwaDukuza area. In support of this aim, primary objectives include:

- Developing a baseline of key policies and frameworks at the national, provincial and local level (Appendix B);
- Consideration of the status quo as well as future pressures to the Municipality;
- Consult stakeholders on climate change management in KwaDukuza;
- Developing a profile greenhouse gas emission profile;
- Profiling the range of climate change impacts and associated risks;
- Outlining opportunities for both adaptation and mitigation responses; and
- Identifying a selection of priority strategy options to direct the municipalities initial climate change management responses.

The strategy ultimately aims to help guide future decision-making in a more responsible and sustainable manner, by highlighting broader impacts and encourages more long-term thinking in terms of sectoral planning.

The methodology followed for this project is outlined in Appendix C.

[1] Appendix A provides a background to the municipality.

[2] Appendix D provides an overview of vulnerable sectors.

1.3 Report Structure

This report provides evidence based strategic recommendations for responses to climate change management issues for vulnerable sectors in the KwaDukuza Municipality. The structure is split into Climate Change Mitigation (Section 2) and Climate Change Adaptation (Section 3) responses, supported by a local Greenhouse Gas Emissions Profile (Appendix I) and a local Climate Impact Profile (Appendix J).

Climate change management considerations and responses highlighted will require action in support of sustainable development in KwaDukuza. Taking into account the capacity of the Municipality to initially respond to these issues in the short term, it is, however, important to phase and balance such requirements over time. In support of this, a number of strategic climate change management priorities have been outlined accordingly in Section 4. This is supported by guiding principles for the implementation of response recommendations (Section 5). The identification of priority areas for action however, by no means diminishes the importance of the wider issues and associated responses identified for action over time.

2. Climate Change Mitigation Responses

2.1 Introduction

With the prospect of economic and population growth, in a business as usual scenario, KwaDukuza would be on a path of increasing emissions of greenhouse gases (GHG) due to higher energy use, production, transport and waste demands[3]. In response to this potential risk, action will be needed to maximise efficiency and make the most of natural resources to deliver a low-carbon future. The use of energy is a prominent theme in climate change mitigation. As such, opportunities for increased renewable energy availability, energy consumption minimisation and awareness are outlined for all relevant sectors in this chapter.

Mitigation refers to actions that reduce the causes of climate change by reducing emissions of greenhouse gases, such as carbon dioxide (CO2). Climate change mitigation refers to two specific aspects that when embraced together can lead to growth, while reducing emissions. These themes are:

- Decreasing usage: using less; using more efficiently; treating wastes as resources;
- Reducing intensity: recognising that some fuels have higher carbon contents than others and moving towards low-carbon and renewable fuels.

In working to manage the risks associated with GHG emissions, climate change mitigation can be categorised into initiatives that either:

- **Build capacity** – Actions to build capacity act as a foundation and are fundamental to the development of mitigation actions. Initiatives that build capacity to mitigate GHG emissions include:
  - Gathering and sharing information (research, data collecting and monitoring, awareness raising);
  - Creating supportive social structures (organisational development, working in partnership with institutions); and
  - Creating supportive governance (regulations, legislation and guidance).
- **Deliver mitigation actions** – Mitigation actions work to reduce increases in GHG emissions or to exploit opportunities to reduce those emissions. Mitigation action falls into the following primary categories:
  - Increasing efficiency;
  - Innovation;
  - Investment in appropriate technologies; and
  - Exploiting positive opportunities through policy.

[3] iLembe DM. 2012. iLembe Regional Spatial Development Plan Phase Three: Towards a Regional Plan. iLembe District Municipality, Umhlali.

2.2 Natural System (Theme One)

2.2.1 Water

Use of water is linked to development and wealth, and with projects for growth in both domestic and industrial sectors, the demand for both clean water and for waste-water processing is likely to grow in the future. Water use is also closely linked with the energy sector in terms of industry (energy generation and use) and the domestic sector (energy use in heating).

A key action is to reduce the overall demand for water on a per capita basis as far as possible while maintaining living standards. Awareness raising and education programmes can be developed for residents to help them use as little water as possible. This puts less pressure on clean water and wastewater processing and in turn would reduce the energy demand in this sector. Use of grey water and water collection should be maintained and enhanced to reduce demand on clean water. Education may be needed to raise awareness of the potential uses of grey water.

Wastewater treatment offers the potential to generate biogases which can be used to partially or fully self-power the water treatment process. These technologies have been widely adopted in Europe and America. In this process, the waste sludge is heated in controlled conditions to generate gases which can be recovered in combined heat and power engines. Since the process is self-perpetuating, it reduces the dependence on fossil fuels. Opportunities for localised/small scale hydro-power should also be explored within and surrounding the study area.

Table 2.1: Mitigation options for the water sector

Build mitigation capacity
Demand ■ Building regulations should deliver new buildings that use minimal potable water, and provide rainwater harvesting. This will help to reduce the demand on the water supply and energy (required for pumping). ■ Awareness and Education campaigns to ensure correct uses of water. This should encourage good water use behaviours including which types of water are suitable for different purposes, and to discourage the wasting of water. Planning approval to consider current and future water availability and adopt targets for waste usage in new developments. It will be crucial to make sure new developments promote efficient use of the water supply to reduce additional demand as far as possible. ■ Water use should form part of the regular audit of industrial facilities to ensure adequate monitoring and management of water use is implemented. **Supply** ■ Identify and map opportunity areas for hydro-power installations within and surrounding the study area. ■ Water treatment works should be required to demonstrate energy efficiency as part of the planning and consenting process.

Deliver mitigation actions

Demand

Water use to be metered for both domestic and industrial clients to develop reduction behaviours. All consumers should pay for what they use to provide a tangible incentive to reduce that usage.

Supply

- Work with key partners (such as service providers, farmers and private investors) to increase hydro-power installations.
- Consider creative opportunities for localised/ small-scale hydro-power installations (e.g.in conjunction with stormwater channels/ infrastructure).
- Explore the use for biogas recovery in waste water treatment processes to make these types of plants self-sustaining in the medium term. A review of the available capacity to implement such technology should be undertaken, and partners sought to deliver upgrades.
- Work to reduce leakages in the system to make sure facilities do not need to over-satisfy the actual demand for water.

Key Partners

- Department of Water Affairs (DWA)
- Department of Education
- Department of Transport (DoT)
- Siza Water (SembCorp)
- Umgeni Water
- iLembe District Municipality (e.g. iLembe Water Services Unit)
- KwaDukuza IDP office KwaDukuza Environmental Services Unit
- KwaDukuza Technical Services Unit
- Mondi Wetlands Programme
- Mondi (Corporate Social Investment/Responsibility section)
- Sappi CSI Team (Corporate Social Investment/Responsibility section)
- Local Farmers
- Private Investors
- eThekwini Municipality (for best practice guidance/lessons learnt)

2.2.2 Agriculture

From a climate change mitigation perspective, land used for agriculture can act as both a sink and a source of GHGs. The way that farming is practiced is of paramount importance – for example in the cane industry, where cane is burned prior to harvesting which releases vast amounts of carbon into the atmosphere and negating the sequestration that occurred during its growing season; or the tilling of soils which releases methane into the atmosphere. In addition agriculture can be used to provide renewable fuels which can be used to provide heat and power to the local community.

Comments were raised in consultations about the lack of use of local wastes. A change in philosophy to recognise 'wastes' as 'potential resources' is needed, as this could potentially deliver local energy sources while relieving pressure on waste management. One such commenter[4] noted that bagasse from sugar mills could be used as an energy source, while crop burning is also noted in the area.

[4] Appendix E

Table 2.2: Mitigation options for the agriculture sector

Build mitigation capacity

Research

- Develop a register of potential resources that could be used as fuels rather than being treated as waste. This should be centrally maintained and frequently updated.
- Identify potential customers in the local community that could potentially receive these fuels. Forums could be held between key commercial and industrial companies in the region in order to facilitate the identification of mutually beneficial streams and to share best practices.

Land-use

- Existing forested areas should be protected to maintain local sinks of GHG emissions. Best practice in forestry management could be adopted to maximise the amount of GHG emissions through planned felling and planting regimes.

Deliver mitigation actions

Working with Farmers

- Develop supply agreements between the agricultural and energy sectors with a view to providing predictable incomes.
- Educate farmers and encourage no-till practices.
- Implement forestry management regime that promotes the protection of GHG sinks while potentially providing resource opportunities in the area (through wood or other crop supply, for example).

Key Partners

- KZN Department of Agriculture and Environmental Affairs (DAEA)
- iLembe District Municipality (e.g. iLembe Economic Development Unit)
- Enterprise iLembe
- Ingonyama Trust
- Co-operatives
- Cane Growers Association
- Chamber of Business
- Tongaat Hulett
- Illovo
- Sappi
- Mondi
- South African Sugar Association (SASA)
- South African Sugar Research Institute (SASRI)
- NGOs (e.g. Wildlands Conservation Trust) and NPOs
- KwaDukuza IDP office
- eThekwini Municipality (for best practice guidance/lessons learnt)

2.3 Built System (Theme Two)

2.3.1 Human Settlements

Settlements are one of the major consumers of energy and other resources and therefore a major contributor to the emissions incurred through the supply of that energy and resources. Therefore there are intimate links between settlements and the sector specific responses that are discussed throughout this section. In the context of climate change mitigation, settlements are important from two aspects – residential buildings, and the proximity of different community facilities and services.

Two options can be explored in order to drive efficiency improvements: upgrading of existing buildings to be more energy efficient in their daily operation and, education as a vehicle for change.

New buildings should be subject to building standards that reflect the ambition of KwaDukuza to reduce GHG emissions. This means that they need to deliver on energy efficiency and water use, with a stretch target of utilising renewable energy where it is feasible, particularly for larger developments which can help to meet the renewable energy targets set out in the Integrated Development Plan.

New development should also be planned to take account the location of key services. Services that are located further away increase the potential for additional transport requirements, either through car use or public transport that could be minimised or avoided if well planned. This means that new settlements might look to deliver local employment opportunities and local services.

Table 2.3: Mitigation options for human settlements

Build mitigation capacity
Planning ■ Review and refine the Spatial Development Framework to explore ways in which it can deliver low-carbon settlements design, lifestyles, transport patterns and behaviour. **Building Standards** ■ Building standards codes should demonstrate the intent of KwaDukuza to make new dwellings as efficient as possible. This means improving insulation, making use of natural ventilation and shading and potentially incorporating renewable energy systems where possible, as well as incorporating waste and water re-use. Every new build should be to South African National Standards (SANS) 10400 standards. ■ Creation of locally specific energy efficiency by-laws for buildings, to augment existing national SANS standards. **Education and Information** ■ Raise awareness of energy efficiency within homes and places of work. Look to provide a clear campaign that highlights the contribution to climate change mitigation that all can make as well as the potential monetary savings that residents could make. ■ Look for partners to develop the capacity of local businesses to undertake energy efficiency works.

Deliver mitigation actions

Incentives

- Look to mechanisms for incentivising retrofitting of energy efficiency initiatives though funding/part-funding or other relief.
- Promote developers that deliver excellent performance in building standards.

Infrastructure

- Prefer development that incorporates renewable energy, especially for large scale developments where there might be suitable economies of scale for its development.
- Prefer development that attempts to provide local services and employment in order to lessen the burden on transport requirements.

Building Performance

- Improve standard of social housing (new and retrofit of existing), particularly to include ceilings to improve thermal performance.

Key Partners

- Department of Human Settlement (DHS)
- KwaDukuza IDP office
- KwaDukuza Housing Unit
- KwaDukuza Disaster Risk Management Unit
- KwaDukuza Environnemental Services Unit (as an informant)
- Green Building Council of South Africa (GBCSA)
- Eskom
- Department of Land Affairs (DLA)
- Ingonyama Trust
- Tongaat Hullett (as key landowners)
- NGOs and NPOs
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality

2.3.2 Waste

Waste management has a key role to play in climate change mitigation. It can be a source of GHG emissions, but it can also play a role in long-term reduction of these emissions.

Landfill is the least desirable outcome for waste management for a wide range of reasons. Landfilled organic wastes generate methane which is a more potent greenhouse gas than carbon dioxide. Landfilling is also least desirable from a resources view since a large part of the waste fraction can be recovered and recycled. Finally, landfills occupy space that may be used more optimally. In a scenario where population and development both increase, a landfill-only policy becomes more difficult to maintain.

Current waste collection practices do not cover all areas reliably. Improvement in the collection service is an important aspect of this, but so is the creation of awareness. The lack of resources to deliver robust services is an important hurdle to overcome. By sending all waste to landfill, potential revenue streams are being lost that could be monetised to deliver better services.

The KwaDukuza Integrated Waste Management Plan strongly highlights the need for waste minimisation, re-use and recycling, in line with the National Environmental Management Waste Act (2008) and the 2000 Polokwane Declaration which prescribes zero waste to landfill by 2022. KwaDukuza is not on track to achieving this. Without intervention, the likely waste volumes are likely to increase (in line with projected economic and population growth).[5] This indicates that landfill (methane) gas generation will continue as per the status quo, if not increase. A 2012 report by the DEA has found that landfill sites typically contribute to 10% of a municipality's annual GHG emissions, signaling a need for immediate intervention.

At the very least, the existing landfills should explore the potential for landfill gas recovery, in which methane is captured for use as fuel in gas engines. This is a widely adopted technology that makes use of what would otherwise be considered a waste product and would contribute to the wider ambition of the Integrated Resource Plan which has set targets for renewable energy generation.

Waste segregation promotes recycling which can lead to reductions in GHG compared to virgin products. It is likely that there may be difficulties in securing local markets for some of the sorted materials. However, metals and glass may have potential markets, particularly the former where global commodity prices are increasing.

Energy recovery may also be an option. With these facilities the waste stream is sorted first and the combustible fraction is burnt in a furnace to provide power and heat. This reduces the demand on landfill and provides a local source of low-carbon energy.

Table 2.4: Mitigation options for the waste sector

Build mitigation capacity
Collaboration ■ Explore the potential for partnerships with other local administrations to identify potential markets for segregated wastes and develop economies of scale for other waste processing. **Policy** ■ Refocus waste management plan to a resource plan. Identify the potential waste streams that could be recovered and explore strategies for delivering a market for these resources.
Deliver mitigation actions
Disposal Sites ■ Reduce ongoing fraction of waste to landfill. Landfilling itself leads to GHG emissions and waste resources that could potentially be reused in the wider community. ■ Undertake a feasibility study for landfill gas recovery. This should assess currently operating and closed landfill sites to assess the amount of gases that could be recovered, and identify potential customers for the energy. ■ Explore the feasibility of energy-from-waste solutions. **Collections** ■ Waste segregation at source. **Markets** ■ Review existing capacity for waste processing and potential markets for receiving waste streams. ■ Landfill tax to deter future landfilling and promote alternative waste management.

[5] http://www.mile.org.za/Intermediary%20Cities/Documents/KwaDukuza%20IDP%202012-17.pdf

Key Partners

- Dolphin Coast Landfill Management (DCLM)
- KwaDukuza Waste Management Unit
- Dolphin Coast Waste Management (DCWM)
- KwaDukuza IDP office
- iLembe District Municipality
- Wildlands Conservation Trust
- Tongaat Hulett
- Mondi
- Sappi
- KZN Department of Agriculture and Environmental Affairs (DAEA)
- Gledhow Sugar Company
- eThekwini (for best practice guidance and lessons learnt)
- NPOs and NGOs

2.3.3 Energy

Energy consumption is expected to increase with projected economic growth in KwaDukuza and climate change will only exacerbate this by increasing average temperatures (and therefore increasing the use of air conditioning, for example) as well as the occurrence of extreme events such as heat waves (which will result in “spikes” in energy usage). Energy embodies the most significant contributor to GHG emissions, and therefore the key pillars of efficiency in use and reducing the carbon intensity are paramount. Energy use has links with planning, waste, industry and transport and all of these sectors will be pivotal in delivering reductions in GHG emissions.

Current energy supply is a mix of grid-supplied electricity and ‘private’ energy supply from biomass and small generators. Eskom has indicated that further large scale investment in the transmission supply witll deliver increased availability to the area. While this will deliver a more secure supply – a key pillar for growth – it will also increase GHG emissions substantially since the predominant source of electricity supplied by Eskom is currently from coal.

During the consultation process, a number of comments made noted the relative lack of development in the renewable energy sector, particularly in wind and solar power. These sources of generation could potentially deliver local energy supply which could provide less dependence on the national grid. There are however significant barriers which will need to be overcome in order to see a successful long term deployment of these technologies, such as the REBID process.

Table 2.5: Mitigation options for the energy sector

Build mitigation capacity
Awareness Raising ■ Raise awareness and importance of energy efficiency in the Municipality. A variety of methods can be used, e.g. community forums, advertising, through the education systems etc. Link to monetary savings and efficiency. ■ Make sure each Department understands the potential contribution it makes to energy use, and what they can do to increase energy efficiency. ■ It could be made mandatory for Departments to reduce energy use and waste generation. Staff should be evaluated against their individual and departmental performance towards Energy Efficiency and Climate Change targets and action integrated into service delivery and daily tasks. **Technical Expertise** ■ Evaluate the level of expertise in the field on energy and/or renewable energy. Consider partnerships with other administrations to explore the potential for energy developments. **Cross-departmental Working** ■ Identify barriers to cross-departmental working to deliver energy efficiency projects. Undertake seminars and workshops on where potential synergies may exist. ■ Make sure planning officers understand the key issues of energy so that future growth can take advantage of efficiencies or local sources of energy.

Deliver mitigation actions

Buildings

- Implement thermally efficient housing delivery, e.g. legislate the provision of ceilings in government-delivered housing (ceilings result in a warmer house in winter; cooler in summer) which will also help avoid additional heating and/ or cooling.
- Ensure that all new buildings follow the building regulations (at minimum) and increase municipal enforcement thereof.
- Use a Municipality building as a showcase for implementing renewable energy/energy efficiency. This will give a good example to the rest of the community as well as a chance to identify local skills and skills gaps in this area.

Infrastructure

- Promote the auditing of the energy efficiency of existing industrial processes and challenge them to improve.
- All waste processes to undertake feasibility studies for recovering energy to contribute to renewable energy targets and waste management. Agricultural wastes should be registered and their suitability for energy recovery determined along with identification of potential customers.

Renewable Energy

- Use National and Provincial solar and wind potential information to assist Municipal planners in identifying potential sites for renewable energy in KwaDukuza that the Integrated Resource Plan can deliver on its ambitions to diversify supply. The Department of Economic Development and Tourism, for example, has made this information freely available to municipalities in KZN.
- Explore the feasibility of potentially developing Power Purchase Agreements, and learn from best practice in South Africa. If feasible, look for outside investment to deliver renewable energy projects through power purchase agreements or similar contracts.
- Explore the potential for use of carbon financing options to increase project feasibility.

Planning

- Look to local new industry that depends on heat next to existing installations that may have waste heat streams.
- Large scale developments to have mandatory energy management plans to ensure that economies of scale can be utilised to deliver local renewable energy.
- Planning decisions should consider whether developments have made optimal use of the local conditions, for example consideration of solar PV/heating, maximising shading, passive ventilation techniques etc. Develop a checklist to streamline decisions within the building regulations.
- Prefer developments that utilise renewable energy.

Key Partners

- ESKOM
- KwaDukuza IDP office
- KwaDukuza Electricity Services Unit
- Department of Education
- Treasury (Renewable Energy Independent Power Producer Procurement [REIPPP] programme)
- Development Bank of South Africa (DBSA)
- Department of Energy (DoE)
- Department of Water Affairs (DWA)
- Department of Economic Development and Tourism (DEDT)
- Department of Trade and Investment (DTI)
- Private Investors
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality
- NGOs and NPOs

2.4 Transport

The IDP points out that the transport industry in KwaDukuza is considered under-developed with uncoordinated public transport systems and inadequate infrastructure to enable this. An Integrated Rapid Public Transport Network (IRPTN) is being introduced to iLembe for this specific reason. In the eThekwini inventory, for example, transport fuels account for about a quarter of the GHG emissions and, are also seen to be important at a national level. Some national regulations are in place that will introduce some biofuels in to transport fuel which will provide a minimum amount of mitigation.

With a likely increased number of middle-income earners in future, there will be an increasing number of new vehicles on the roads in KwaDukuza because it is a growing economy. Unless vehicles operating from renewable energy are mainstreamed/ incentivised, or effective public transport systems are operational, local transportation-related GHG emissions will increase and there will be increased dependency on fluctuating oil prices which will drastically affect the local economy. KwaDukuza may be able to help influence this by using its own vehicle fleets to set a good example.

Keeping the number of car trips to a minimum is a key factor on limiting GHG emissions, as well as improving the Level of Service (LoS) of the roads and intersections which would mean less time idling in traffic. This may require twin stream policies of dis-incentivising personal car travel (e.g. through taxes, parking rates etc.) and incentivising public transport (e.g. inventing in facilities, keeping fares low).

Table 2.6: Mitigation options for the transport sector

Build mitigation capacity
Awareness Raising ■ Education programme on making optimal use of public transport, cycling and walking. **Planning** ■ New development should demonstrate how it will utilise existing public transport or support new public transport initiatives to limit the proliferation of private car transport. ■ Wider planning should try to promote local employment and services to limit the need for longer distance journeys.

Deliver mitigation actions

Modal Shift

- Effective transport planning and management towards encouraging a shift from private to public transport.
- Park and ride facilities to encourage private car users to use public transport.
- Support walking and cycling modes, e.g. cycle lanes and storage.
- Roll out of bus rapid transport and school bus systems (an IRPTN is proposed for iLembe).
- Engage with local business and logistics companies to encourage fleet efficiency/use of rail.

Deterrents

- Allocate road space to public transport vehicles.
- Increase cost of private car transport such as through road space charges and consideration of emissions taxes (e.g. on fuel purchases). Importantly, any taxes must be ring-fenced so that such funds can be used specifically for climate change projects/initiatives in future (e.g. awareness campaigns).

Technology and Design

- Set minimum standards for new additions to government vehicle fleet efficiency.
- Set minimum standards for new additions to public transport and taxi vehicles.
- Improve road design so that vehicles can travel to destinations more efficiently with less time on the road, and thus lower emissions.

Key Partners

- Department of Transport (DoT)
- South African National Roads Agency Limited (SANRAL)
- KwaDukuza IDP office
- KwaDukuza Transportation Unit
- iLembe District Municipality
- Taxi Associations
- Public Rail Association of South Africa (PRASA)
- Transnet
- eThekwini Municipality (for best practice guidance/lessons learnt)
- NGOs and NPOs

2.5 Socio-economic System (Theme Three)

2.5.1 Working with Business

Business has a key role to play in climate change mitigation. Particularly in the use of energy, there can be direct monetary benefits in improving energy efficiency. Businesses operating in the manner of Business as Usual may find that they are left behind in the future with rising energy costs making them uncompetitive. Larger businesses may also have the ability to invest in low-carbon and renewable energy technologies which could insulate them from rising energy prices in the medium-term.

A new generation of more environmentally informed consumers will lead the process of transformation in consumer behaviour and this may call for changes to manufacturing processes to provide “sustainable” goods.

Businesses can also form partnerships to better work together to supply energy and wastes between each other which may complement both businesses.

Table 2.7: Mitigation options for the business sector

Build mitigation capacity
Awareness Raising ■ Organise and promote business forums to develop local links and maximise opportunities for collaboration. ■ Develop a knowledge exchange network for businesses to be able to share best practice. ■ Encourage and educate industries and business on extended producer responsibility.
Deliver mitigation actions
Monitoring ■ Produce an inventory of heavy emitters in KwaDukuza. ■ Introduce mandatory GHG emissions data capture and reporting. ■ Auditing of energy efficiency at large installations. **Technology** ■ Work with local business to reduce dependence on increasingly costly energy sources. ■ Encourage CSI projects that focus on community-based adaptation projects. **Investment** ■ Explore potential for incentivising investment in low-carbon technologies. ■ Encourage use of available carbon-financing mechanisms to encourage project development.
Key Partners ■ KwaDukuza IDP office ■ KwaDukuza Economic Development Unit ■ eThekwini Municipality (for best practice guidance/lessons learnt) ■ iLembe District Municipality (e.g. ilembe Economic Development Unit) ■ Enterprise iLembe ■ Chamber of Commerce ■ Department of Trade and Investment (DTI) ■ KZN Department of Economic Development and Tourism (DEDT) ■ NGOs and NPOs

2.5.2 Education Awareness and Capacity Building

Driving change must start at a local level. In order to empower vulnerable communities and future generations on climate change mitigation and adaptation, educational reform, awareness campaigns and capacity building is needed. Without it, the status quo of unsustainable development and consumption will occur and prevent the Municipality from following a sustainable growth path.

Many of the technical improvements might require additional capacity and resources to deliver. Some of this expertise may not currently exist in the area. In this case partnership working, especially with other regional bodies will be an important part of delivering the mitigation actions identified throughout this section.

Table 2.8: Mitigation options for education awareness and capacity building

Build mitigation capacity
Training ■ Train and recruit staff to be able to deliver on the initiatives listed below. ■ Explore conducting a baseline staff awareness survey with ICLEI-Africa. ■ Strengthen human resources and climate change knowledge within key departments which have a prominent role to play within the municipal arena, relating to climate change (e.g. electricity, waste, human settlements, planning). **Communication** ■ Sharing experiences and lessons, to inform others and future actions and policies. ■ Develop local and regional networks and forums to build business links and identify opportunities. ■ Actively seek investors for renewable energy projects.
Deliver mitigation actions
Projects ■ Roll out practical, interactive education programmes at schools and community groups. ■ Perform plays for communities with a climate change-based story line. ■ Documenting, developing and sharing information on climate change, vulnerability and adaptation. ■ Encouraging local voluntary action for promoted energy efficiency measures.
Key Partners ■ Department of Education ■ KwaDukuza IDP office ■ KZN DAEA ■ NGOs and NPOs ■ eThekwini Municipality (for best practice guidance/lessons learnt) ■ iLembe District Municipality

2.6 Governance (Theme Four)

2.6.1 Integration, Planning and Partnerships

Governance is a crucial part of GHG mitigation. Leadership must come from the top, with strong messages and policies forming the framework for successful development of mitigation programmes. Every head of Department must have accountability for delivering actions in support of mitigation. It is therefore critical that all Departments work together to recognize cross-department benefits. Examples of synergies are between energy and waste and, energy and transport.

In addition, planning rules and building standards guidance can provide the essential framework for promoting low-carbon development. While low-carbon development may not be expedited, some consideration should be given to removing any barriers that might dissuade development.

No local inventory of GHG emissions has yet been produced, but the partnership with ICLEI-Africa should lead to the development of a local inventory where local energy data is available. This will be an important source of information in terms of targeting and planning for GHG mitigation.

Partnerships can also play an important role in the delivery of initiatives. Many mitigation actions require economy of scale which may mean KwaDukuza needs to work with other administrations in order to gain the sufficient funding to realize both GHG emission and cost benefits. KwaDukuza can take the lead in establishing these partnerships.

Table 2.9: Mitigation actions for governance

Build mitigation capacity

Integration

- Adequate climate change capacity at the local government level must be accommodated in the municipal structure.
- Each Department should understand what they can do to help reduce energy and GHG emissions – a local emissions inventory would help with this as it would provide the baseline and thereafter identify areas where emissions are increasing and/ or decreasing .

Partnership Working

- With limited financial and human resources, it is difficult to divert resources from basic service delivery. In this regard it is critical to create partnerships with key organisations to respond to action plans and identify issues where different Departments can work together to deliver mutual benefits.
- Partnering should extend outside of the Municipality services. Local businesses can contribute to successful partnerships and more regional working can bring isolated expertise together.
- Conduct baseline capacity assessment with ICLEI-Africa in order to explore which institutional and governance mechanisms may be necessary to mainstream climate change into decision-making.

Deliver mitigation actions

Integrated Development Plan

- Municipality leadership must demonstrate and articulate a commitment to reducing GHG emissions
- The next Integrated Development Plan should factor in the findings of the CCRS and develop policies that can support efforts to reduce GHG emissions.
- Iterations should take place with both annual and 5 year IDP revisions, as new and more sophisticated information becomes available.
- These IDP plans must filter down and cross-cut into all municipal plans and service departments – each department needs responsibility on delivering GHG reductions.

Access to Funding

- Boost efforts on compiling sound applications to access climate change/ 'green' funding - such as that of the DBSA Green Fund.

Key Partners

- KwaDukuza IDP office
- KwaDukuza Town Planning and Building Control Unit
- KwaDukuza Environmental Services Unit
- KwaDukuza Special Projects Unit
- All other relevant municipal Line Units in KwaDukuza Municipality
- ICLEI-Africa
- NGOs and NPOs
- Local Businesses
- Enterprise iLembe
- Chamber of Commerce
- National and Provincial Government departments
- Key Funders (e.g. DBSA, DEDT, World Bank, LOTTO)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality

As a note of caution, it is important to note one of the obstacles encountered by the eThekwini (Durban) Municipality. In their experience of climate change projects, a lack of awareness within the senior management structures and staff in other line-function departments proved counter-productive to some of their mitigation initiatives. One key reason is the nature of climate change projects that have been implemented in Durban. An example of this is the undertaking of the GHG inventory and the energy efficiency in buildings projects. These were projects that consultants were commissioned to undertake, and which were to be overseen by municipal staff that did not have an understanding of why these projects were being implemented. A symptom of their lack of awareness coupled with the complexity of climate change was the apparent weak co-ordination between the various municipal line departments and the municipal environmental department.[6]

[6] Mokwena, L. 2009. Municipal Responses to Climate Change in South Africa: The case of eThekwini, the City of Cape Town and the City of Johannesburg. Centre for Policy studies, Johannesburg.

3. Climate Change Adaptation Responses

3.1 Introduction

KwaDukuza is becoming increasingly vulnerable to changes in weather extremes as a result of climate change.[7] In response to the risks presented form current and projected climate change, actions are required to manage this increasing vulnerability in the form of climate change adaptation.

Climate change adaptation refers to adjustments or changes in decision environments, which work to enhance resilience or reduce vulnerability to current or projected changes in climate or their effects, or which moderate harm or exploit beneficial opportunities.[8] In working to manage such risks, climate change adaptation can be categorised into initiatives that either:

- **Build adaptive capacity** – Actions to build adaptive capacity act as a foundation and are fundamental to the development of adaptation actions. Initiatives that build capacity to adapt include:
  - Gathering and sharing information (research, data collecting and monitoring, awareness raising)
  - Creating supportive social structures (organisational development, working in partnership, institutions),
  - Creating supportive governance (regulations, legislations, and guidance).
- **Deliver adaptation actions** – Adaptation actions work to reduce vulnerability to climate risks or to exploit opportunities. Adaptation action falls into the following primary categories:
  - Accepting impacts and bearing losses
  - Preventing effects or reducing risks
  - Offsetting losses by spreading or sharing risks
  - Exploiting positive opportunities

Climate impacts and measures to manage potential risks that may arise are often specific to the context in which they are set. Therefore, innovation is often required in the identification and design of adaptation measures.

3.2 Natural Environment (Theme One)

3.2.1 Water

Climate change adaptation is a key challenge for the already stressed water sector to increase its resilience to a changing climate. Primary issues include:

- Understanding of impacts to the sector, specifically in relation to the resilience of infrastructure assets, demand, supply and water quality;
- Understanding of the impact on wider sustainability issues (social, economic and environmental);
- Ensuring that decision-making takes account of water security beyond current planning horizons; and
- Developing flexible and responsive water management regimes.

[7] As illustrated by Appendix J.

[8] Adger et al (2007) Assessment of adaptation practices, options, constraints and capacity. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry et al Eds., Cambridge University Press, Cambridge, UK, 717-743.

A key challenge with respect to adaptation is the lack of clear evidence and complex interactions within the wider environment and how this may affect the KwaDukuza area in future. This is further complicated by the interdependencies with other sectors such as agriculture, energy, and business sectors.

Climate change adaptation action will also need to balance consideration for wider social and economic influences such as population growth and changes in land use; and the need to mitigate climate change by reducing energy use, while maintaining water and environmental standards.

The table below outlines potential climate change adaptation responses for the water sector that seek to build resilience in the sector, while taking into consideration wider implications and influences.

Table 3.1: Adaptation options for the water sector

Build adaptive capacity
Municipal Policy ■ The Cape Metropolitan Council developed the following policy statement in 2007: "…to develop and manage, in a participatory manner, the implementation of a socially beneficial, technically feasible, economically effective, ecologically sustainable water demand management strategy, which will reduce the projected demand in greater Cape Town by 20% by 2010" [9]. The Municipality should consider developing similar sustainability polices that also support climate change adaptation responses, not only for the water sector. **Water Company Climate Change Strategy** ■ Umgeni Water is responsible for supplying water to KwaDukuza, yet their strategic plans (based on the Department of Water Affairs) do not yet include impacts of climate change on the availability of water. For example, the water supply is currently designed to withstand a 1:100 year drought. Climate change has the potential to increase the occurrence and severity of drought events and future management plans will need to consider this, as drought-induced water shortages have already been experienced in the Western Cape for example. The University of KwaZulu Natal is currently working to help the water company with its planning. This process should be supported by the Municipality with the outcomes communicated so other Municipalities and organisations can benefit. **Monitoring Systems** ■ The monitoring and forecasting of water flows, floods and droughts needs to be improved to better inform policy, strategy and action planning in the water sector. This can be achieved through the development of partnerships and networks with key stakeholders such as water companies and water research institutes. The Municipality can play a key role in facilitating the formation of these partnerships and networks. Such activity can also have a key role in informing the planning and development of infrastructure and early warning systems. **Demand Management** ■ Prepare response plans to balance the needs of competing users when water availability is reduced (drought years, peak seasons). An example would be asking residents to stop watering gardens and washing cars, etc.

9

Mukheibir. P. & Ziervogel. G. (2007). Developing a Municipal Adaptation Plan (MAP) for Climate Change: The city of Cape Town. Journal of Environment and Urbanisation, (19:143)

Awareness and Education Campaigns

- Improving the provision of and access to water should also be coupled with improving the efficiency with which water is used. Awareness raising and education programmes can be developed for residents to help them use as little water as possible. Water availability is already an issue in the eThekwini region and some measures have already been put into place to conserve water, e.g. campaigns, replacements of pipes, and leak detection. These measures should be continued and built upon. This can also include changes in agricultural management practices in line with water scarcity (e.g. changes in crop types, dry land farming).

Planning Approval

- Planning approval needs to consider current and future water availability. The Municipality can have a key role in ensuring future developments use water sustainability.

Supply

- A ten point plan was established in 2004 for the city of Cape Town to achieve greater water conservation, complimenting the existing water demand management strategy. A number of these included water restrictions, water tariffs, reducing leaks, pressure management and awareness campaigns which could be replicated in KwaDukuza.

Deliver adaptation actions

Preservation of Wetlands

- The conservation and restoration of wetlands can acts as a buffer zone to provide a natural response to flood risk management.[11] The Municipality needs to ensure that land use and planning promote the designation and preservation of wetlands and coastal areas through the establishment of regulations and enforcement.

Demand

- A number of measures can be implemented to manage demand. These include asset management solutions (such as pressure management) or the provision of and encouragement of the use of water conservation technologies such as low flush toilets and low flow showerheads.

Rainwater Harvesting

- The Municipality should facilitate and encourage the use of 'grey water' for toilet flushing, car washing and irrigation.

Supply Management

- Greater reserves, buffer capacities and management of resources need to be built into water company strategies and responses, although these can be difficult to create. This should also include the reduction of leaks. Response options for peak supply in drought years need further investigation (from cost benefit perspective and development approach): increased storage capacity/widening of dams, trucking of water, desalination and development approvals. This should extend to water access by rural communities and support of local livelihoods.

Key Partners

- Department of Water Affairs (DWA)
- Siza Water (SembCorp)
- Umgeni Water
- iLembe District Municipality (e.g. Water Services Unit)
- KwaDukuza IDP office
- KwaDukuza Environmental Services Unit
- KwaDukuza Technical Services Units
- Mondi Wetlands Programme

[11] http://www.grabs-eu.org/membersArea/files/new_orleans.pdf

- Mondi (e.g. Corporate Social Investment/Responsibility section)
- Sappi (e.g. Corporate Social Investment/Responsibility section)
- Local Farmers (e.g. those who irrigate/those with dams on their properties)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- NGOs and NPOs

3.2.2 Coastal and Marine

The Integrated Coastal Management Act (2009) requires coastal management plans to protect built and natural environments and which should consider impacts of coastal flooding and wave damage. Coastal buffer zones can prevent damages to property and allow dunes and coastal vegetation to re-establish after a storm. The Berg Water Management Area (WMA) assessment study also states that no development or investment decisions should be made without taking into account the potential effects of climate change on water resources.[12]

The main areas for adaptation action include:
- Considering climate change during the planning process around the coast;
- Encouraging research and the monitoring of climate impacts on fisheries; and
- Including climate change risks in the development of Coastal Management Plans.

More detail can be found in Table 3.2.

A Coastal Vulnerability Index has been produced for KwaZulu-Natal which identifies areas of risk, moderate risk and high risk to coastal/beach erosion. Areas most vulnerable to coastal erosion are those that are heavily settled (Zimbali to Salt Rock and Zinkwazi) and all river mouths (probably due to upstream catchment practices that increase runoff). Erosion rates can be affected by sea level rise or intense rainfall events and these high risk stretches of coastline must be carefully managed.

[12] Mukheibir. P. & Ziervogel. G. (2007). Developing a Municipal Adaptation Plan (MAP) for Climate Change: The city of Cape Town. Journal of Environment and Urbanisation, (19:143)

Table 3.2: Adaptation options for the coastal and marine sector

Build adaptive capacity
Planning ■ There is an opportunity for the Municipality to use the Coastal Vulnerability Index (CVI) mapping of high and moderate risk areas when making planning and development decisions. More strict municipal planning and decision making guidelines around coastal activities, especially within 200m of the coastline (i.e. more stringent set-back lines) are required and including consideration of the Coastal Vulnerability Index is a good starting point. ■ The areas identified as high risk should have site specific Shoreline Management Plans developed for them (in line with recent Coastal Management Programme findings and recommendations) and these areas or communities should be prioritised in terms of funding and resources. **Research** ■ Changes in water temperatures can result in the migration of fish populations to other areas where ideal conditions are now met. Research into the potential impact on fisheries and therefore the whole marine and coastal ecosystems can be useful to be able to predict the movement of fish populations which may impact tourism as well as local economies. The Municipality can encourage such research by engaging with universities, Ezemvelo KZN Wildlife and/or the Ocenographic Research Institute.
Deliver adaptation actions
Coastal Management ■ Climate change risks should be considered when developing Coastal Management Plans as these can help reduce vulnerability if implemented. Potential actions include reinforcing beach infrastructure at areas of high risk; relocating existing developments away from coastal areas at high risk; and reinstating natural beach/dune vegetation or increasing natural shoreline buffers to protect against increased runoff from more intense storms.
Key Partners ■ KZN Department of Environmental Affairs (DAEA) ■ KwaDukuza IDP office ■ KwaDukuza Beach Management Unit ■ KwaDukuza Development/Town Planning Unit ■ KwaDukuza Environmental Services Unit ■ Coastwatch ■ Oceanographic Research Institute (ORI) ■ Ezemvelo KZN Wildlife (EKZNW) ■ eThekwini Municipality (for best practice guidance/lessons learnt) ■ iLembe District Municipality (including the iLembe Coastal Working Group) ■ Univiersities

3.2.3 Biodiversity

While habitats are constantly affected by short-term seasonal uncertainties, climate change may occur faster than they can respond or adapt. Such pressures are aggravated by humans encroaching on critical biodiversity areas, watercourses and coastlines through changes in land use and pollution. These reduce the capability of these natural habitats to provide the ecosystem services that we rely on from pollination and soil quality, to water quality and flood prevention along the coast.

Actions to improve the resilience of biodiversity include:

- Including climate risk in planning and management of natural systems;

- Raising awareness of the importance of green spaces and infrastructure for planners and architects;
- Ensuring that natural habitats are protected;
- Monitoring invasive species; and
- Managing fire risk.

More detailed information can be found in Table 3.3.

This is an exceptionally complex sector, characterised by the involvement of many different groups with widely differing agendas and by significant interaction with a range of other sectors whose focus may not be on biodiversity or ecosystem services.[13]

Table 3.3: Adaptation options for the biodiversity sector

Build adaptive capacity
Planning and Management ■ The finalisation of the KwaDukuza Biodiversity Open Space Management Plan should be encouraged and used in conjunction with vulnerability mapping exercises and other related management plans (e.g. shoreline management, informal settlement management) to work towards a unified strategy to protect and improve natural habitat within the Municipality. The roll-out of Community Based Ecosystem Adaptation (CEBA) projects should also be promoted.
Education and Training ■ Landscape architects and planners should be made aware of the importance of green space and natural habitats within their work. Not only do they help promote biodiversity, they also help reduce runoff from intense rainfall events, and also improve health and wellbeing of the people in the local area. The Municipality can educate architects and planners on promoting the use of green infrastructure and green space in developments and also make their consideration mandatory.

[13] UK Climate Change Risk Assessment (2012) Biodiversity. Available at: http://www.defra.gov.uk/environment/climate/government/risk-assessment/

Deliver adaptation actions

Protecting Green Spaces and Natural Habitat

- Remnant patches of riparian vegetation and coastal forest exist, along with limited examples of coastal grassland. These are important for conservation. Three fragments of Ngoye Forest and Grassland should be proclaimed as reserves in a joint exercise with Ndwedwe Local Municipality and with the assistance of the South African National Biodiversity Institute (SANBI) and Ezemvelo KZN Wildlife.
- Protect and increase existing ecosystems and green spaces for flood risk management, reduction of the heat island effect and agriculture and biodiversity support. The ecosystems that provide such functions include: wetlands, river courses, dunes, land care/erosion prevention, and water sheds.
- There is also the possibility to encourage the introduction of wildlife corridors so that species can move with climate change. Species that cannot move will face competition with other incoming species and even face extinction.

Invasive Species

- While some species may leave the Municipality as the climate shifts, others may move into the area. Whilst not all species will be considered pests, they should be monitored to ascertain whether they will harm the natural habitat in any way. This is especially important for the agricultural and forestry sectors, where pests can ruin entire crops (this is especially problematic in monoculture farms). Management plans need to be devised for those species that are shown to pose a risk and information can potentially be obtained from other countries that have dealt with a similar issue.

Fire Risk

- Higher temperatures and drier conditions can lead to an increased risk of wildfires. There are a wide range of options to address this, from training to controlling the necessary burning of vegetation, removing plantations from areas where climate change may make them less productive, and creating fire breaks between green spaces and residential areas[14]. The Municipality will need to be able to increase future fire fighting and rapid response capabilities to be able to deal with increased occurrences.

Key Partners

- Ezemvelo KZN Wildlife (EKZNW)
- KwaDukuza IDP office
- KwaDukuza Environmental Services Unit
- KZN Department of Environmental Affairs (DAEA)
- Department of Environmental Affairs (DEA)
- South African National Biodiversity Institute (SANBI)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality

  NGOs (e.g. WESSA, Endangered Wildlife Trust and Wildlands Conservation Trust) and NPOs

3.2.4 Agriculture

The importance of agriculturally productive land is highlighted by the fact that South Africa is now a net-importer and is thus food insecure. The agricultural sector will need to adapt to changes in climate by adapting agricultural practices, changing crop types or livestock, and improve their ability to plan under uncertainty.

Adaptation options for the agricultural sector include:

[14] Mukheibir. P. & Ziervogel. G. (2007). Developing a Municipal Adaptation Plan (MAP) for Climate Change: The city of Cape Town. Journal of Environment and Urbanisation, (19:143). Sage

- Increasing research on the impacts of climate change;
- Developing diversification strategies for farmers;
- Creating early warning systems and encouraging response planning;
- Promoting community-based adaptation projects; and
- Working directly with farmers to raise awareness on recommended actions.

More detail on these actions can be found in Table 3.4.

Climate change will not be the only pressure on agriculture: there will be increased competition between food, fodder and biofuel crops; there will be an emphasis on the retention/protection of natural areas; and markets and customer demand may shift due to changes in food prices or climate itself. The speed and extent of change may exacerbate rural poverty and population migration to urban areas or to richer countries.

Table 3.4: Adaptation options for the agriculture sector

Build adaptive capacity
Research ■ Research should be encouraged to highlight the potential of changing crop/ livestock types, cropping times, and irrigation methods, or even moving towards dry land farming to diversify agricultural activities. More information on potential new pests and diseases should also be considered now so that the information is available if they do become present in the future.
Diversification ■ Diversification is a strategy that the Municipality can promote to reduce the reliance of farmers on their income from farming. Potential non-farm activities can include moving into the tourism sector for example. Having income from a variety of streams means that the individual is more resilient to one stream being reduced or completely destroyed.
Early Warning Systems ■ The Municipality can support the development of an early warning system that provides daily weather predictions and seasonal forecasts by using existing networks and knowledge of the local communities. These systems can help farmers plan their work better and also make them aware of oncoming severe weather events.
Response Planning ■ As with communities in general, farmers need to know how best to clear up after an extreme event such as a flood or storm. The Municipality can aid farmers by providing networks so farmers can share best practice and learn from each other.
Deliver adaptation actions
Community Work ■ The Municipality can help promote organisations and businesses to work with communities on community-based adaptation projects such as fruit tree growing for example. It not only helps the business in terms of corporate social responsibility, it also helps the community provide for itself (in this case, by growing fruit).
Working with Farmers ■ Research carried out in universities and often in different countries is often not accessible to farmers. The Municipality can help bridge this gap by providing an information network where farmers can access relevant information in a language that they understand. Once they have the relevant information, farmers can also be assisted to implement recommendations from research in terms of crop types, relocation, providing shade for livestock, diversification etc.

Key Partners

- KZN Department of Agriculture and Environmental Affairs (DAEA)
- iLembe District Municipality (e.g. iLembe Economic Development Unit)
- KwaDukuza IDP office
- KwaDukuza Town Planning Unit
- Enterprise iLembe
- Ingonyama Trust
- Co-operatives
- Cane Growers Association
- Chamber of Business
- Tongaat Hulett
- Illovo Sugar
- South African Sugar Association (SASA)
- South African Sugar Research Institute (SASRI)
- Mondi
- Sappi
- NGOs (e.g. Wildlands Conservation Trust) and NPOs
- eThekwini Municipality (for best practice guidance/lessons learnt)

3.3 Built Systems (Theme Two)

3.3.1 Human Settlements

The majority of the built environment has been designed for the climate that existed when it was built and is therefore not necessarily equipped to cope with current and future climates. Future housing infrastructure will have to be planned and designed to withstand higher temperatures, more intensive rainfall and greater flooding risks. This should apply indiscriminately to both existing and new settlements that are in key risk areas, but with a primary focus on the poor.

The following actions can help improve the resilience of human settlements:

- Vulnerability mapping to identify areas or communities at high risk;
- Using the planning system to ensure that new developments are resilient;
- Ensuring the building design standards are resilient to future climate change;
- Improve the conditions of informal settlements;
- Promote green space and infrastructure in developments; and
- Relocate communities at high risk that cannot be reduced.

More detail can be found in Table 3.5.

The sector may therefore need to consider suitable approaches for adaptation to a changed climate. Air conditioning may make the Urban Heat Island effect worse; passive cooling measures for buildings are an alternative.

Adaptation measures to reduce the risk of stormwater events include; monitoring and warning of impending disaster risks, reducing impacts of natural hazards through infrastructural means e.g. flood detention ponds and weirs, increasing the flood event return period that structures are designed to accommodate, maintenance of stormwater drains and developments of resilient infrastructure including low-income homes and sewerage treatment installations to cope with flash floods.

Table 3.5: Adaptation options for human settlements

Build adaptive capacity
Vulnerability Mapping ■ Identifying, mapping and assessing key risk areas or settlements will help create an inventory of priority communities that are at high risk which the Municipality can then pass on to other partner organisations that can help with the management of these areas. ■ Areas where development is limited due to flood risks, such as the existing 1:100 year flood line no development zone, will require revision. Climate change is expected to increase the magnitude and frequency of flood events, therefore reducing the return period of current standards.
Planning ■ The Municipality has the opportunity to use its planning powers to ensure that climate risks are factored into the planning of developments. The outputs of the Department of Human Settlement (GIS-based) study on the impacts of climate change on rural and urban housing could be used to better inform planning decisions once it has been completed. It is important to ensure that new buildings are not built in flood plains and take more cognisance of high water marks. KwaDukuza's new Disaster Risk Management offices, for example, were destroyed in a flood in 2009 and are currently being rebuilt there even though they will be situated in a flood plain. This highlights the need to get flood risk considerations on the planning agenda to avoid similar projects going ahead in the future. ■ Ensure that climate impacts are factored into emergency response planning and disaster risk management.
Building Standards ■ As under the Planning section above, the Municipality can ensure that climate change is considered in building standards and codes to ensure that comfort levels can be maintained during extreme events such as heat waves. It is possible to learn best practice in terms of building standards from other countries or regions that are currently experiencing the climate that KwaDukuza is predicted to experience. An example of a requirement is to improve the standard of social housing (new and retrofit of existing) by including ceilings to improve their thermal performance.
Informal Settlements ■ Informal settlements are difficult to regulate. Individual homes are often built too close together which increases fire risk and they are particularly vulnerable to flooding due to their relatively poor construction and location on the land. Disaster risk reduction measures, including improved infrastructure, planning and management will need to be considered by the Municipality.
Deliver adaptation actions
Green Spaces and Infrastructure ■ Green spaces and green infrastructure such as green roofs absorb intense rain runoff and can also improve sanitation. They also promote biodiversity as well as health and wellbeing for people that use the space. Planners and designers should be encouraged to increase the use of such features in new developments and renovations.
Community Relocation ■ Where possible, communities that lie in high risk areas (to flooding in particular) should be encouraged (and assisted, where it is deemed necessary) to relocate by the Municipality. Settlement in flood prone areas should be avoided in general. In coastal areas, this could be done by increasing setback lines from the coast and watercourses in planning documents.

Build adaptive capacity
Key Partners ■ Department of Human Settlement (DHS) ■ KwaDukuza IDP office ■ KwaDukuza Town Planning Unit ■ KwaDukuza Housing Unit ■ KwaDukuza Disaster Risk Management Unit ■ KwaDukuza Environnemental Services Unit (as an informant) ■ Department of Land Affairs (DLA) ■ Ingonyama Trust ■ Tongaat Hulett (as key landowners) ■ eThekwini Municipality (for best practice guidance/lessons learnt) ■ iLembe District Municipality

3.3.2 Waste

As mentioned in the Impacts section above, the waste sector will be affected in a similar manner to human settlements; energy and transport in terms of asset and operator management, and these sections should be considered with the potential adaptation actions outlined in Table 3.6 below.

Table 3.6: Adaptation options for the waste sector

Build adaptive capacity
Communication ■ The Municipality will need to include the waste sector when creating communication links between construction, commerce and industry to share best practice methods within and outside the sector and promote resilience when planning and designing developments.
Deliver adaptation actions
Disposal Sites ■ Through its planning powers, the Municipality should ensure that climate risks are considered during the proposal of new waste management sites, and that the management of new and current sites include consideration of rising water tables, flooding, coastal erosion and high winds as well, as these can all impact badly on waste disposal sites and the surrounding environment. **Communities** ■ Education and Awareness raising in communities to encourage waste minimisation, re-use and recycling. **Outdoor Working** ■ Organisations need to be encouraged to provide proper training for outdoor workers (such as waste collectors) to raise awareness of the risks of working in extreme temperatures as a health and safety requirement.

Key Partners

- Dolphin Coast Landfill Management (DCLM)
- Dolphin Coast Waste Management (DCWM)
- KwaDukuza IDP office
- KwaDukuza Waste Management Unit
- KZN Department of Agriculture and Environmental Affairs (DAEA)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality
- NGOs and NPOs

3.3.3 Energy

Energy consumption is expected to increase with projected economic growth in KwaDukuza and climate change will only exacerbate this by increasing average temperatures as well as the occurrence of extreme events such as heat waves.

Key actions that can help improve the resilience of the energy sector include:

- Raising awareness among local residents and businesses to improve their energy efficiency will not only help reduce carbon emissions; it will help reduce the strain on energy infrastructure that is already under stress;
- Improved forecasting services for improved planning;
- Carrying out a risk assessment of the infrastructure to highlight priority areas and assets;
- Improving the thermal efficiency of buildings; and
- Improving the resilience of energy infrastructure.

More detail can be found in Table 3.7.

The energy sector is particularly important in terms of resilience as all other sectors are heavily reliant on electricity from residents using electricity in their homes, to communication via the internet and healthcare facilities being able to provide care.

A major challenge with respect to adaptation, however, is the uncertainty surrounding the precise way the energy sector will evolve in the coming years and decades, with the energy mix beyond 2050 particularly unclear. Fossil fuels, renewables and nuclear power all have different vulnerabilities to climate change.[15]

[15] UK Climate Risk Assessment (2012) Energy. Available at: http://www.defra.gov.uk/environment/climate/government/risk-assessment/

Table 3.7: Adaptation options for the energy sector

Build adaptive capacity

Awareness Raising

- The Municipality can help support awareness-raising campaigns for residents to promote energy efficiency in general. This can help alleviate some of the pressures that the energy industry will face under conditions such as heat waves when the physical infrastructure itself is already under stress.

Forecasting Service

- Water levels are extremely important for power stations to provide cooling. Reductions in water levels in rivers can therefore negatively impact the ability to provide power from inland stations and the ability to be able to predict these low levels can aid business planning processes.
- Climate change risk assessment of energy infrastructure.
- The Municipality can encourage and support the energy providers in undertaking a risk assessment to highlight priority areas for action. This will help raise the awareness around current and future risks and help shape design, operational and maintenance activities.

Deliver adaptation actions

Improved Thermal Efficiency of Homes

- Thermally efficient housing delivery will help avoid additional heating and/ or cooling and therefore improve the general efficiency of the building, e.g. legislate the provision of ceilings in government-delivered housing which result in a warmer house in the winter and a cooler house in summer. Improved resident comfort will also help improve general health and wellbeing within the area.

Improved Resilience of Energy Infrastructure

- The Municipality, in partnership with the energy industry, can provide guidance on design standards for energy infrastructure considering future climate risks. Using their planning powers, there is the potential to encourage new and retrofit projects to consider climate risk. Energy infrastructure generally has a long life-cycle. However, when replacement is necessary, measures to reduce climate risks (e.g. inclusion of improved flood defences) can be built into new designs.

Key Partners

- ESKOM
- KwaDukuza Electricity Services Unit
- KwaDukuza IDP office
- Department of Education
- Treasury (Renewable Energy Independent Power Producer Procurement [REIPPP] programme)
- Enterprise iLembe
- Development Bank of South Africa (DBSA)
- Department of Energy (DoE)
- Department of Water Affairs (DWA)
- Department of Economic Development and Tourism (DEDT)
- Department of Trade and Industry (DTI)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality
- Private Investors (Local and International)
- Farmers (as major landowners)
- NGOs (e.g. Wildlands and WESSA) and NPOs

3.3.4 Transport

The transport industry is considered under-developed with uncoordinated public transport systems and inadequate infrastructure. There is an opportunity to ensure that this development will result in a resilient transport network. Transport infrastructure is already vulnerable to weather extremes and if not considered during design and planning stages, will be compounded by climate change impacts in the future. Due to links between different forms of transport and across different sectors, impacts affecting one transport network can have a knock-on effect in others.

The main adaptation actions within the transport sector include:

- Raising awareness of the need to adapt plans and designs, but also operational processes;
- Including the transport sector into emergency response planning; and
- Ensuring that construction and design standards are resilient to climate change risks.

More detail can be found in Table 3.8.

Table 3.8: Adaptation options for the transport sector

Build adaptive capacity
Awareness Raising ■ Not only transport planners and designers need to be made aware of future climate risk to ensure that projects are resilient; operators also need to be informed about the risks of working under extreme weather conditions (e.g. higher temperatures) and what emergency response processes need to be followed during an extreme event such as a flood. ■ Operators of transport networks should also be made aware of what they should do during extreme weather events such as heat waves, floods, or intense rainfall events and storms. The Municipality can act as an information source or awareness-raising hub for local residents.
Emergency Responsiveness ■ Emergency response systems will rely on transport networks to access affected areas during extreme weather or flood events. The Municipality can assist in planning emergency responses by widening their scope to include risks from extreme weather and flood events and suggesting options such as diversions for example. Another option is to develop early warning systems that provide weather predictions to warn operators of high risk weather so that they can react accordingly.
Deliver adaptation actions
Construction and Design Standards ■ Through appropriate planning policies and building standards, Municipalities can ensure that transport infrastructure such as roads, railways and bridges are prepared for climate-related risks to the built environment (e.g. increased temperatures, flooding, and high winds) by including these issues in design standards. ■ The Municipality should revise maintenance and operation regimes of their infrastructure to include current and future climate risks.

Key Partners

- Department of Transport (DoT)
- Taxi Associations
- KwaDukuza IDP office
- KwaDukuza Town Planning Unit
- KwaDukuza Transportation Unit
- Public Rail Agency of South Africa (PRASA)
- Transnet
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality

3.4 Socio-Economic Systems (Theme Three)

3.4.1 Human Health and Wellbeing

KwaDukuza's communities and society in general could be subject to varying degrees of physical and mental health issues resulting from climate change, due to land and water stress, weather extremes, food insecurity, and disease vectors. Populations that are stressed may even begin to migrate either away from or into the region depending on the quality of life in surrounding areas.

Priorities to improve the resilience of human health and wellbeing include:

- Awareness raising in communities;
- Improving emergency response systems;
- Issuing health alerts;
- Addressing migration of people communities;
- Improving sanitation;
- Ensuring that healthcare resources are adequate; and
- Ensuring healthcare assets are resilient to climate risks.

More detail can be found in Table 3.9.

It should be noted that there are two general areas in which potential responses to climate change can sit. Actions can either focus on communities by working with residents and emergency response teams, or they can focus on healthcare providers by ensuring that staff and resources will be able to cope and improving the physical resilience of assets and buildings.

Some adaptation policies and measures (e.g. wider deployment of cooling systems in hospitals and care homes) may have substantial implications in terms of both capital and running costs and energy/carbon emissions which highlight the need to consider climate mitigation when developing adaptation actions. Another major challenge is the uncertainty regarding the precise size, age distribution and socio-economic composition of the local population over the coming decades.[16]

[16] UK Climate Change Risk Assessment (2012) Health. Available at: http://www.defra.gov.uk/environment/climate/government/risk-assessment/

Table 3.9: Adaptation options for the health and wellbeing sector

Built adaptive capacity

Awareness Raising and Training

- Communities need to be aware of the risks that they may face (e.g. vector-borne diseases, heat, air pollution, floods), what response plans have been put in place to help, and what they can do themselves to reduce their own vulnerability. Municipalities can play a central role in their local communities and can therefore act as an awareness-raising agent.

Emergency Response Systems

- It is likely that extreme events will become more frequent and therefore that emergency response teams will be required more often. The Municipality can help ensure that emergency response teams are aware of and equipped to deal with extreme weather events and other impacts of climate change by providing information and signposting to other sources. They can also assist in coordinating the delivery of nutrition programmes where climate impacts affect livelihoods and food security.

Health Alerts

- Health alerts can help ensure that all entities within the health sector (hospitals, doctors surgeries, care homes, etc.) are aware of impending weather conditions and extremes. The Municipality can plan a key role in building and supporting health alerts for events such as heat waves, floods, or even air pollution.

Migration

- Populations may begin to slowly migrate with changes in climate or extreme weather events (for example, people may leave an area if it floods regularly). Municipalities may choose to develop policies and management strategies to handle migrant-related issues which include mental health impacts such as stress, and physical impacts, such as disease, in temporary living areas that may not offer ideal living and sanitation conditions.

Deliver adaptation actions

Sanitation

- Healthcare facilities need to be clean to be able to treat patients properly and ensure adequate levels of comfort. Considering that healthcare facilities may come under additional pressure with climate change, it will be important for Municipalities to ensure that sanitation requirements are improved to curb disease.

Healthcare Resources

- If the demand for healthcare facilities in terms of physical as well as mental health, facility managers will need to be made aware so that they can prepare themselves by increasing staff numbers and/ or supplies, and ensure that staff are aware of and able to cope with the new risks (e.g. new diseases). Communication across the sector will be key to deliver an integrated approach, which can be facilitated by the Municipality.

Buildings

- The healthcare sector needs to improve the resilience of its assets as well as its services. Through appropriate planning policies and building standards, Municipalities can ensure that healthcare facilities such as hospitals, care homes, etc. are prepared for climate-related risks to the built environment (e.g. increased temperatures, flooding, and high winds). Ideally these potential impacts will be included in design and planning to incorporate infrastructure such as green and blue spaces, for example.

Key Partners

- Department of Health (DoH)
- Department of Home Affairs
- KwaDukuza IDP office
- KwaDukuza Environmental Health Unit
- World Health Organisation (WHO)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality
- NGOs and NPOs

3.4.2 Working with Business

The ability to adapt to climate change varies between industry and organisations which are influenced by their level of awareness, size, available resources, as well as decision-maker buy-in. Businesses operating in the manner of Business as Usual may find that they are left behind as other companies can take advantage of market shifts and show leadership.[17] A new generation of more environmentally informed consumers will lead the process of transformation in consumer behaviour and this may call for changes to manufacturing processes to provide “sustainable” goods.

Actions to improve the resilience of businesses include:

- Raising awareness within the business community;
- Improving knowledge transfer to avoid duplication of work;
- Linking emergency planning with business continuity;
- Diversification within the tourism industry; and
- Including business resilience in procurement standards for the Municipality.

More detail can be found in Table 3.10.

There are strong interdependencies between businesses and other sectors (e.g. transport, energy, water and the built environment) and there is therefore an opportunity to work across a range of sectors to build resilience. In particular, potential climate impacts such as overheating of buildings and increased pressure on water resources may have major knock-on effects for this sector.

[17] UK Climate Change Risk Assessment (2012) Business, Industry and Services. Available at: http://www.defra.gov.uk/environment/climate/government/risk-assessment/

Table 3.10: Adaptation options for the business sector

Build adaptive capacity

Awareness Raising

- Businesses will be affected by extreme weather events and climate change directly through their assets and indirectly through their supply chains and shifting markets. Small Medium and Micro Enterprises (SMMEs) in particular are often unaware of the risks or do not have the resources to inform themselves on climate change. Education programmes for local businesses on improving their own resilience to climate change as well as their supply chains can be supported by Municipalities as they are often a trusted source of information.

Improving Knowledge Transfer

- Knowledge transfer and information sharing networks help promote innovation and also help avoid duplication of work and effort. Municipalities can support the development of knowledge exchange networks for businesses so they can share best practice, work together, and potentially learn from other countries or sectors. Cross-sectoral work is particularly important as many are interlinked or influence each other.

Emergency Planning and Business Continuity

- Businesses should be included in planning emergency responses as they will rely on infrastructure for staff to be able to get to their places of work as well as their supply chains to be able to continue running after a flood and/or other extreme weather event.

Diversification in Tourism

- The main area of tourism is along the coastal regions for the area. There is an opportunity for the Municipality to encourage businesses reliant on tourism to diversify their income by promoting tourist activities that are not solely reliant on the coast (e.g. inland wildlife, walking, etc.) – or certain weather conditions.

Deliver adaptation actions

Procurement Standards

- There is an opportunity for the Municipality to include climate resilience as a requirement for organisations and businesses that wish to tender for projects. This will help drive local businesses to address their climate risks so that they can win more work.

Key Partners

- KwaDukuza Economic Development Unit
- KwaDukuza IDP office
- iLembe Economic Development Unit
- Enterprise iLembe
- Chamber of Commerce
- Department of Trade and Industry (DTI)
- Department of Economic Development and Tourism (DEDT)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality

3.4.3 Education Awareness and Capacity Building

Driving change must start at a local level. In order to empower vulnerable communities and future generations on climate change mitigation and adaptation, educational reform, awareness campaigns and capacity building is needed. Without it, the status quo of unsustainable development and consumption will continue and prevent the Municipality from following a sustainable growth path.

Actions to improve resilience through education and training programmes include:

- Improving training and education programmes and facilities;
- Expanding communication networks;
- Deliver projects within schools; and
- Document climate impacts and actions so that this can be shared.

More detailed information can be found in Table 3.11.

Table 3.11: Adaptation options for education awareness and capacity building

Build adaptive capacity
Training ■ To be able to deliver education and training programmes, people must be first recruited and trained to be able to deliver the desired programmes. They must be able to successfully teach others as well as be familiar with the subject areas. The Municipality should consider training and recruiting staff to be able to deliver on the projects listed below. ■ There is an opportunity for the Municipality to encourage and support other organisations that are considering climate adaptation to take advantage of internships which help up-skill young residents and can also embed adaptation consideration into their thinking which they can then take further into their careers. ■ Strengthen human resources and climate change knowledge within key departments which have a prominent role to play within the municipal arena, relating to climate change (e.g. electricity, waste, human settlements, planning).
Communication ■ Current networks should be expanded and supported to raise awareness and share experiences and lessons with other training and education providers, so that best practice can be shared and included into future actions and policies.
Deliver adaptation actions
Projects ■ A variety of projects and programmes can be rolled out to improve awareness of residents by engaging with communities and schools. Practical, interactive education programmes at schools can help engage children early on and plays can be performed for communities with a climate change-based storyline for example. ■ Due to resource constraints, communities will need to be made aware of actions they can take themselves to better prepare for climate risks and reduce reliance on other organisations. Encouraging local voluntary action can be promoted for disaster management as a starting point.
Documentation ■ There is an opportunity for the Municipality to use its central position to provide a central repository for information on climate change, vulnerability and adaptation actions, or support another partner organisation in doing so through existing contacts and networks. This will provide a central database from which local residents and organisations can take information to share it with others or develop awareness-raising programmes, for example.

Key Partners

- Department of Education
- Department of Health (DoH)
- Department of Water Affairs (DWA)
- Department of Environmental Affairs (DEA)
- KZN Department of Agriculture and Environmental Affairs (DAEA)
- KwaDukuza IDP office
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality
- NGOs (e.g. WESSA) and NPOs

3.5 Governance (Theme Four)

3.5.1 Integration, Planning and Partnerships

The public sector – Government departments, local authorities and public agencies – should:

- Provide adaptation services directly where they are a public good;
- Enable private adaptation through regulation and price incentives;
- Assist vulnerable committees to adapt to climate change; and
- Provide information about climate risks.[18]

Municipalities are in an exceptional position to help deliver and promote action on adapting to climate change and building resilience. Their central locations within communities and existing networks can help encourage partnership and cross-sector working. Table 3.12 highlights the different functions that local government has and how their powers can promote action in terms of building climate resilience.

Table 3.12: Summary of how local authorities can increase climate resilience in their localities

Adaptation Priority Area	Duties/ Powers	Adaptation Impact
Land Use Planning	■ Local Development Plans ■ Development management ■ Building control	■ Steer developments to areas of lowest climate risk ■ Increase green infrastructure ■ Increase sustainable urban drainage
Designing and Renovating Buildings	■ Planning functions ■ Strategic role in housing provision ■ Owners of social housing (in some cases)	■ Require resilience measures in new developments ■ Retrofit own estates (including schools) and social housing ■ Encourage others (private sector housing and businesses) to retrofit
Managing Natural Resources	■ Manage public open spaces, nature reserves, parks and wetlands ■ Duty to protect biodiversity	■ Expand and improve ecological resilience of green spaces ■ Make space for buffers along rivers and the coastline

[18] The Grantham Research Institute, London School of Economics (2013) Policy Brief: Independent National Adaptation Programme. Available at: http://www2.lse.ac.uk/GranthamInstitute/publications/Policy/briefs.aspx

Providing Infrastructure	▪ Build and maintain non-trunk roads ▪ Provide bus shelters, street lighting, parking spaces ▪ Carry out works to manage flood risk from surface runoff and smaller water courses	▪ Resilient roads and road-related infrastructure ▪ Minimise damage to buildings and infrastructure from floods
Emergency Planning	▪ Emergency planning ▪ Flood risk management strategies ▪ Education and awareness ▪ Social and health care	▪ Prevent and respond to the impacts of extreme weather events ▪ Ensure business continuity and continuity of key public services ▪ Ensure most vulnerable sections of population are protected

Source: Committee on Climate Change (2012)[19]

This work will involve collaboration between departments on the local level to deliver education schemes or encourage local developments in areas of low climate risk. Collaboration with government departments at regional and national level will also be necessary to ensure that resilience measures are included in building standards and other policies and legislation. Communication and partnership working will be vital to advance in this area and a lot of work has already been carried out internationally which can be learned from.[20]

Climate change related time frames are often at odds with development planning and decision making time frames: budget cycles usually run over three year periods, political office and IDPs have five year time horizons, whereas infrastructure often has a life span of over 50 years which is well into the era of severe climate change. This highlights the need for awareness raising and the inclusion of long-term decision making into the current land use planning processes as current planning decisions can affect the vulnerability of future generations. Actions that local governments can take have been outlined in Table 3.13.

[19] Committee on Climate Change (2012) How local authorities can reduce emissions and manage climate risk. Available at: http://archive.theccc.org.uk/aws/Local%20Authorites/1584_CCC_LA%20Report_bookmarked_1b.pdf

[20] The UK, for example, has completed climate change risk assessments for key sectors. These can be found at: http://www.defra.gov.uk/environment/climate/government/risk-assessment/. Other European countries have produced their own strategies which can be found in a PEER (2009) article named “Europe adapts to climate change – comparing national adaptation strategies”, which is available at: http://www.peer.eu/fileadmin/user_upload/publications/PEER_Report1.pdf

Table 3.13: Adaptation actions for governance

Build adaptive capacity
Integration ■ Adequate climate change capacity needs to be integrated at the local government level so that additional work can be undertaken efficiently and effectively. This includes developing appropriate, integrated decision-making frameworks, local implementation capacity, and coordination. ■ Focus on allocating a higher proportion of the municipal budget to climate change adaptation related projects and processes. **Reviewing Current Policies and Standards** ■ Current agricultural, construction, water abstraction, etc. related policy frameworks should be reviewed to ensure that they enable (and do not hinder) near-term and long-term climate resilience in terms of food security, land, water security, planning, and building standards. Some of these policies are created nationally and these should be revised in partnership with Municipalities. **Partnership Working** ■ With limited financial and human resources, it is difficult to divert resources from basic service delivery. In this regard it is critical to create partnerships with key organisations to respond to action plans. **Provision of Guidance for Local Residents and Businesses** ■ The provision of user-friendly and relevant information, guidance, incentives and tools can encourage private adaptation and help remove barriers. The central role of the Municipality would be ideal to disseminate this information to as wide an audience as possible.
Deliver adaptation actions
IDP Planning ■ The next IDP revision must factor in the findings of the CCRS and be built into Strategic Action Plans. Iterations should take place with the usual IDP 5 year revisions, as new and more sophisticated information becomes available and outcomes from monitoring and evaluating of successes of various plans come to light. These IDP action plans must filter down and cross-cut into all municipal plans and service departments. **Land Use Planning** ■ Development in areas of high flood risk should no longer be allowed in terms of health and safety of communities as well as costs incurred for clean-up and rebuild. If development is necessary, it should be ensured that flood risk is reduced as much as possible and that flood risk isn't increased in other areas as a result of development. The use of green infrastructure can also help alleviate runoff during intense rainfall events and also help keep cities cool, encourage biodiversity, and promote health and wellbeing for local people. These and Sustainable Urban Drainage Systems should be promoted or required for new developments. **Resilient Buildings and Infrastructure** ■ Municipality-owned buildings and infrastructure can be made resilient to current weather extremes through capital and maintenance programmes when resources are available. This can also act as a driver for other infrastructure organisations to do the same, in parallel with enforcing building regulations and planning policies. **Emergency Planning** ■ Civil protection is a key theme for local governments and the Municipality can work towards this by putting in place emergency plans with partners for communities as well as business continuity management arrangements for their own organisation. During a severe weather or flood event, the Municipality can act as a key informant, advising the public in the event of an emergency, and co-operating with other local responders.

Key Partners

- KwaDukuza IDP office
- KwaDukuza Town Planning and Building Control Unit
- KwaDukuza Environmental Services Unit
- KwaDukuza Special Projects Unit
- All other relevant municipal Line Units
- ICLEI-Africa (particularly for first IDP revision)
- NGOs and NPOs
- Local Businesses
- Enterprise iLembe
- Chamber of Commerce
- National and Provincial Government Departments with the ability to influence climate change adaptation (e.g. Department of Environmental Affairs and Department of Agriculture and Environmental Affairs)
- eThekwini Municipality (for best practice guidance/lessons learnt)
- iLembe District Municipality

NOTE: eThekwini produced a report on a cost-benefit model they have developed to prioritise adaptation options based on the most economically efficient municipal adaptation plans (MAPs) that they have implemented over the past few years.[21] Outcomes of the modelling suggest that climate adaptation is an inter-disciplinary process, which highlights the need for communication. It also highlights that educational and socio-institutional programmes are the most economically effective while infrastructural and ecosystem rehabilitation based responses are the least. This should be borne in mind when municipal responses are being prioritised and selected for implementation in the KwaDukuza area.

[21] eThekwini Municipality (2012) A Benefit-cost analysis of the eThekwini's climate change adaptation efforts.

4. Priority Climate Change Strategy Recommendations

4.1 Introduction

The first five year planning and implementation period will be critically important in setting the Municipality up for climate change responsiveness. During this five year period, strategic response options will need to be adopted into the IDP (during revisions). Municipal budget and human resources allocations to various municipal departments will therefore need to be ratified and made available.

For the current five year municipal planning cycle, recommendations for priority strategic climate change management responses are outlined below. Adaptation responses are considered to be of primary political importance in KwaDukuza due to the increasing need to empower the community to respond to uncertain climate risks. This, however, does not detract from the need to implement climate change mitigation recommendations as part of a robust Municipality response to climate change risk as well.

Key adaptation and mitigation responses are identified below, as well as several over-arching (cross-cutting) responses that are not necessarily linked only to specific sectors.

4.2 Strategic Climate Change Mitigation Priorities

4.2.1 Water

A. Education for minimisation of water wastage and pollution

Potable water will become an increasingly critical resource in the face of climate change. Water pollution and water wastage pose great threats to its availability.

Strategic recommendations- New buildings should be regulated by the municipality in line with SANS Building Regulations *inter alia* to use minimal potable water and provide rainwater harvesting,

Water use to be metered for both domestic and industrial clients to develop reduction behaviour. All consumers should pay for what they use to provide a tangible incentive to reduce that usage.

Increased educational programmes must be run by DWA in conjunction with Umgeni Water, iLembe DM and KwaDukuza, as well as in schools by the Department of Education. Partnerships with NGOs or NPOs must also be explored. Ultimately it is significantly more cost effective to increase education around water pollution and wastage, than it is to install bigger pipes, or to build water treatment facilities and wastewater treatment works.

4.2.2 Agriculture

A. Maximise agricultural GHG sinks and minimise GHG sources

The ability for agriculture to act as both a sink and source of GHG emissions is important to note. Land use management can determine how effectively an agricultural establishment acts as a carbon sink so that there is a net gain in terms of overall emissions reductions.

Strategic recommendation - Work with local farmers to educate them on the basics of GHG sinks and sources so that they are better informed. Encourage no-till practices and waste recycling (e.g. with the production of biomass energy). Partner with SASA and SASRI to collaborate and enhance these efforts.

4.2.3 Energy

A. Awareness raising

Raise awareness and importance of energy efficiency in the area across all the population and economic strands.

Strategic recommendation - A variety of methods can be used to raise awareness, e.g. community forums, advertising, through the education systems etc. Incentives and/or links to monetary savings are recommended.

B. Creation of an inventory

Compile a complete and accurate emissions baseline/inventory of key emitters and/or key emitting sectors in conjunction with ICLEI-Africa. This will greatly assist in setting goals for emissions reductions across sectors, as well as the ability to target key (heavy) emitters for improved operations and better efficiency.

Strategic recommendation - Assist ICLEI-Africa with all of their inventory queries and encourage line departments to supply information **timeously**. Educate officials in advance on the reason for this, so that they may assist more effectively during data collection.

C. Investment in renewable energy resources.

If feasible, look for outside investment to deliver renewable energy projects through power purchase agreements or similar contracts.

Strategic recommendation - Use Municipal Town Planning resources to identify potential sites for renewable energy that the Integrated Resource Plan can deliver on its ambitions to diversify supply.

D. Encourage efficiency

There is a need for increased municipal enforcement of more thermally-efficient buildings. At minimum all new buildings should follow South African National Standards (SANS) 10400 standards and building regulations pertaining to energy efficiency.

Strategic recommendations - The development of autonomous ("quick win") projects, such as in-house municipal reduction of electricity consumption is strongly encouraged for KwaDukuza, to set a positive example and become one of the only energy efficient municipalities in KZN, which will encourage advocacy. As far as possible, in addition to 'new builds', existing municipal buildings must be retrofitted to be more energy efficient. Staff should be evaluated against their individual and departmental performance towards integration of energy efficiency into service delivery and related daily tasks.

4.2.4 Human Settlements

A. More efficient dwellings

Building standards should demonstrate the intent of KwaDukuza to make new dwellings as efficient as possible.

Strategic recommendation - The creation of by-laws (in line with SANS 10400 standards) to improve energy efficiency in new/existing buildings. This means, for example: improving insulation, making use of natural ventilation and shading, a incorporating renewable energy based systems where possible, as well as incorporating rainwater harvesting.

4.2.5 Waste

A. Waste minimisation, segregation and recycling

Education around waste minimisation, separation of waste at source and recycling are key principles of good waste management.

Strategic recommendations – The municipality, in conjunction DCLM, DCWM and with strategic partners must create enabling conditions for waste segregation at source (e.g. rollout of 2 bag system) and recycling programmes. They must explore the potential for partnerships with other local administrations to identify potential markets for segregated wastes. Furthermore, KwaDukuza must create enabling conditions for DCLM for landfill gas recovery and electricity sales back to the municipality. A preliminary study should include currently operating and closed landfill sites to assess the amount of gases that could be recovered, and identify potential markets/customers for the energy. Finally, educational programmes around waste minimisation and recycling must be encouraged at a grass roots level, in partnership with schools, the Department of Education and NGOs.

4.2.6 Transport

A. Encourage public transport and more energy efficient vehicles

Public transport is a significantly more energy and cost effective way of commuting.

Strategic recommendations - Set minimum standards for new additions to government vehicle fleet efficiency as well as minimum standards for new additions to public transport and taxi vehicles. In addition to the proposed Integrated Rapid Public Transport Network (IRPTN) for iLembe, park and ride facilities (e.g. bicycles and bicycle routes) should be established to encourage private car users to switch to a more efficient, economic mode of transport along key corridors. It should be borne in mind by decision-makers that this could bolster tourism activities too.

4.2.7 Working with Business

A. Changing Business as Usual

Businesses and their activities can greatly impact and influence local emissions (e.g. manufacturing).

Strategic recommendation - Produce an inventory of heavy emitters in KwaDukuza and develop a knowledge exchange network for businesses to be able to share best practice (see Section 4.3.1 below).

4.2.8 Education Awareness and Capacity Building

A. Empowering officials to set an example

Education is of key importance to an informed and empowered community. That said, change needs to begin with KwaDukuza officials.

Strategic recommendations – Explore conducting a baseline staff awareness survey with ICLEI-Africa. Roll-out presentations on climate change, vulnerability, adaptation and mitigation to all municipal staff based on gaps identified with ICLEI-Africa.

4.2.9 Integration, Planning and Partnerships

A. Capacity building with partnerships

Adequate climate change capacity at the local government level must be accommodated in the municipal structure. In addition, partnerships should extend outside of Municipal services so that efforts can be combined and thus gain momentum. Local businesses can contribute to successful partnerships and more regional working can bring isolated expertise together.

Strategic recommendations - Conduct baseline capacity assessment with ICLEI-Africa in order to explore which institutional and governance mechanisms may be necessary to mainstream climate change into decision-making.

Furthermore, KwaDukuza must ensure that the next Integrated Development Plan factors in the findings of the CCRS and develops policies that can support efforts to reduce GHG emissions. These IDP plans must filter down and cross-cut into all municipal plans and service departments – each department needs responsibility on delivering GHG reductions.

4.3 Strategic Climate Change Adaptation Priorities

4.3.1 Water

A. Encourage mainstreaming of climate change adaptation into water sector policy, strategy formation and action planning

Climate change has the potential to increase the occurrence and severity of weather events resulting in either more extreme drought or flooding. The monitoring and forecasting of water flows, floods and droughts also needs to be improved to better inform policy, strategy and action planning in the water sector.

Strategic recommendation – Water resource planning will need to better balance the needs of competing users when water availability is reduced (drought years, peak seasons). This can be achieved through the development of partnerships and networks with key stakeholders. For example, the University of KwaZulu-Natal are currently working to help Umgeni Water improve its planning. The Municipality should encourage and participate in such partnerships and networks, with the aim to informing decision-making processes.

B. The role of land use planning in building resilience

The conservation and restoration of wetlands can act as a buffer zone to provide a natural response to flood risk management.[22]

Strategic recommendation – The planning system can play a major role in building resilience to climate change risks and ensuring future developments use water sustainability. Planning approval needs to consider current and future water availability. The Municipality needs to ensure that land use and planning policy promotes the designation and preservation of wetlands and coastal areas through the establishment of stricter regulation and enforcement.

[22] http://www.grabs-eu.org/membersArea/files/new_orleans.pdf

4.3.2 Coastal and Marine

A. Enhancing coastal resilience

Coastal areas identified as 'high risk' in the recent Coastal Vulnerability Index (CVI) and Coastal Management Programme (CMP) should be prioritised in terms of funding and resources. More specific municipal adaptation management plans may be required for such areas.

Strategic recommendation - There is an opportunity for the Municipality to develop robust coastal adaptation plans, including setback lines, informed by the detailed findings of the KwaDukuza CMP and CVI to limit development in high and moderate risk areas. There are also opportunities to partner with the local Coastal Working Group, EKZNW and NGOs that are active in the area. Climate change risks should be considered when developing these plans as this can greatly help reduce vulnerability if implemented. Potential actions include:

- reinforcing beach infrastructure at areas of high risk;
- relocating existing developments away from coastal areas at high risk; and
- reinstating natural beach/dune vegetation or increasing natural shoreline buffers to protect against increased runoff from more intense storms.

4.3.3 Biodiversity

A. Encouraging conservation

Natural biodiversity areas and corridors will form important buffers against extreme weather events and longer term climatic changes.

Strategic recommendation - The implementation of KwaDukuza Biodiversity Open Space Management Plan should be encouraged from the highest municipal planning level and used in conjunction with vulnerability mapping exercises and other related management plans (e.g. shoreline management, informal settlement management). This will work towards a unified strategy to protect and enhance natural habitat within the Municipality which acts as a buffer. Community Based Ecosystem Adaptation (CEBA) projects should also be promoted, as is the case in eThekwini Municipality, whereby they partnered with an NGO. The opportunity to partner with eThekwini should be discussed and formalised in the interests of best practice and information-sharing.

In addition, remnant patches of riparian vegetation and coastal forest exist, along with limited examples of coastal grassland. These are important for conservation. Three fragments of Ngoye Forest and Grassland should be proclaimed as reserves in a joint exercise with Ndwedwe Local Municipality and with the assistance of SANBI and Ezemvelo KZN Wildlife.

B. Management of the increasing risk of wildfires

Higher temperatures and drier conditions can lead to an increased risk of wildfires in KwaDukuza.

Strategic recommendation - The Municipality will need to be able to increase future fire fighting and rapid response capabilities to be able to deal with increased occurrences. There are a wide range of options to address this, from training to controlling the necessary burning of veld vegetation, removing and relocating plantations from areas where climate change may make them less productive and creating fire breaks between green spaces and residential areas.

4.3.4 Agriculture

A. Improving the adaptive capacity of the agriculture sector with research

The Municipality can help bridge this gap by providing an information network where farmers can access relevant information in a language that they understand, and thus be more empowered with the onset of climate related changes.

Strategic recommendations - The municipality must encourage communication between farmers, SASA, SASRI and local universities/tertiary institutions. The establishment of a forum should be considered in this regard, because of the many potential role-players. Funders/donors should also be invited to the forum, to enhance research opportunities to a wider audience, and covering a wider spectrum of crop/livestock types.

Research should be encouraged to highlight the potential of changing crop/ livestock types, cropping times, and irrigation methods, or even moving towards dry land farming to diversify agricultural activities. More information on potential new pests and diseases should also be researched so that the information is available if they do become increasingly problematic future. Once farmers have the relevant information, they can also be assisted to implement recommendations from research in terms of crop types, relocation, providing shade for livestock, diversification etc. This is also critical for improving and ensuring food security in future.

B. Avoidance of devastation to agricultural infrastructure and yields

The Municipality should support the development of an early warning system that provides daily weather and seasonal forecasts by using existing networks and knowledge of the local communities.

Strategic recommendation - Once the iLembe Disaster Risk Study has been completed, the opportunity exists for KwaDukuza to partner with iLembe to develop an early warning system for farmers in the area (e.g. for risks such as impending drought, floods and or high wind speed). These systems can help farmers plan their work better and also make them aware of oncoming severe weather events.

4.3.5 Human Settlement

A. Determining vulnerability to flood risk

Climate change is expected to increase the magnitude and frequency of flood events, therefore reducing the return period of current standards.

Strategic recommendation - Identifying, mapping and assessing key risk areas or settlements will help create an inventory of priority communities that are at high risk. Areas where development is limited due to flood risks, such as the existing 1:100 year flood line, will require revision with a long term focus, and new setback lines will need to be mapped and implemented.

The Municipality has the opportunity to use its planning powers to ensure that climate risks are factored into the planning of developments. The outputs of the Department of Human Settlement (GIS-based) study on the impacts of climate change on rural and urban housing could be used to better inform planning decisions once it has been completed. It is important to ensure that new buildings are not built in flood plains and take more awareness of high water marks. KwaDukuza's new Disaster Risk Management offices, for example, were destroyed in a flood in 2009 and are currently being rebuilt there even though they will be situated in a flood plain. This highlights the need to get flood risk considerations on the planning agenda to avoid similar projects going ahead in the future. Spatially defined vulnerability mapping is critical in this regard.

Where possible, communities that lie in high risk areas (to flooding in particular) should be encouraged to relocate by the Municipality. Settlement in flood prone areas should be avoided in general. In coastal areas, this could be done by increasing setback lines from the coast and watercourses in planning documents.

4.3.6 Transport

A. Resilient Infrastructure

The findings of the iLembe Disaster Risk Study, once complete, must be considered in order to develop a resilient transportation sector in KwaDukuza. Increased stormwater, for example, will need to be adequately managed to ensure the safety of commuters.

Strategic recommendation – Stormwater catchpits must be cleaned regularly throughout the year and maintained by KwaDukuza officials to avoid blockages during storm events (which are predicted to become increasingly intense and, at times, unseasonal).

The Municipality must also act as an information source/awareness-raising hub for local residents and operators of transport networks to develop the sector's adaptive capacity. Capacity building measures for municipal staff could also include developing early warning systems of high risk/extreme weather events.

Planning policies and guidance on building and design standards can used to support adaptation plans pertaining to transport infrastructure. The Municipality should also require operators to develop and implement climate change adaptation strategies informed by a robust climate change risks assessment. This is relevant to other infrastructure sectors too.

4.3.7 Education and Awareness

A. Building the Municipality's adaptive capacity

Capacity building provides an essential foundation from which climate change adaptation.

Strategic recommendation - The Municipality can use its position to act as a central repository for information on climate change and support organisations through existing contacts and networks.

4.3.8 Human Health and Well-Being

A. Emergency planning

Extreme weather events will become more frequent and intense and therefore the assistance of emergency response teams will be required more often.

Strategic recommendation - The Municipality can ensure emergency response teams are aware of and equipped to deal with extreme weather events and other impacts of climate change by providing information and signposting to other sources. This should include the development of early warning systems, coupled with adequate staffing and financial resources.

4.3.9 Working with Business

A. Developing resilient business

Businesses should be included in planning emergency responses as they will rely on infrastructure for staff to be able to get to their places of work as well as their supply chains to be able to continue running after a flood.

Strategic recommendation - There is an opportunity for the Municipality to include climate resilience as a requirement for organisations and businesses that wish to tender for projects. This will help drive local businesses to address their climate risks so that they can win more work.

4.3.10 Integration, Planning and Partnerships

A. Catalysing local action with partnerships

Municipalities are in an exceptional position to help deliver and promote action on adapting to climate change and building resilience. Their central locations within communities and existing networks can help encourage partnership and cross-sector working, such as with the establishment of working groups and forums.

Strategic Recommendation – In the spirit of co-operative governance, the opportunity exists for the municipality to apply for funding from other spheres of government – e.g. National. Donor organisations and/or NGOs are also key entities which the municipality could collaborate with on projects and/or to gain extra momentum in the form of extra resources, as is the case with their partnership agreement with ICLEI-Africa. These organisations must be identified and consulted over the next five year planning period in order to catalyse and better-coordinate climate change responses within the KwaDukuza area.

B. Enhanced local level governance

Adequate climate change capacity needs to be integrated at the local government level so that additional work can be undertaken efficiently and effectively. This includes developing appropriate, integrated decision-making frameworks, local implementation capacity, and coordination.

Strategic Recommendation - The next IDP revision must factor in the findings of the CCRS and be built into Strategic Action Plans (such as Municipal Adaptation Plans – MAPs). Iterations should take place with the usual IDP 5 year revisions, as new and more sophisticated information becomes available and outcomes from monitoring and evaluating of successes of various plans come to light. These IDP plans must filter down and cross-cut into all municipal plans and service departments.

4.4 Over-arching Recommendations for the first Five Year Planning Period

Several recommendations not necessarily pertaining to either mitigation or adaptation are provided below. These are considered critical to the implementation of a robust climate change response strategy for the municipality. They have been specifically identified for their ability to create conditions for enhanced awareness and capacity to respond, by the Municipality.Awareness raising with the establishment of a Climate Change Forum.

KwaDukuza must act as a catalyst for creating a climate change forums for driving change (e.g. in the business sector). The forum must cover topics relating to anything from: energy efficiency and emissions reductions to adaptation and awareness.

Forums are an economically efficient way of educating role-players and sharing best-practice ideas/methodologies. Socio-institutional interventions have proven to be highly effective in eThekwini Metropolitan Municipality. The creation of a forum would serve to inform and empower the broader KwaDukuza community and key climate change role-players could develop local links and maximise opportunities for collaboration in accessing funding

The availability of funding is often a limiting factor to both project proposals and project roll-out. In the face of often limited municipal budgets, it is critically important to bolster efforts on compiling sound applications to access climate change related ‘green’ funding - such as that of the DBSA Green Fund and those mentioned in Appendix B (Section B.5). A boost in funding could have significant positive impacts for KwaDukuza and thus the Municipality should invest time in researching and making these types of applications.

4.4.1 Municipal Budgeting

KwaDukuza must focus on allocating a higher proportion of the municipal budget to internal climate change capacity-building, mitigation and adaptation related projects and processes.

4.4.2 Municipal Structure (Human Resources)

KwaDukuza must strengthen human resources and climate change knowledge within key departments which have a prominent role to play within the municipal arena, relating to climate change (e.g. electricity, waste, human settlements, planning, coastal management and environment).

With limited financial and human resources, it is difficult to divert resources from basic service delivery. In this regard, it is critical to create partnerships with key organisations to respond to action plans.

4.4.3 More Focussed Municipal Plans

KwaDukuza must develop more focussed Municipal Mitigation and Adaptation Plans (MMPs and MAPs) for key municipal departments such as: electricity, waste, human settlements, planning, coastal management and environment (noting the opportunity to draw from eThekwini's recent work with its line departments, as well as opportunities to partner with government departments, business or NGOs operating within the same - or similar - sectors).

4.4.4 Possible Linkages with Other Plans

KwaDukuza must explore links between this strategy and the local economic development strategy (LEDS) which is currently being developed, in order to identify opportunities to drive investment in the green economy, locally, and also to fit with the regional commitment made by iLembe to becoming a green economy destination.

4.4.5 Research

Research is a key means of progressing knowledge about future trends, risks and opportunities for any sector. KwaDukuza must encourage areas of research where knowledge gaps have been identified. For example: in conjunction with business and universities, the municipality could develop a register of potential resources in the area that could be used as fuels/for electricty rather than their being treated as waste. This register should be centrally maintained by the municipality and frequently updated, for potential end-users to access the latest, most accurate information. The same should be applied for other critical information sources like floodline data, updated setback lines and so forth. This, in turn, will empower and better inform the broader KwaDukuza community.

5. Implementing Climate Change Strategy Recommendations

5.1 Introduction

The following principles set out high level recommendations to assist decision-makers in implementing and mainstreaming recommendations outlined in this climate change response strategy. Specifically, they highlight general management principles to bear in mind when selecting individual responses, pitching project ideas to stakeholders and implementation and monitoring thereof, going forward.

5.2 Implementation responses

Implementation of any successful climate change strategy or response will require a combination of capacity building and implementation actions. The ultimate success of climate change response measures implemented by the Municipality will depend upon its adaptive capacity and the capacity of the sectors which it supports as well as those which support it. Understanding the nature of the issue and risks, identifying and engaging stakeholders, assessing the situation (risks and thresholds) and potential responses are crucial to the management of climate risk.

The selection of climate change response measures needs to take account of the contribution towards achieving desired outcomes, the nature of associated risks, costs and technical feasibility. Sustainable measures should also consider the potential conflicts and synergies with other wider objectives, as well as consideration of the implications of non-climatic factors. Practical, cost-effective climate change response measures that deliver the required outcome should be identified and selected where possible. Such measures can be categorised as:

- **No-regret options** – response measures that are worthwhile whatever the extent of future climate change. These measures are justified under current and future climate conditions.[23]
- **Low-regret options** – response measures for which the associated costs are relatively low and for which the benefits, although primarily realised under projected future climate change, may be relatively large.
- **Win-win options** – response measures that have the desired result in terms of minimising the climate risks or exploiting potential opportunities but also have other social, environmental or economic benefits.

In working to implement potential responses to climate risks for different sectors it is important to consider the following principles that will support the effective implementation of the various adaptation and mitigation strategies/ response options:[24]

- **Work in partnership** – Identify and engage your stakeholders and ensure they are well informed.
- **Climate Impacts** - Understand risks and thresholds, including associated uncertainties.
- **SMART Adaptation** - Determine and communicate SMART* objectives/outcomes
- **Sustainable adaptation** - Manage climate and non-climate risks using a balanced approach, in the context of sustainability and development objectives
- **Prioritise risks** - Focus on actions to manage priority climate risks and opportunities
- **Current climate risk** - Address risks associated with current climate variability and extremes as a baseline for taking action to address long-term climate change risks and opportunities.
- **Management of uncertainty** - Consider the best approach for decision-making under uncertainty

* Specific, Measurable, Achievable, Results-oriented, Time-bound

[23] UKCIP (2006) Identifying Adaptataion Options

[24] http://www.ukcip.org.uk/adopt/adaptation-checklist/

- **Adaptation response** - Recognise the value of no/low regrets and win-win adaptation options in terms of cost-effectiveness and multiple benefits
- **Mal-adaptation** - Avoid actions that limit or restrict future adaptation or the adaptation of others.
- **Monitoring and Evaluation** - Review the continued effectiveness of adaptation or mitigation decisions by adopting a continuous improvement approach that includes monitoring and re-evaluation of risks.

5.3 Specific Adaptation Considerations

The development of an implementation of climate change adaptation will require significant structural and organisational change. In support of adaptation actions there are a number of key considerations that need to be taken into account in formulating responses: [25]

- **Decision timescales**: Climate change responses need to consider the lifetimes of adaptation decisions from conception to decommissioning. The longer the period the greater the uncertainty associated with the effects of climate change impacts, the greater the potential for 'lock-in' and mal-adaptation. Risk adverse or flexible responses can reduce this risk.
- **Activity**: Long-term decisions can limit adaptive capacity and the implementation of strategies as they are often difficult or expensive to reverse. The opportunities for adaptation, such as the end of planning periods or asset at the end of their design life, need to be identified and acted upon.
- **Sector complexity**: Complexity can reduce adaptive capacity when many stakeholders are involved in decision-making and when their agendas differ substantially. Engagement with stakeholders can allow for the integration of stakeholder views.

5.4 Sustainability

Climate change responses can have wider impacts than those targeted (both positive and negative). Successful strategies can potentially enhance other social, economic and environmental objectives associated with sustainable development (such as job creation). Conversely, seemingly successful strategies can in fact negate positive objectives by taking local job opportunities away (procuring solar technology from abroad for example).

Sustainable response options selected can be achieved using an integrated approach, considering climate change responses in asset management planning alongside wider impacts on sustainability, delivery and other project performance indicators. Importantly, the consideration of multi-benefit approaches can support genuine business cases for investment proposals.

5.5 Stakeholder Engagement

Stakeholder consultation is an essential element of any decision making process. Engaging stakeholders in the decision-making processes increases the likelihood that climate change response initiatives will be locally appropriate, and thus adopted and sustained. It is essential in support of any climate change management decision-making that stakeholders are identified and their views considered within the decision-making process.

[25] DEFRA (2012) UK Climate Change Risk Assessment http://www.defra.gov.uk/environment/climate/government/risk-assessment/

5.6 Monitoring and Evaluation

Periodic monitoring and evaluation of climate change adaptation responses implemented is essential in the management of uncertainty and success of measures over time. The implementation of monitoring and evaluation regimes can help maintain the effectiveness of interventions. The implementation of interventions should be documented to ensure knowledge sharing of opportunities and limitations to others facing similar climate change adaptation challenges.

In light of the ever-changing economic, political and regulatory environment, revisions to the CCRS document as a whole, as well as individual projects selected in the IDP process, will need to be undertaken at minimum every five years. For example, legislation enforcing carbon taxes may come into effect nationally and thus municipalities, in addition to civil society and all other government departments will need to respond accordingly. Furthermore costly weather /climate event may divert important resources from indented allocation such as investment in prevention.

By defining a baseline and clarifying goals, the effectiveness of interventions can be evaluated to identify whether or not interventions have achieved desired outcomes. Climate response measures can also be compared to other interventions within the sector in order to determine relative performance. This should also include an assessment of the efficiency and sustainability of measures in comparison to recent technological development or thinking. Based on this evaluation, interventions should be reviewed to determine whether a change in response is required. This should then be used to inform IDP revisions of key projects and budget allocations.

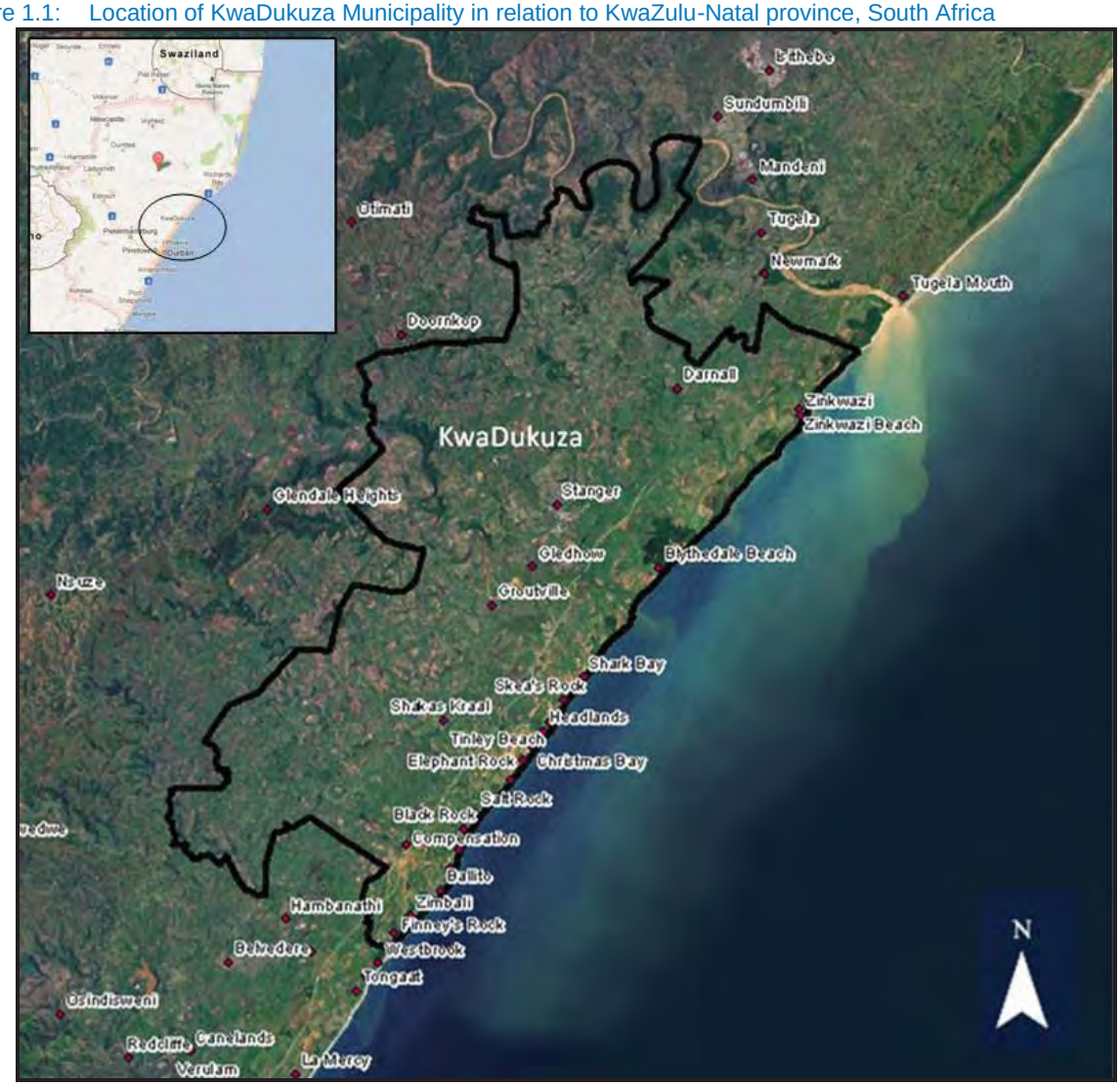
Appendices

Appendix A. KwaDukuza Municipality Background

A.1. Overview

The KwaDukuza Municipality lies within the iLembe District Municipality in the province of KwaZulu-Natal, South Africa and comprises a total area of 735km² (Figure 1.1). It occupies 52km of the coastal stretch and is an average of 23km in width. KwaDukuza is also situated along the N2 movement corridor between the Ports of Durban and Richards Bay (Figure 1.2) and, as such, is considered part of a key economic development and opportunity corridor. Its proximity to King Shaka airport and Dube Trade Port to the south of the Municipality is a further enabler to economic activity for the Municipality.

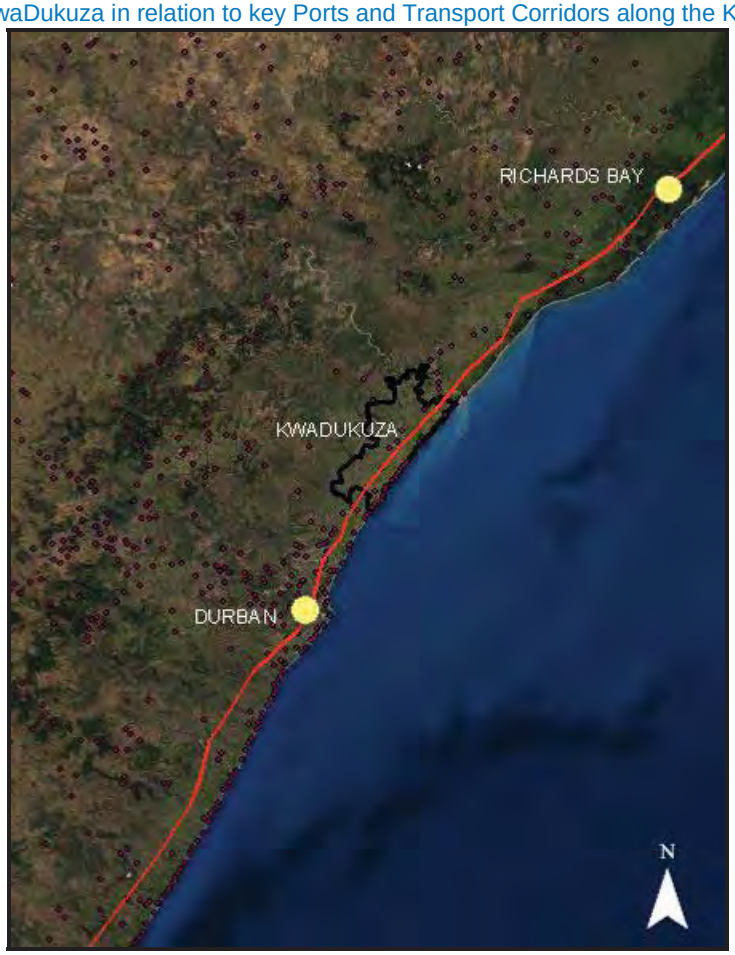
Figure 1.1: Location of KwaDukuza Municipality in relation to KwaZulu-Natal province, South Africa



Source: Mott MacDonald, 2013

The economy is dominated by agriculture (primarily sugarcane), light industry (engineering, wood products, paper and packaging), businesses and tourism. The primary aspects drawing tourists to the KwaDukuza area are its beaches, warm climate, cultural heritage and wildlife.[26] A variety of clustered, ad hoc settlements and small towns exist in the Municipality and these are linked with a well-developed network of roads and rail infrastructure, servicing its population of 600 000, of which approximately 350 000 is rural.

Figure 1.2: Location KwaDukuza in relation to key Ports and Transport Corridors along the KZN coastline



Source: ESRI Streaming Aerials, 2010

To quote the Municipality, KwaDukuza is defined as an area of great potential and as being “a city in the making”. With a projected economic growth rate of between 3 and 5% over the next 20 years, it is a municipality with one of the fastest growing economies in South Africa.[27] [28]

[26] South African Local Government Association (SALGA) (2012). Local Government Handbook South Africa: A Complete Guide to the Municipalities in South Africa. Yes! Media, Claremont.

[27] KwaDukuza Municipality. 2011. Environmental Policy. Ballito, KwaDukuza.

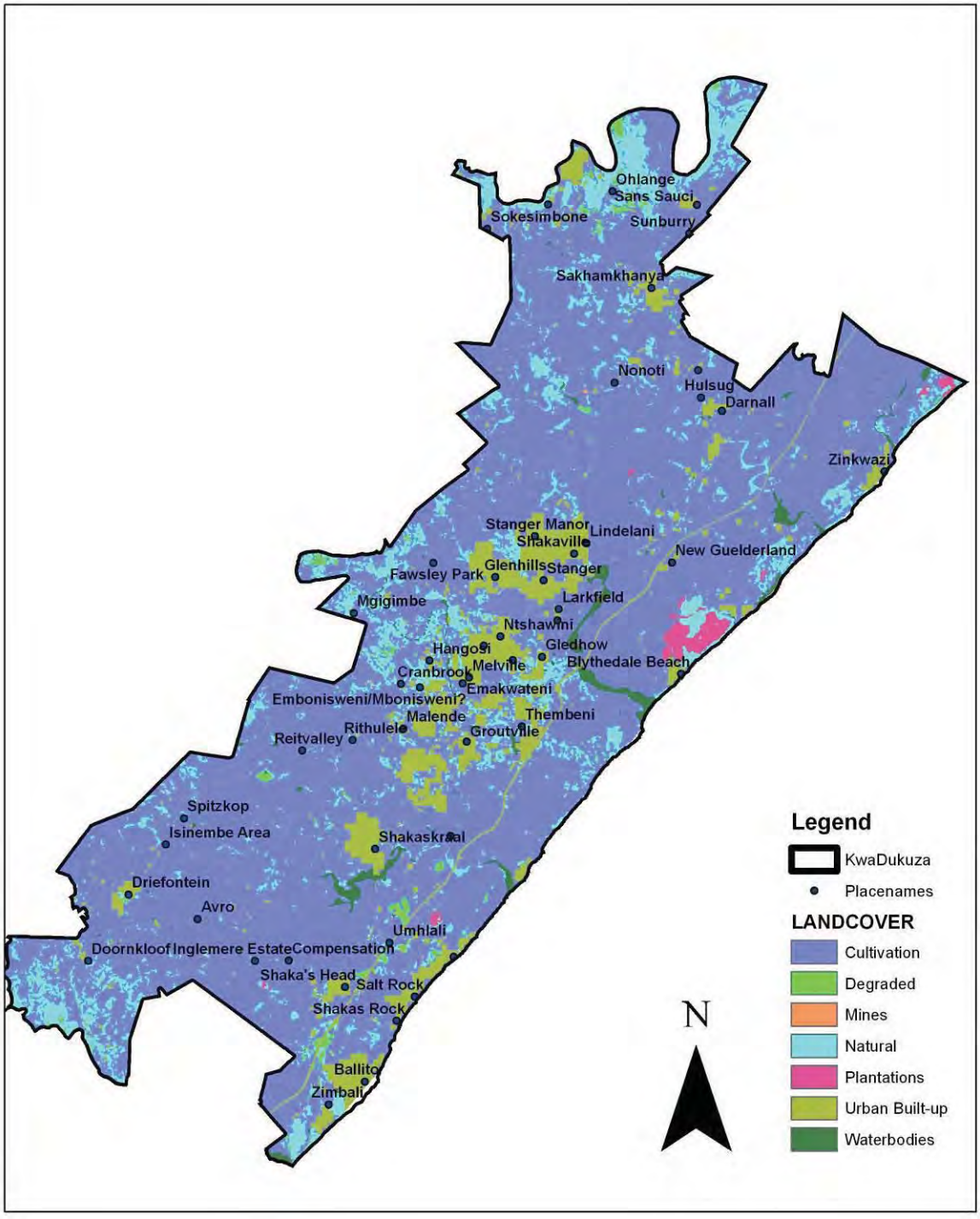
[28] iLembe DM. 2012. iLembe Regional Spatial Development Plan Phase Three: Towards a Regional Plan. iLembe District Municipality, Umhlali.

A.1.1. Land Use

The KwaDukuza Land-use map provides an indication of activities taking place at a ground level (Figure 1.3). The Municipality has undergone vast levels of cultivation owing to its fertile soils (primarily sugar cane, forestry and subsistence farming).

There are many urban built-up areas situated primarily along its coastal towns (Ballito, Salt Rock, Blythedale and Zinkwazi), as well as inland industrial centres such as KwaDukuza, and settlement areas such as Groutville and Shaka's Kraal. A relatively small proportion of the study area is considered natural or pristine. The study area is well-endowed with a series of natural watercourses, wetlands and dams, while its coastline is punctuated with a number of estuaries (saline wetlands).

Figure 1.3: Land Use Map of KwaDukuza showing high levels of Cultivation and Urban Built-up areas



Source: SANBI, 2009

Appendix B. Policy Context

B.1. International Climate Change Policy

Greenhouse Gases allow incoming radiation to pass through the atmosphere but prevent much of the outgoing radiation from escaping to outer space. Over time, increased concentrations of these gases in the atmosphere are widely accepted to lead to the accelerated warming of climates around the world. This is often referred to as 'global warming' with the associated impact referred to as 'climate change'.

The greenhouse effect is a natural phenomenon; the issue of global warming, and therefore climate change, refers to an 'enhanced greenhouse effect' due to human activity. Numerous compounds are known to contribute to global warming. Climate change is most closely associated with carbon dioxide (CO2) due to the wide range of sources and overall contribution to the total volume of GHGs in the atmosphere. CO2 is a gaseous product released during combustion of carbon/hydrocarbon based fuels with the amount released dependent on the carbon content of the source fuel. CO2 is not a toxic gas but it is widely accepted as being the most significant contributor to the 'global warming' effect due to the quantity of gases released on a global scale.

In response to increasing levels of atmospheric greenhouse gases, an international response was formed. The United Nations Framework Convention on Climate Change (also known as the Kyoto Protocol) was first adopted for use on the 11th December 1997 and was set up to tackle global warming by introducing targets for countries to reduce emissions of GHGs including CO2 to a stable or lower level. The key aim of the Kyoto Protocol was to ensure a collective reduction in emissions by 5.2% compared to 1990 levels for all industrialised countries (known as Annex I countries since those that are obligated are listed in Annex I of the Protocol) in a commitment period of 2008-2012. This limit was adopted to stabilise atmospheric levels of CO2.

South Africa joined the UNFCCC in 2002 and as such is classed as a non-Annex I country. This means that South Africa does not have a formal target to reduce emissions under the Kyoto Protocol but are committed to the general theme of reducing emissions. The Department of Environmental Affairs is responsible for the legal implementation of the Protocol in South Africa, including reporting requirements.

The Kyoto Protocol expired in 2012. Extensive international discussions took place between 2010 and 2012 to revise the Kyoto Protocol. In 2012, a Doha Amendment was adopted which extends the agreement to a second period of 2013 to 2020, with some other minor changes to the detail of the Protocol. However the Doha Amendment did not change which countries were required to meet GHG emission reductions. Presently, no countries have formally ratified the Doha Amendment.

The United Nations Framework Convention on Climate Change (UNFCCC) commits all Parties to formulate, implement, publish and update adaptation measures, as well as to cooperate on adaptation. Countries have submitted information on their adaptation plans in their 5th National Communication to the UNFCCC.[29]

These Parties have already highlighted the most important elements that might be part of an enhanced multilateral response to climate change up to and beyond 2012. Adaptation was identified to be one of the five key building blocks (shared vision, mitigation, adaptation, finance and technology) of a future climate change deal.

[29] http://climate-adapt.eea.europa.eu/web/guest/adaptation-strategies

The importance of adaptation was reiterated in the Copenhagen Accord[30], which emphasizes that enhanced action and international cooperation on adaptation is urgently required to ensure the implementation of the Convention by enabling and supporting the implementation of adaptation actions aimed at reducing vulnerability and building resilience in developing countries, especially in those that are particularly vulnerable, especially least developed countries, small island developing States and Africa.

Under the negotiating process towards Cancun, countries made progress in defining a comprehensive adaptation framework, which will enable all countries to share knowledge and lessons learned from adaptation and developing countries to develop and implement adaptation measures supported through scaled-up financial support, technology and capacity-building. The final elements of the framework remain to be agreed through the negotiations.

Parties have emphasized that adaptation (the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities) and mitigation (human intervention to reduce the sources of greenhouse gases[31]) need to be accorded the same level of importance. Adaptation does not replace mitigation of greenhouse gas emissions. On the contrary, both adaptation and mitigation need to be pursued in parallel during the same period of time, thus complementing each other, and they need to be implemented through sufficient financing and appropriate technology.[32]

B.1.1. COP 17 – Durban (2011)

The UNFCCC in Durban, South Africa, was held from 28th November to 11th December 2011. The meeting resulted in the adoption of 19 COP decisions and 17 CMP decisions and the approval of a number of conclusions by the subsidiary bodies, most notably the establishment of a second commitment period under the Kyoto Protocol, a decision on long-term cooperative action under the Convention, the launch of a new process towards an agreed outcome with legal force applicable to all parties to the Convention, and the operationalisation of the Green Climate Fund.[33]

[30] Copenhagen Accord was a result of the COP15 negotiations

[31] IPCC, 2012: Glossary of terms. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555-564.

[32] http://unfccc.int/press/fact_sheets/items/4985.php

[33] http://www.iisd.ca/vol12/enb12534e.html

B.2. South Africa Climate Change Policy

Before launching into South African climate change policy, it is considered necessary to consider the overall legal framework for government responses to environmental problems and thus climate change related challenges.

B.2.1. The Constitution (1996)

South African Constitution (**Act 108 0f 1996**) imposes the promotion and protection of the country's natural environment and the rights of South African citizens to access and enjoy a healthy natural environment. Section 24 of the Constitutional Bill of Rights for instance state that everyone has the following rights:

- To an environment that is not harmful to their health or wellbeing; and
- To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that:-
  - Prevent pollution and ecological degradation
  - Promote conservation
  - Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

This legislation represents a challenge against the backdrop of a suite of developmental needs for *inter alia* housing, service provision and economic growth.

The primary policy approach in respect of climate change response is framed within the **National Climate Change Response (NCCR) White Paper (2011)**. This document outlines strategic priorities, provides direction for action and delineates responsibilities for the different spheres of government.

B.2.2. National Development Plan (2010)

President Zuma appointed the National Planning Commission (NPC) in May 2010 to draft a vision and National Development Plan (NDP) for consideration by Cabinet and the country. The NPC is an advisory body consisting of 26 experts drawn largely from outside government.

As a long-term strategic plan, it serves four broad objectives:

- Providing overarching goals for what we want to achieve by 2030;
- Building consensus on the key obstacles to us achieving these goals and what needs to be done to overcome those obstacles;
- Providing a shared long-term strategic framework within which more detailed planning can take place in order to advance the long-term goals set out in the NDP; and
- Creating a basis for making choices about how best to use limited resources.

The Plan aims to ensure that all South Africans attain a decent standard of living through the elimination of poverty and reduction of inequality. It therefore defines a desired destination and identifies the role that different sectors of society need to play in reaching that goal.

The intention of the National Development Plan (NDP) is to make the most of South African citizens - their goodwill, skills and resources. It aims to step away from Business as usual and to spark a cycle of more sustainable, low emission development that will expand opportunities, build capabilities and raise living standards.

National government aims to create five million jobs by 2020 (which is approximately three million more than the anticipated growth rate which has been extrapolated from the years 2002 to 2009). Related to this is the **New Growth Path** which is targeting opportunities for 300 000 households in agricultural smallholder schemes and 145 000 jobs in agro-processing by 2020, while there is potential to upgrade conditions for 660 000 farm workers. In terms of the green the economy, there is the national goal to create 300 000 additional direct 'green jobs' by 2020.

B.2.3. Climate Change Response White Paper (2011)

A White Paper is a policy document that states an entity's position, philosophy or framework on a social or political subject.

The South African National Government recognises the need to plan for a low carbon future and commit to post-Kyoto negotiations that took place in Copenhagen in 2009 during the UNFCC fifteenth Conference of the Parties (COP15). The South African government's NCCR White Paper was developed in 2011 and focuses on three key aspects:

- Adaptation;
- Mitigation; and
- Mainstreaming sustainable and 'climate-resilient' development.

The NCCR White Paper requires all government departments and state-owned enterprises to achieve "full alignment with the national climate change response" by way of reviewing their legislation, policies, strategies, governance structures and plans. National government will then determine any legislative or regulatory changes deemed necessary.

B.2.3.1. Adaptation

According to the document, South Africa's overall approach to adaptation will include:

- developing climate change adaptation strategies based on risk and vulnerability reduction;
- partnership with other organisations, where appropriate, and seek to share resources, technology and learning to coordinate a regional response;
- acknowledgment of the Stern Review, which estimates that damages from unmitigated climate change could range between 5% and 20% of global Gross Domestic Product (GDP) annually by 2100 – erasing a lot of South Africa's developmental gains over the past few years;
- embracing flexibility to adjust to changing circumstances, since future climate trend uncertainty rises steeply over the longer-term; and
- the need for focused monitoring and evaluation systems to update knowledge of how rapidly change is occurring and the effectiveness of adaptation responses to ensure better spend.

A key feature of adaptation responses is that they have a much stronger local framework than that of mitigation responses. Their benefits may also appear much faster and are usually more 'tangible'. Effective adaptation responses can also potentially create many jobs, particularly "green jobs" with reforestation projects, for instance, and could contribute significantly to sustainable development goals. Well planned adaptation responses can often be effectively integrated with sustainable development policies.

According to the paper, effective planning and coordination of an integrated adaptation response will require the following:

- Early warning and forecasting for disaster risk reduction.
- Medium-term (decade-scale) climate forecasting to identify potential resource challenges in advance.

- Long-term climate projections that define the range of future climate conditions.

As a first step in ensuring that appropriate adaptation responses are mainstreamed into sectoral plans, a sub-committee of the Intergovernmental Committee on Climate Change (IGCCC) will be established to perform climate risk analyses on all sectoral plans.

It is equally important to note that, in addition to a refinement of top-down approaches, the paper acknowledges that developing more detailed bottom-up approaches which are informed by the responses of local communities and local government and which will deliver results with a higher degree of confidence than is currently possible.

B.2.3.2. Mitigation

South Africa recognises that stabilisation of GHG concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system will require effective international co-operation. As a global citizen with moral as well as legal obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, South Africa has pledged ambitious targets for climate change mitigation, has a world-leading mitigation policy vision in the shape of the long-term mitigation scenario (LTMS). It aims to embark upon its fair share of global GHG-mitigation efforts by reducing national GHGs by 34% by 2020 and 42% by 2025.[34]

Achieving these targets based on the current trajectory (business-as-usual) is going to be an enormous challenge for the country which operates primarily on coal based thermal energy. If South Africa is serious about achieving these pledges, current decision-making within all sectors, particularly energy and transport should be made within the framework of such a plan.

South Africa's overall approach to mitigation will include:

- adopting a "carbon budget approach" to provide for flexibility and least-cost mechanisms for organisations in each relevant sector and/or sub-sectors;
- where appropriate, translating carbon budgets into organizational/company-level desired emission reduction outcomes;
- requiring companies and economic sectors or sub-sectors for which desired emission reduction outcomes have been established to prepare and submit mitigation plans, setting out how they intend to achieve the desired emission reductions;
- developing a system of Green House Gas (GHG) monitoring; and
- deploying a range of economic instruments and monitoring and evaluation (M&E) tools to support the system of desired emission reduction outcomes.

[34] National Government of the Republic of South Africa (RSA). 2011. National Climate Change Response White Paper (online). Available from http://www.polity.org.za/article/white-paper-on-the-national-climate-change-response-gazette-no-34695-notice-757-2011-10-19

B.2.3.3. Mainstreaming Sustainable and 'Climate-Resilient' Development

The white paper also points to a commitment on the part of government to promoting and expanding the "green economy" and to mainstream it into development. A low-carbon development path would require monetary and value-based development indicators that would include: economy, society and the environment.[35] [36]

The paper identifies near-term priority flagship programmes for numerous sectors (e.g. waste, energy, transport and water) and outlines its plans for job creation and resource mobilisation (finance, education and science and technology), as well as requisite institutional arrangements.

B.2.3.4. The Responsibility of Local Government

Section 10.2.6 of the NCCR White Paper notes the key role of local government as a site of climate change response delivery flowing from its responsibilities as detailed in the objectives and powers and functions accorded to local government in the **Constitution of South Africa (108 of 1996)** and the **Municipal Systems (32 of 2000)** and **Structures (117 of 1998) Acts**.

The National Climate Change Response White Paper (2011)[37] identifies the climate response areas of local government as:

- building resilience within the local population;
- planning settlements in the context of climate change;
- urban development;
- provision of infrastructure and services; and
- water and energy demand management.

Climate change is a dimension that has strong relevance in local government's ability to meet its **Constitutional objectives (section 152 (1)** of sustainable service delivery, social and economic development and promotion of a safe and healthy environment. Local government has to adhere to environmental principles and take environmental considerations into account in its planning processes. Some significant principles contained in the **National Environmental Management Act (NEMA) (107 of 1998) and the White Paper of Environmental Management Policy for South Africa** include that local planning must take into account global/international issues (GHG emissions would be a good example of this, having little immediate local impact, but substantial impact when combined with all global contributions), that this must be brought into planning as early as possible and that natural resources must be protected for the benefit of present and future generations.[38]

[35] Sabinet. 2012. National Response to Climate Change: White Paper Released (online). Available from http://www.sabinetlaw.co.za/environmental-affairs-and-water/articles/national-response-climate-change-white-paper-released

[36] WWF. 2010. Transport roundtable drives SA towards a low-carbon future (online). Available from http://www.wwf.org.za/media_room/news/

[37] National Government of the Republic of South Africa (RSA). 2011. National Climate Change Response White Paper (online). Available from http://www.polity.org.za/article/white-paper-on-the-national-climate-change-response-gazette-no-34695-notice-757-2011-10-19

[38] DEA. 2012. Let's Respond: A Guide to Integrating Climate Change Risks and Opportunities into Municipal Planning. Sustainable Energy Africa and Palmer Development Group, Pretoria.

In light of new information coming to the fore and the need for iterative planning, the NCCR White Paper is due to be reviewed every 5 years.

B.2.4. The Twelve National Outcomes (2010)

For the 2010-2014 period, National Cabinet approved 12 National Outcomes aimed at addressing the main strategies of government. Although these outcomes were developed to be the strategic focus of government institutions, it must be acknowledged that these outcomes have definite implications for the strategic plans and visions of municipalities.

Of the 12 Outcomes, Outcome 10 is key in the context of this report, and includes the identification of the following strategic priorities:

- Protection and enhancement of environmental assets and natural resources;
- Development of a strategy which is in line with the COP 17 resolutions; and
- Tackling environmental issues such as climate change, global warming and environmental degradation.

On the back of this, KwaDukuza Municipality has identified the roles it can play in ensuring the success of these strategic focus areas.[39] Section B.4.1 outlines their response to Outcome 10 as it relates to climate change.

B.3. Provincial Climate Change Planning and Policy

The Provincial Planning Commission, KZN Department of Agriculture and Environmental Affairs (DAEA) and KZN Department of Economic Development and Tourism (DEDT) are three organisations/departments that are very active in the KZN province regarding both climate change policy and responsiveness.

B.3.1. KZN Provincial Growth and Development Strategy (2011)

The KZN Provincial Growth and Development Strategy (PGDS) was commissioned by the KZN Provincial Planning Commission. It is a strategic guideline document for the province which identifies Seven Provincial Strategic Goals. Of the seven, two are key goals in the context of the KwaDukuza CCRS, whereby KwaDukuza Municipality has responded with their own, more tailored goals:

- Under Goal No. 4 **(Response to Climate Change):** KwaDukuza Municipal greening programmes are to serve as the corner stone of our Climate Change strategy throughout the municipality. Tree planting initiatives in Municipality‘s various wards; and
- Under Goal No. 7 (**Spatial Equity**) :To develop *inter alia* long term strategic plans to facilitate the achievement of Vision 2030 (e.g. City Development Strategy, Transportation Plans, Spatial Plans, Climate Change).

[39] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

B.3.2. KZN Climate Change Policy Directive (2010)

The KZN DAEA compiled a Climate Change Policy Directive in response to observed changes in climatic trends over the KwaZulu-Natal region which was noted to be consistent with climate change projections. This includes observed warming trends in the north-eastern, Midlands and south coastal parts of the province. Also, wetting trends have been observed over parts of the region during the month of February, which is considered abnormal.

The Province acknowledges that if no action is taken, the instability of the climatic conditions in the Province will:

- increase the incidence and severity of extreme weather events such as storms, droughts, floods and heat waves;
- cause sea levels to rise;
- shift and expand certain disease and pest vectors and further stress on already vulnerable species and ecosystems;
- threaten KwaZulu-Natal's natural resource base;
- alter ecosystem and cause changes that will negatively influence human-beings; and
- impact communities and economies negatively.

The Department thus indicates a need for Sector Departments to develop sector plans for the mitigation and adaptation of Climate Change impacts. While local government departments are not explicitly mentioned, the fact that climate change mitigation and adaptation happens primarily at a grass roots level means that local government involvement is critical.

B.3.3. KZN Green Economy Strategy (2012)

The KZN DEDT commissioned a provincial green economy strategy which states that by 2025, KwaZulu-Natal will be a province where the economy provides opportunities for all its residents to prosper, and where the natural resources are enhanced and used sustainably in supporting basic needs as well as 'green' economic growth.

The paper states that the green economy is not an additional component of the existing economy or a separate approach to economic development. It states that there is only one economy – the green economy, which means that the current economy must be re-orientated to become the green economy.

The principal aim of this Green Economy Strategy is to support and direct the re-orientation and growth of the KwaZulu-Natal economy to become increasingly competitive and resilient, by:

- Increasing resource use efficiency in business and government infrastructure and development;
- Increasing the supply of renewable energy;
- Securing the supply of ecosystem services from the province's natural assets; and
- Reducing environmental and climate related risks; and in so doing
- Create sustainable jobs for local people;
- Reduce poverty; and
- Address social equity throughout all regions of the province.

In addition the Department has prioritised the following three goals:

- Creating enabling activities for the green economy in KZN;

- Setting an example with daily governmental activities; and
- Undertaking pilot projects throughout the province.

Examples of each of these are provided below.

Creating enabling activities for the green economy

- The DEDT has established waste to energy guidelines for local municipalities and has set up an advisory panel to review proposals, as well as funding for technical evaluations of any proposals entering the municipal space which officials are not capacitated to handle or meaningfully evaluate.
- They provide provincial solar and wind potential maps free of charge to municipalities and developers.
- Their establishment of the Green Economy Technical Assistance Fund and the Gigima Fund (see Section B.5.2 below).
- The creation of a GIS tool for the identification of constraints to developers wanting to establish wind or solar farms in KZN.

Setting an example with government activities

- Assisting government departments with technical advice to understand their emissions sources and measurement thereof.

Undertaking pilot projects

- The KZN Red Hub - a partnership project to produce renewable energy being driven by local (eThekwini and iLembe) and provincial (DEDT) government.
- DEDT is working with South African Sugar Association (SASA) to generate a targeted 1000MW of energy from biomass in the province.

B.4. Regional/Municipal Climate Change Policy (2012)

Local government represents the third tier of government in South Africa. The principal mandate of local government is to implement policies and programmes as set out by the national and provincial spheres, as well as act as the chief agent for service delivery to their local communities.

KwaDukuza has shown a commitment to the environment in the form of both their IDP, municipal mission statement and their environmental vision. In respect to tackling climate change, COP17 (Durban) was successful in bringing local government together in the creation of the Durban Adaptation Charter. The Durban Adaptation Charter commits Local Governments to local climate action in their jurisdiction that will assist their communities to respond to and cope with climate change risks thereby reducing vulnerability.[40] KwaDukuza was a signatory to this Charter in December 2011.

B.4.1. IDP response to National Outcome 10

The KwaDukuza Municipal IDP for 2012-2017 stipulates the following in response to National Outcome 10 (Protection and enhancement of environmental assets and natural resources): "**Environmental issues such as climate change, global warming, and environmental degradation are some of the priorities that have been identified during this [planning period].**"

[40] http://www.durbanadaptationcharter.org/

B.4.2. Municipal Mission Statement

At an over-arching municipal level the Municipality strives to achieve the following:

"By 2030, KwaDukuza shall be a vibrant city competing in the global village economically, socially, politically and in a sustainable manner."

B.4.3. Municipal Environmental Vision

The KwaDukuza Environmental Policy is a statement of intent towards KwaDukuza Municipality's objectives regarding its environment. It aims to ensure that the principles of sustainability are adhered to across sectoral policies, strategies and programmes within the municipal environment.

At a departmental level, the KwaDukuza Environmental team strives to achieve the following:

*"[KwaDukuza] Municipality strives to be an **environmentally sustainable** municipality that **anticipates, manages, and reduces its vulnerability to potential global and local environmental shocks** and **works consistently with the department of environmental affairs to drastically reduce the impact of its built environment and urban processes** on the broader envelope of natural resources."*

More specifically, with regards to climate change, it is committed to:

- The implementation of cost effective programmes to reduce greenhouse gas emissions and the releases of ozone-depleting substances; and
- Green economy initiatives that promote social inclusiveness and sustainable development, as a response to the challenges and will ensure the implementation of Community Ecosystem Based Adaptation …which focuses on the restoration and care of the ecosystems that ensure the welfare and livelihood of communities …and encourages the creation of green jobs.

These signify a commitment to both climate change mitigation and adaptation at a local level which will see KwaDukuza heading in a new, sustainable and more equitable developmental path. These commitments, along with provincial and national imperatives, are what will underwrite the CCRS and the strategies going forward.

B.5. Funding

A suite of international and local 'green funds' are available to organisations such as local government, however, the reality is that local governments find it difficult to access these funds as they are either not known, and/or the application requirements are onerous on often-constrained human resources. Several prominent local and international funds are nevertheless highlighted below as examples.

B.5.1. The DBSA Green Fund

In response to the national challenge for both emissions reductions and increased job creation, the DEA has established a Green Fund to support the transition to a low carbon economy whilst delivering high-impact socio-economic and environmental co-benefits. The DEA has appointed the Development Bank of Southern Africa (DBSA) as the implementing agent of the Green Fund, with an initial allocation of R800 million.

The Green Fund provides catalytic finance to facilitate investment in innovative green projects that will support both poverty reduction and job creation. More information on the funding windows and eligibility criteria can be found online at:
http://www.environment.gov.za/?q=content/projects_programmes/greenfund.

B.5.2. KZN DEDT Funding

The KZN DEDT has set up two funds:

- The **Green Economy Technical Assistance Fund** – this is for funding of technical/feasibility studies, to take to an idea to bankable phase (approximate value is R250 000); and
- The **Gigima Fund** – for project level financing (maximum of R5 000 000).

While the DEDT is primarily focusing on mitigation-related (renewable energy) projects, the Department is showing a substantial commitment to the green economy, which is a positive step in the direction of sustainability.

B.5.3. Other International Funds

There are a variety of international funds that support projects on climate change and low carbon development. Examples include the Adaptation Fund provided by the UNFCCC[41] or the UK International Climate Change Fund. [42]

UK International Climate Change Fund (ICCF) will provide R32 billion between April 2011 and March 2015 to support international poverty reduction by helping developing countries to adapt to climate change, take up low carbon growth, and tackle deforestation. The ICCF is aiming for a balanced allocation between adaptation (50%), low carbon development (30%) and forestry (20%) and resources will be used to:

- Build global knowledge and evidence that low carbon, climate resilient development supports growth and reduces poverty;
- Develop, pilot and scale up innovative low carbon, climate resilient programmes and approaches to reduce emissions, support adaptation and protect forests, including biodiversity;
- Support country level action on low carbon, climate resilient development, including Reducing Emissions from Deforestation and Forest Degradation;
- Build an enabling environment for private sector investment and to engage the private sector to leverage finance and deliver action on the ground; and
- Mainstream climate change into UK overseas development assistance, EU development assistance and Multilateral Development Bank (MDB) lending.

[41] More information available at: http://unfccc.int/cooperation_and_support/financial_mechanism/adaptation_fund/items/3659.php
[42] International Climate Fund (ICF) Implementation Plan 2011/12 – 2014/15 Technical Paper

Appendix C. Methodology

C.1. Introduction

The KwaDukuza Climate Change Strategy is underpinned by an evidence based assessment. This chapter outlines how strategic recommendations were formed based on the following assessment process.

C.2. Approach

In order to identity strategic priorities for climate change mitigation and adaptation response the following stages were undertaken:

- Scoping the issue of climate change management in KwaDukuza
  - Identifying the international, national and local policy context (Appendix B)
  - Review of key evidence and literature
  - Development of risk sector profiles (Appendix D)
  - Stakeholder engagement (Appendix E)
- Detailed assessment of risks and identification and appraisal of strategic responses
  - Development of a greenhouse gas emissions profile (Appendix I) and climate impact profile (Appendix J)
  - Outline of strategic climate change mitigation (Section 2) and adaptation (Section 3) responses
  - Identification of strategic climate change management priorities (Section 4)
  - Outline of guiding principles in support of implementation (Section 5).

C.3. Stakeholder Engagement

A vital element of the CCRS process is community and stakeholder engagement. As part of the scoping phase of the project, a series of stakeholder workshops was held to facilitate the inclusion of local knowledge systems and to discuss sectoral risks and practical responses in more detail. In addition to the identification of focus areas, the intention of the workshops was to also identify key implementing agents and partners, as well as any institutional and/or governance gaps.

The stakeholder database can be found in Appendix E.

Two Community workshops were held on 26 February 2013 – one in KwaDukuza and one in Ballito. Two separate venues were chosen to attract the attendance of a wider range of participants from differing backgrounds and knowledge groups. All stakeholders on the stakeholder database were invited to attend via email, as well the general public, who were invited through the printed media (Stanger Weekly, North Coast Courier and Ballito Fever). The objective of the workshops was to introduce the greater community to the CCRS process, to get an understanding of their local knowledge and key concerns, as well as to answer any queries. Thus, the workshops involved a presentation by the project team followed by a comments, question and answer session. The minutes, presentations and attendance registers of these workshops can be found in Appendix E.

A Project Steering Committee (PSC) meeting was held on 28 February 2013, whereby key role-players from the stakeholder database were identified by the client and project team and invited to participate in a more focussed workshop. The workshop was aimed at identifying key strategies for each theme and sector identified in the CCRS process (see Section 4 below which outlines Key Themes). The PSC workshop involved a more detailed presentation and a 2 hour discussion of key actions and responses across sectors (present and future). The minutes and attendance register of the PSC can be found in Appendix F.

The above workshops and PSC meeting provided a valuable opportunity to introduce key stakeholders to one another and to enhance the community of practice in climate change responsiveness. One of the key findings were that both climate change mitigation and adaptation concerns were being raised. This indicates that those in attendance (representative of decision-makers, business, NGOs and the community of KwaDukuza) were relatively well-informed when it comes to their general understanding of climate change related issues, impacts and associated response options.

Following the PSC meeting, a brief introductory presentation was delivered to Council at their monthly Economic Development and Planning Portfolio Committee meeting. The intention of this presentation was to explain the CCRS process, why it is being undertaken, and to respond to any queries.

Brief one-on-one engagement also took place with ICLEI - Local Governments for Sustainability - Africa and the Mott MacDonald project team in February 2013. Opportunities for alignment and key gaps were discussed. It was discussed that the KwaDukuza CCRS mitigation findings in particular, will form the basis (or part-thereof) of ICLEI-Africa's Urban-LEDs work going forward. The project with ICLEI-Africa will focus on further development, strengthening and deepening of the Municipality's approach to low emission development (or mitigation), including a detailed energy and greenhouse gas inventory.

The final KwaDukuza CCRS report will be presented to the same portfolio committee in May 2013, once complete. This will ensure that the report is explained, so that the end product may be better referenced, applied and used by Council.

C.4. Supporting Data and Information

C.4.1. Emissions

The various emissions profiled for South Africa, KwaDukuza and its neighbouring municipality, eThekwini, were the latest available, were sourced online and via municipal officials who hold records of indicative data (such as fuel consumption, electricity consumption and organic waste volumes). Unfortunately large discrepancies exist, particularly for KwaDukuza, where there is a lack of baseline data available. This is largely owing to the fact that more extensive data was not able to be sourced within the project timescales, and that no former climate change or mitigation-related studies have been compiled for KwaDukuza prior.

The emissions section of this report attempts to make a 'first step' at inventorying carbon emissions for KwaDukuza (albeit sectoral, and in all cases limited to areas of municipal functions – not for the entire community residing in the area). As such, the report acknowledges the gaps in emissions data and information for KwaDukuza outlined in this report and draws quite strongly from national and local (neighbouring) municipal data, information and (in the case of future actions) targets. Because KwaDukuza is one of the fastest growing economies in South Africa, the assumption was made that future emissions would be higher than the national average. This is described in more detail in the Sections that follow.

C.4.2. Climate Change Adaptation

Climate and projected climate change data has been gathered from a variety of sources using the most up-to-date climate observations and the multi-model projections. However, any decision-making made on the basis of the findings of this report will need to be risk based and therefore take account the uncertainty associated with climate change projections:

- Modelling uncertainty – arising from incomplete understanding of the climate system, and the inability to model it perfectly. The projected increase in temperature is expected to exacerbate the possibility of drying, or even counteract any possible increases in rainfall, through increased evapotranspiration, which would detrimentally affect the agriculture and water resources of the country.
- Natural climate variability – arising from both internal and external factors on the climate system. These model simulations show wide disagreements in projected changes in the amplitude and frequency of future El Niño events, contributing to uncertainty in future climate variability in projections for this region.
- Emissions uncertainty – arising from not knowing the amount of future global greenhouse gas emissions. The mean, maximum and minimum of the ensemble of 15 models, under three emissions scenarios (SRES A2, A1B and B1).
- Contributions to uncertainty from downscaling - It is important to note that projections discussed in the report are based on climate models with coarse spatial resolution, which hampers their ability to simulate regional-scale climate features of the region.

Appendix D. Key Themes and Sectors

Before launching into risks and adaptation and mitigation responses for each sector for the CCRS, an introduction to the status quo of the various sectors is considered necessary. The situational analysis of these themes informs the later stages of the report where the climate context, associated risks and responses are profiled.

D.1. Overview of Themes and Sectors Studied

Four overarching themes were identified by the project team, and these were broken down into several sectors in line with KwaDukuza's local activities and circumstances (Table 4.1 below).

Table 5.1: Key Themes and Associated Sectors

THEME	SECTOR
NATURAL SYSTEM	Water
	Coastal and Marine
	Biodiversity
	Agriculture
BUILT SYSTEM	Human Settlements
	Waste
	Energy
	Transport
SOCIO-ECONOMIC SYSTEM	Human Health and Wellbeing
	Working with Business
	Education Awareness and Capacity Building
GOVERNANCE	Integration, Planning and Partnerships

It should be noted that while some of these themes have specific links to either adaptation more-so than mitigation (and visa versa), all are introduced below as an overview.

D.2. Theme One: Natural System

D.2.1. Water

KwaDukuza, like most of KwaZulu-Natal, has the fortune of good levels of rainfall (approximately 830mm annually). However population increase, pollution and climate change uncertainty are recognised as major threats to this resource.

D.2.1.1. Water and Natural Systems

The study area is drained by rivers generally flowing westwards to eastwards through the study area. The Mdloti River is located furthest south followed by the Tongaat River, the Umhlali River, the Mvoti River and the Nonoti River before reaching the Tugela catchment area (the largest river in KwaZulu-Natal). The Tugela River itself flows adjacent the northern extent of KwaDukuza but its mouth lies in Mandeni.

There are wetlands associated with all KwaDukuza's river systems, in addition to low-lying areas of the study area which typically house wetlands. Recent studies have shown wetlands to be more numerous

(316 recorded) and much further in extent than was previously recorded - covering 988.1ha (1.6%).[43] Delineated wetlands too are generally found to exceed the delineated boundaries, e.g. where commercial crops have been retracted and natural vegetative cover has been restored (e.g. Simbithi Residential Estate).

D.2.1.2. Water supply

Two water management areas exist in the Municipality:
- Mvoti to Umzimkhulu: 62702.4ha (99.04% of Municipality)
- Thukela: 4216ha (6.66% of Municipality)

Umgeni Water is the bulk service provider to the KwaDukuza area. The iLembe District Municipality is the Water Services Authority (WSA) and Siza Water is the water services provider to the Dolphin Coast area.

Umgeni Water focuses a lot of effort on water availability and security. If water supplies ever run low in dams, they alert the iLembe District, KwaDukuza and, if necessary, the community.

Development and unplanned settlement patterns are a key threat to the natural water system (rivers and wetlands). A recent study by the Institute of Natural Resources (2012)[44] highlighted risks associated with the reliance on water supplied from the Doringkop area. If anything happens to that source, in the way of pollution or reduced supply, water supply will be drastically affected for KwaDukuza.

A process of auditing is still required to establish water quality levels with specific reference to industrial and sewage pollution in rivers of the iLembe District Municipality, as well as sources of such pollution.

D.2.2. Coastal and Marine

D.2.2.1. Estuaries

The coastline is punctuated by a series of estuarine systems in fair to good condition. Most of them are closed systems, but in major storm or tidal events they breach their banks.[45]

The following estuaries (and their associated ecological condition) exist in KwaDukuza:
- Mdlotane Temporarily closed estuary - good condition
- Mhlali - Temporarily closed estuary -fair condition
- Mvoti - River mouth - good condition
- Nonoti - Temporarily closed estuary - poor condition
- Seteni - Temporarily closed estuary -fair condition
- Zinkwazi - Temporarily closed estuary -fair condition

D.2.2.2. Coastline and Marine

The iLembe coastline is key to its tourism industry. It has experienced damages over the past decade – in particular the severe storm event of 2007. This event resulted in shoreline retreat and erosion to the natural beaches, as well as damages to infrastructure such as buildings, roads and other services. Rehabilitation was very costly for the Municipality and its private landowners.

[43] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.
[44] Institute of Natural Resources (2012). KwaDukuza Biodiversity Open Space Management Plan. KwaDukuza Municipality, Jballito
[45] SANBI (2011). National Biodiversity Assessment, Volume 3: Estuary Component Technical Report. Pretoria.

While the marine environment is almost totally out of the jurisdiction of KwaDukuza, it is important to note the importance of maintaining the marine environment in terms of sediment type and levels, water quality and biodiversity. In this regard, role-players and partners play a critical role, e.g. catchments management forums which monitor/oversee catchment wide issues such as sedimentation. A coastal working group also exists in the iLembe region. This working group is very active in the area, and also act as PSC members on the Ezemvelo-KZN Wildlife (EKZNW) Working for the Coast Programme.

D.2.2.3. Coastal Vulnerability Index

The KZN Coastal Vulnerability Index (CVI)[46] is an invaluable tool for coastline management in KwaZulu-Natal. Commissioned by the Provincial Department of Agriculture and Environmental Affairs, it highlights sections of the coast which are at greatest physical risk (e.g. to erosion) of storm surges and sea level rise, and what coastal features may be impacted. The study took into account: existing beach width, dune width, distance to the 20m isobath, rocky outcrop percentages, and the width of dune vegetation to arrive at risk categories (risk, moderate risk and high risk – see Table 5.2 below).

Table 5.2: CVI ratings and associated meaning

Risk Category	Description
Risk	· Lowest risk category – likelihood of impact or damage is lower. · Physical parameters are in good condition. · If developments in these areas are approved they may increase the vulnerability of these areas. · New developments should be set-back appropriately so as to maintain the natural functioning of the coast.
Moderate Risk	· Sites are at higher risk than areas of *risk*, but lower than areas of *high risk*. · Likelihood of sites being damaged is higher. · Retreat and defence should be explored for existing infrastructure. · New developments should be set-back sufficiently or alternative sites should be considered.
High Risk	· Considered to be the most susceptible to the effects of erosion, sea-level rise or extreme events. · Existing developments have a *high* likelihood of being damaged. · It is recommended that the options of retreat and defence be explored. · New developments should be set-back sufficiently to ensure that they are not damaged. · Alternatively new sites for the development should be considered.

Source: DAEA, 2012

Appendix G shows areas of risk (yellow), moderate risk (orange) and high risk (red) on the KwaDukuza coastline. It is evident that the areas most vulnerable to coastal erosion are those that are heavily settled (Zimbali to Salt Rock and Zinkwazi) and all river mouths (due in part to upstream catchment practices that increase runoff). With the onset of more intense rainfall events, these high risk stretches of the coastline must be carefully managed and reinforced. Appendix E contains the overall CVI fact sheet for the iLembe District area.

Furthermore, a Coastal Management Programme (CMP)[47] was developed for KwaDukuza in 2008 in line with the National Integrated Coastal Management Act of 2008 and has proposed specialised management efforts for sections of the KwaDukuza coastline and its varying features and prioritises them.

[46] DAEA (2012). KwaZulu-Natal Coastal Vulnerability Assessment. O.R.I, Durban.

[47] KwaDukuza (2009). KwaDukuza Coastal Management Programme (in Draft). KwaDukuza.

D.2.3. Biodiversity

The natural vegetation found in KwaDukuza comprises two biomes, namely the Indian Ocean Coastal Belt Biome and Savanna Biome. Remaining natural areas in the Municipality comprise only 6 322.5 ha (10% of the Municipality) and no protected areas exist within the municipal area. Only pockets of forest have been left undeveloped and very little grassland. The only naturally remaining area of coastal grassland is located in Nonoti and its protection from pressures such as development and climate change related impacts is therefore of critical importance.

In the hinterland the natural vegetation is threatened by sporadic, informal settlement in the tribal areas. In the past, small villages have tended to establish at random in more remote areas of the Municipality causing further fragmentation of natural vegetation units. Other threats to biodiversity are commercial agriculture (see land use map in Section 2 above), over-grazing, alien plant infestation (which is transforming valuable natural land into impenetrable scrub) and a lack of formal protection.[48]

Natural vegetation provides a host of ecosystem services such as acting as a carbon sink (carbon sequestration), providing aesthetic appeal and supports a wealth of faunal biodiversity. Wetlands and estuaries (described above) are also highly valued systems, acting inter alia as areas of flood attenuation, breeding grounds, as areas of refuge and as nurseries/homes to fish, reptiles, mammals and birds. As such, the aforementioned threats to these systems must be actively managed to avoid any exacerbation of impacts by climate change. Ways of doing this are explored in the sections that follow.

D.2.3.1. BOSMap

The Municipality has recently undertaken a biodiversity open space mapping and planning process (otherwise referred to as BOSMap). This plan, recently adopted by Council (2013), is a positive step in the right direction for the Municipality as it embarks on securing key natural areas and parks in future.

In addition to the Municipality, the DAEA and EKZNW are key custodians of biodiversity in the KwaDukuza area.

D.2.4. Agriculture

Agriculture is one of KwaDukuza's primary economic drivers, contributing to 23% of the total gross domestic product. The dominant agricultural product is sugar cane. There are however, also other agricultural products such as vegetables, flower and sub-tropical fruit. The majority of the commercial farming areas consist of large-scale activities. The Municipality also accommodates areas of forestry and related paper mills.[49]

[48] SSI, 2012. iLembe Environmental Managemnt Framework Status Quo Report: Biodiversity Specialist Study. iLembe District Municipality, Umhlali.

[49] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

The Municipality's proximity to the Dube Tradeport, south of KwaDukuza, is of key importance both agriculturally and economically. The Dube Tradeport houses a wealth of technical skill and advanced agricultural technology. As such, the Dube Trade Port has created a highly competitive operating environment that is attracting a wide range of investors, operators, users and tenants and it is expected to provide economic benefits for the area of KwaDukuza and its surroundings.

A recent study of South African agricultural systems and international trade revealed that the country is now a net-importer of food. KwaDukuza, as one of the top growing economies in South Africa, faces increased risk of food insecurity with expected increasing human settlement (if left un-checked, urban sprawl) and development pressure on its land. A recent flux of the development of gated estates is also contributing to such pressure on the availability of land for crop production. Over 55% of the KwaDukuza population are subsistence farmers. Competition for differing land uses (biodiversity reserves, agriculture, private/public development and industry) is therefore expected to rise in future and planning for this is critical. The iLembe Regional Spatial Development Plan (IRSDP)[50] commissioned in 2012 will prove to be a useful plan to the Municipality in this regard. The plan attempts to integrate key sectoral drivers (economic, transportation, settlement, environmental and agricultural) to strike a balance that is sustainable – albeit at the regional level.

D.3. Theme Two: Built System

D.3.1. Human Settlements

In terms of settlement patterns in KwaDukuza, existing urban development is located in the formally established towns of KwaDukuza, Ballito, uMhlali, Shaka's Kraal, Prince's Grant, Blythedale Beach, Tinley Manor, Zinkwazi and portions of Groutville. Peri-urban to semi-rural settlement occurs throughout much of the central areas of the Municipality, extending from the northern boundary adjacent to the Tugela via KwaDukuza, Groutville and uMhlali to the southern edge abutting eThekwini. However, densities and development quality varies significantly throughout. While some rural settlement occurs in the Groutville area, most rural and traditional settlement is concentrated inland in the north-western Ingonyama Trust areas. A variety of new housing areas are in the process of either being planned and established throughout the Municipality, from Ballito in the south to Darnall in the north.[51]

In terms of general development areas, ribbon development occurs along the main access corridors of the N2, the R102 is and the roads are 614 and R74 that links the hinterland with the coast and to an extent the tertiary roads that occur in the study area. Similarly, much of the developmen~~t~~ is focused the coast where there are tourism and business-related job opportunities and in industrial centres such as Stanger (IDP, 2012/17).

[50] iLembe DM. 2012. iLembe Regional Spatial Development Plan Phase Three: Towards a Regional Plan. iLembe District Municipality, Umhlali.

[51] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

D.3.2. Waste

The newly opened New Guelderland Landfill site provides the formal disposal destination for solid waste and, more recently, also hazardous waste for the iLembe District and beyond. Dolphin Coast Waste Management (DCWM) is responsible for the collection and disposal of solid waste in the KwaDukuza area, and as a transfer station has a mandate to reduce, re-use and recycle waste entering the site. However there are still many steps the Municipality and its citizens need to take to be effective in curbing the amount of waste that ends up in the landfill. In contrast, the sugar and paper industries are resourceful and re-use a lot of their waste for process such as co-generation (biomass energy production).

There is no formal solid waste removal and disposal service outside of formally declared towns in KwaDukuza. Communities in these 'outlying' areas typically dispose of waste indiscriminately and either burn it, dump or bury it. Local (informal) recyclers however contribute to diverting specific waste streams (e.g. glass) from the landfill site and thus the opportunity exists to formalise these as green jobs. [52]

D.3.3. Energy

Eskom, the national electricity utility, is the bulk supplier of energy to the Municipality. 95% of this energy is derived from coal, 4% nuclear and 1% hydro-power. Nationally, it intends feeding a higher mix of renewable energy into the grid through the Renewable Energy Independent Power Producer Programme (REIPPP) programme which invites successful bidders to supply renewable based energy (primarily through solar, concentrated solar and wind technology) at a fixed rate.

Eskom supplies bulk electricity to KwaDukuza who are in turn responsible for reticulations to residents and business. The Municipality earns most of its revenue by supplying this service to its residents and this can prove difficult in terms of the promotion of de-centralised, renewable-based energy supply. That said, local governments should be encouraged to change this mind set as smaller municipalities often are provided limited electricity, which limits their growth. If renewable energy and energy efficiency are implemented at the local level however, municipalities will have the capacity to grow economically on a low emission pathway. This, in turn, will create alternative revenues for municipalities such as KwaDukuza as there will be a sufficient energy mix to sustain the expected growth and services.

Occasionally bulk electricity supply is interrupted and this could negatively affect business and industrial development in the area. However, Eskom has indicated that it plans to increase its capacity in the area. The KwaDukuza Municipality has also developed its Energy Master plan aimed at effectively addressing issues relating to the provision of electricity.[53]

Key energy consumers in KwaDukuza are: Industrial and manufacturing operations including the Stanger Sappi Paper Mill and Sugar Mills in Darnall and Gledhow. Just outside of KwaDukuza, in the iLembe District, is the Isithebe Industrial Estate in the Mandeni area (north of KwaDukuza) and the UThongathi/Maidstone industrial areas in eThekwini (south of KwaDukuza).

[52] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.
[53] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

D.3.4. Transport

KwaDukuza Municipality has strong North-South linkages via the N2 and Provincial road R102. These roads provide key linkages to the main coastal nodes and the main Provincial economic hubs (eThekwini and uThungulu). There are also distinct East-West linkages via the R74 and R614 roads, which connect inland and coastal nodes, as well as other municipalities within the iLembe District such as Mandeni and Maphumulo and beyond (such as uMvoti, Greytown). According to the IDP,[54] Metrorail is the backbone of public transport in KwaDukuza with approximately half (49%) of the population (based primarily inland) which do not have access to any formal mode of transportation.

An Integrated Rapid Public Transport Network (IRPTN) plan is being developed by iLembe District Municipality in conjunction with the Department of Transport (DoT). As a result, it will *inter alia* enable and improve access to and from KwaDukuza. An important component of the IRPTN will be to focus on densifying transportation within the various corridors where higher accessibility exists. In line with other IRPTN projects in South Africa, this will be undertaken using more efficient vehicles and at an affordable rate to residents.

The general presiding poor condition of municipal roads is due to a poor standard of storm-water management and a lack of maintenance. KwaDukuza has since developed its roads and storm water master plan to address constraints related to its infrastructure, in acknowledgment of the fact that flooding impacts are greater when storm water drainage is poor or inadequate.

D.4. Theme Three: Socio-Economic System

D.4.1. Human Health and Wellbeing

The Municipality is serviced by a number of both public and private clinics and hospitals. Administratively, KwaDukuza falls under iLembe District Health Office and is currently managing eight clinics. Key challenges exist in this sector, primarily in state owned facilities, due to funding constraints and a lack of trained staff. There is currently a pending matter on the provincialization of clinics and other health centres run by municipalities.

The Municipality has a high HIV/AIDS infection rate, as exists in the province of KZN, and Tuberculosis and Pulmonary Tuberculosis is listed a primary cause of death. The Municipality aims to undertake a series of Health & Wellness Programmes and to intensity efforts on their KwaDukuza HIV & AIDS Strategy. A Local AIDS council has been established in this regard.

The iLembe District has recently (2013) commissioned a detailed Disaster Risk Study for the region and this has a strong focus on human vulnerability and climate change related disasters which are likely to impact both human health and infrastructure. The District has indicated that this information will be made readily available to KwaDukuza once complete. There are no formal early warning systems currently in effect.

[54] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

In terms of sanitation, poorly maintained, and at times inundated sewage works (from storm events), causes raw sewage to enter streams and rivers. Similarly, unregulated industrial processes often results in pollution entering watercourses. Water pollution has therefore been identified as a key risk to human health for downstream users reliant on natural watercourses for water supply needs (as per 5.1.1 above). Poor waste management in poorly serviced areas (described above – section 5.3.2) is also a key risk to human health and well-being.

Fortunately, KwaDukuza is listed as a malaria-free area.

D.4.2. Working with Business

As described above, KwaDukuza is one of the fastest growing economies in South Africa. It is located along eThekwini-iLembe-uMhlathuze Corridor and it is situated less than 50km outside of the King Shaka Airport and Dube Tradeport which are bringing an increased number of visitors to the area. A strength-weakness-opportunity-threat (SWOT) analysis was undertaken by the Municipality which suggests that it possesses the tools to play an active part in the global economy.[55]

Partnering with business is recognised as a key element to ensuring the success of this statement. The iLembe Chamber of Commerce is very active in this space. In addition, Enterprise iLembe (EI), a Section 21 company which drives development in the District, has been established. It functions outside of the more bureaucratic municipal structures and typically enters into Private Public Partnerships (PPPs) and that are catalytic for the region, e.g. events such as the Prawn and Jazz Festival, Mr Price Pro surf event and developments such as the Sangweni Tourism Centre and a series of Agri-Hubs. In situations where the Municipality finds it increasingly difficult to provide funding and other resources to develop the required infrastructure to adequately exploit the opportunities offered by new developments, EI facilitate/assist greatly in this regard.

Spatially, agricultural activities occur throughout the KwaDukuza area, while commercial local level activities are located in all urban and peri-urban areas; the major commercial and light industrial development is located in the Stanger, Umhlali and Ballito areas, as well as transport corridors linking these centres. Tongaat Hullet have a large presence in KwaDukuza in the form of land ownership and existing (and pending) developments. Planning and partnering with them, as well as other big businesses is key to a more sustainable region.

Industrial and commercial complexes in KwaDukuza are not yet fully attuned to the need to reduce their energy usage and emissions. The IDP recognises the need for a formal auditing and inventorying process to assess the amount of pollutants being released into the atmosphere which to date has not been undertaken. This lack of information means that carbon and carbon-equivalent emission control levels cannot be enforced in the Municipal area. In future, national regulations and the creation of by-laws may greatly assist in the monitoring and enforcing of this.

In terms of tourism, the current primary factors attracting tourists to KwaDukuza include: beaches, culture and wildlife. The KwaDukuza area is very rich in Zulu and Indian heritage and this can be found particularly in the Shakaskraal and Stanger areas. Recreation and eco-tourism related services in the area has significant potential for growth and the Municipality has expressed a will to enhance and extend this sector.

[55] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

D.4.3. Education Awareness and Capacity Building

Education in KwaDukuza is provided through both public and private means. The KZN Department of Education is the mandated custodian of education in KwaDukuza. Education levels are not meeting targeted levels nation wide, with over 58% of the population not having completed high school or higher education[56]. However, in KwaZulu-Natal which is rich in culture and tradition, it is important to recognize all forms of knowledge, including traditional and creative knowledge.

Similarly, while electronic, audio or visual media are an effective means of communication for some citizens, story telling and plays is an equally effective means of communication in other circles.

The Environmental Chapter of the IDP[57] acknowledges that community wellbeing and empowerment must be promoted through environmental education, and the raising of environmental awareness. Environmental education is highlighted foremost as a key project for the IDP planning period (table 5.3) and appears several times in the KwaDukuza Strategic Environmental Assessment Sustainability Framework Matrix developed by the Municipality in 2008.

Table 5.3: Education and Awareness Programme objectives (as listed under matrix of Key Environmental Strategies)

PROGRAMMES	OBJECTIVES	ACTION
Education & Awareness Program	Training of Councilors, Municipal Department's Leaders, service providers, etc. to ensure that sustainability is incorporated within the District at all levels and across functions.	Yearly programme and is ongoing

D.5. Theme Four: Governance

D.5.1. Integration, Planning and Partnerships

The Municipal IDP is the primary planning tool for municipalities and operates on a 5 year planning cycle. Environmental governance does not appear as a distinct power and function of KwaDukuza Municipality in the IDP (Table 5.4). Instead, it is housed under the municipal planning function, which is not unusual for most municipalities – if there is an Environmental Unit at all. The status of Environmental Officials is however, gaining not only momentum but importance, primarily due to new laws and regulations being passed.

[56] Statistics South Africa (2011). South African Census. Pretoria.

[57] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

For example, the National Environmental Management Act (NEMA) 1998 regulations delegate powers to municipalities in terms of approved planning tools for their area of jurisdiction (SDFs, EMFs, MOSS plans etc.) – particularly evident in Listing Notice 3 (GNR 346). The adoption of new municipal by-laws can also arise out of such planning documents. Furthermore, as major landowners, municipalities have an obligation to undertake Duty of Care – and this requires the advice of environmental professionals on a daily basis as municipalities go about service delivery and maintenance of their servitudes, property and critical open spaces. These two examples simply highlight some of the requirements, whether expressed or inferred, of municipalities to fulfil their environmental obligations.

In terms of other government departments operating in KwaDukuza, during stakeholder consultation, it became abundantly clear that communication strategies also need to be enhanced between them. For example, several departments [such as Umgeni Water, Department of Water Affairs (DWA), DEA, EKZNW, Eskom, the disaster risk Unit of iLembe] are undertaking progressive work in areas such as climate change and are not communicating to each other. Thus, opportunities for synergy and collaboration are not realised. If communication between departments improves, opportunities for partnerships are increased.

Table 5.4: Extract from IDP 2012/17 of Municipal Powers and Functions (note that Environmental Management is not explicitly stated, but instead falls under Planning)

1.3. KwaDukuza Powers And Functions

The following are the powers and functions assigned to KwaDukuza

• Air & Noise Pollution • Beaches and Amusement Facilities • Billboards & Display of Advertisements in Public Places • Building, Trading Regulations, Liquor & Public, Nuisance Control • Cemeteries, Funeral Parlours & Crematoria • Child Care Facilities • Cleansing & Trade Areas • Electricity Reticulation • Fencing and Fences	• Fire Fighting Services Licensing, Facilities for Accommodation, Care & Burial of Animals • Local Tourism • Local Amenities • Local Sport Facilities • Markets Stalls / Trade Areas • Municipal Abattoirs • Municipal Planning • Municipal Public Transport • Municipal Parks and Recreation • Municipal Roads	• Pontoons, Ferries, Jetties, Piers & Harbours • Storm Water Management • Pounds • Public, Nuisance Control Fire Fighting Services • Public Places • Pontoons, Ferries, Jetties, Piers & Harbors • Refuse Removal, Refuse Dumps & Solid Waste • Street Trading • Traffic and Parking • Storm Water Management

Source: IDP, 2012

Appendix E. Records of Stakeholder Workshops

E.1. Minutes and Attendance Register of KwaDukuza Meeting

KwaDukuza Climate Change Response Strategy Stakeholder Workshop

Venue: KwaDukuza Town Hall
Date: 26 February 2013
Time: 09h00
Attendees: See attendance register attached as Appendix A.

Mava Ntanta (MN) welcomed all to the meeting and explained the background to the project and the need for it. He introduced the Mott MacDonald project team and handed the floor over to Dr David Viner (DV), the Technical Team Leader for the project.

(Please see Appendix B for a copy of presentation.)

Hazel Dlamini (HD) translated the presentation into isiZulu.

The discussion has been captured as a list of comments and responses in Table 1, below.

Ref	Issue	Identified by	Respondent	Response
1.	For all of these themes, will they have a way forward?	Chimene Pereira (CP)	Mott MacDonald	DV – Yes, a strategy will be developed with a focus on all of these themes.
2	We are a water scarce country, we thus need to preserve water and explore all avenues, eg. Rainwater Harvesting – important for sustaining our community.	Nomusa Xaba (DAEA)	Mott MacDonald/ KwaDukuza Local Municipality (KLM)	DV – Strategy will look at how KLM can better preserve and distribute water to those who need it. HD – Biodiversity and Open Space Management Plan (BosMap) highlights risks with water supplied by one area (Doringkop) – if anything happens to it, water supply will be drastically affected for KwaDukuza. Need stricter policies in place.
3	In terms of Human Settlements, I'm concerned over the quality of housing. Foundations are cracking. How can we ensure this is avoided?	Shama Sanadeo	Mott MacDonald/ KwaDukuza Municipality	DV – Comes down to construction methods, design of buildings, quality of the materials used or the areas they are constructed in (high water tables for example). HZ – Added that there are more appropriate places to develop. eg: coastal Vulnerability Index (CVI) shows places that should not be developed on the coast (vulnerable places). Perhaps a similar tool could be

				developed for housing. DV – any pictures will help – please send/email to us.
4	I'd like to see KLM having more awareness of the high water mark. I think this needs to come out of the Climate Change Response Strategy (CCRS).	S P Funeka (DAEA)	Mott MacDonald/ KwaDukuza Municipality	DV – Avoid building in areas with a high water table (site specific study / KLM wide study is needed for this, eg. Geotechnical study) and any other options to increase drainage. CCRS doesn't delve into this in detail. HD – Clarified that this study will indicate further areas identified for further study. Actions will be prioritized through the CCRS. Not very site specific. A need for further ground-truthing may be identified.
5	Item 6 (waste) is a huge issue in local areas – not properly collected. KLM needs to tighten it up! I want it noted that it should be sorted at source and separated (especially in places that have no services).	Philisiwe Ndlovu	KwaDukuza Municipality	HD – Noted.
6	Collection of waste from households is not adequate and KLM is slacking.	BP	Mott MacDonald	DV – Noted.
7	Land fill gas and methane levels should be measured and harvested.	Ward Rep	KwaDukuza Municipality	HD – Agreed, methane is a very powerful greenhouse gas (GHG) and should be harvested and used instead of being released into the atmosphere.
8a	There are many links across sectors, e.g. water quality impacts on human health and well-being and even agriculture. A holistic approach needs to be taken to sector responses.	CP	Mott MacDonald	DV – Agreed. Climate Change must be mainstreamed.
8b	Business & Tourism is huge in terms of emission impacts.	CP	Mott MacDonald	DV – Agreed, and Tourism may improve due to expected "good climate" in KLM, compared to other regions.
9	Will Business As Usual (BAU) be considered for each theme?	CP	Mott MacDonald	DV – Yes and energy will be a huge element – we need to mitigate enough to avoid projected BAU scenarios.
10	Peak oil prices means food prices will also go up	CP	Mott MacDonald	DV – Noted and agreed.

11	KLM should not be viewed / studied in isolation.	CP	Mott MacDonald/ KwaDukuza Municipality	DV – Noted. HD – Asked attendees to please keep emailing issues and comments and stated that participation in the CCRS process does not stop here. HD - mentioned ICLEI and their involvement in facilitation KLM with GHG reductions. Environmental monitoring forum and Lower Tugela Biodiversity Group needs to engage with the CCRS too. Please send comments by the 8th March 2013. Draft will be provided to all for comments and we will discuss at next Environmental Monitoring Forum Meeting. DV – requested members to please mark up areas of concern on map provided.

HD thanked everyone for attending and requested that they contact her or Mott MacDonald with any further queries. She also requested that any further comments should be submitted by the 8th March 2013 to;

Jessica Brislin Tel: 031-5664368 Email: jessica.brislin@mottmac.com

Pravina Govender Tel: 031-5664368 Email: pravina.govender@mottmac.com

Meeting was closed at 11h25.

KWADUKUZA CCRS PUBLIC MEETING: 26 FEBRUARY 2013 — KWADUKUZA MUNICIPALITY — Mott MacDonald — **LOCATION:** KWADUKUZA

NAME	SURNAME	ORGANIZATION	DESIGNATION/ TITLE	ADDRESS	CONTACT NO		EMAIL ADDRESS
Dumisani	Mhlongo	DEDT	Regional Manager	270 Jabu Ndlovu St Pmburg	033 264 2780	0716892778	mhlongod@kzndted.gov.za
Catherine	Zulu	Dept		16a Dube Tollgate	0833722789		
Chimene	Pereira	KDM	Chief Planner	Unit 12 Colenmore 30 Youngs Avenue Dbn	0324375066	0837653789	Chimenep@kwadukuza.gov.za
Shamq	Samadeo			WARD 13	0845481958		
Philisiwe	Ndlovu	W.t. Environmental		15	0765897591		
Mervyn	Krishna	Wakky		Wakky	0823680903		mervynkrishna@gmail.com
Jessica	Brill	MMA	Env Consultant	Unit 7 Rydalvale Park, Douglas Saunders Drive, La Lucia Ridge	031 566 4368		jessica.brill@gmail.com
Dr David	Vine	MM	Principal Advisor CC	Dencter House Cambridge UK	+44 1500 075 605016		david.vine@mottmac.com
Pravina	Govender	MM	Planning Consultant	Rydall Vale Park, La Lucia	031-5664368	0824119853	pravina.govender@mottmac.com

KWADUKUZA CCRS PUBLIC MEETING: 26 FEBRUARY 2013

KWADUKUZA MUNICIPALITY

Mott MacDonald

LOCATION: KWADUKUZA

NAME	SURNAME	ORGANIZATION	DESIGNATION/ TITLE	ADDRESS	CONTACT NO		EMAIL ADDRESS
THEMBEKA	MTHULI	KWADUKUZA MUNICIPALITY	SENIOR ENVIRONMENTAL OFFICER		076 331 4306		thembeka.mthuli@gmail.com
Nontando	Shandu	KDM	Enviro Intern	Stanger	078 413 1424	032 946 8065	ntandos@kwadukuza.gov.za
Jasmine	Arcop	Ward Committee Enviro. Rep.		Stanger	082 429 6487		
MAVA	MTANTA	KDM	DIR – DEV PLAN	KWADUKUZA	082 301 0459		mavan@kwadukuza.gov.za.
Nomusa	Xaba	DAEA	Assistant Manager		032-437 7500 082 820 2511		nomusa.xaba@kzndae.gov.za
S. P. ~~FUNEKA~~	Funeka	DAEA - Ilembe office	Ass. Manager.	P/Bag x 10691 KwaDukuza, 4450	032 437 7500/1 0825896122		S.funeka@kzndae.gov.za
BORIS M.	Buthelezi	KDM	WC	BORIS'U 9 Stanger 4450	083 474 0479		-
MANDLA	MCANTANA	KDM	WEM.	68 Valley View KWADUKUZA	0727823928		
NOMUSA	Dlamka				0730842664		
CATHERINE S.	Zulu	Ward Committee Enviro-Rep	Dept 86	16 on Dube Toll gate Kwadukuza	0833722799	Tkembe	
NOTHANDO	MSOMI	KMD ENVIRO	ENVIRO INTERN	KWADUKUZA	0731166513		nothandomsomi@gmail.
Bayisile	Phasi	KDM	W/C.	KWADUKUZA	0781049246	WARD 26.	-
NELISA	MSOMI	KDM	TOWN PLNTECH	KWADUKUZA	0710935585		NelisaM@kwadukuza.gov.za
Fokko	Fokkens.	Gledhow Blyfkedale	Manager. Envig. Projects	Box 830 STANGER 4450	082 774 1597		squarefox@saol.com

Mphoko M. ~~ENVIROM~~ 072 013 2123 ward 24

E.2. Minutes and Attendance Register of Ballito Meeting

KwaDukuza Climate Change Response Strategy Stakeholder Workshop

Venue: Ballito Council Chambers
Date: 26 February 2013
Time: 14h00
Attendees: See attendance register attached as Appendix A.

Hazel Dlamini (HD) welcomed all to the meeting and explained the background to the project and the need for it. She introduced the Mott MacDonald project team and handed the floor over to Dr David Viner (DV), the Technical Team Leader for the project.

(Please see Appendix B for a copy of presentation.)

No translation was required at this meeting.

The discussion has been captured as a list of comments and responses in Table 1, below.

Ref	Issue	Identified by	Respondent	Response
1	I want to caution people to a caveat in the White Paper on Climate Change. While the targets are ambitious, it hinges heavily on whether the Northern Hemisphere gives us money to do so.	Terry Bengis (TB)	Mott MacDonald	DV - Noted
2	In terms of a GHG inventory, eThekwini has done great work. iLembe unfortunately hasn't had the money to do so. South African Local Government Association (SALGA) has set aside approximately R30 million for this.	TB	Mott MacDonald	DV - Noted
3	At a local planning level, why are we not insisting on solar panels on the roof of each new building? It is a huge opportunity lost. Instead, ESKOM is spending R360 million on importing and installing new electrical cables. There's also interest charged on this loan.	TB	Mott MacDonald	DV - Noted.
4	In terms of transport, taxi industries need to stop being politicized. There is a biodiesel plant in Mandeni which is no longer operating due to lack of demand.	TB	Mott MacDonald	DV – An incentive needs to be looked at like Clean Development Mechanisms (CDMs)
5	In South Africa, approximately only 20 CDMs have been undertaken (one was by SAPPI). The GCE is a local South African version you should look into.	TB	KwaDukuza Municipality	HD – In addition, we must remember the requirement for energy efficiency in buildings in terms of new building regulations.

6	Buildings need to be designed to be cooler in summer and warmer in winter.	Phumlani Shamase	KwaDukuza Municipality	HD - Agreed.
7	We have enough wind and warmth and yet nothing is happening to harness this energy. Three wind turbines could provide KwaDukuza Local Municipality (KLM) with the base loads it needs – but we have to fit under the REFIT / REIPPP programme which has bid windows only once a year. If Council makes money out of electricity, then why not install their own facilities? They have rates and taxes to fall back on.	TB	KwaDukuza Municipality	HD – Agreed that we need to interrogate revenue aspects and arguments.
8	Peaking power plant proposed in KLM creates no local jobs, needs fossil fuels to be brought into the area from afar and will lead to the destruction of a sensitive area. Ironically, it is situated next to a sugar mill which can supply energy from bagasse.	Di Jones (DJ)	KwaDukuza Municipality	HD – Noted, thank you.
9	The New Disaster Risk management offices were destroyed in a flood (2009) and are being rebuilt there. It's in a flood plain. Why are we building on the same site ?	DJ	KwaDukuza Municipality	HD – A question might be: can or should we expropriate or zone for no development in these areas?
10	National Environmental Management Act (NEMA) case law is useful and trumps anything.	TB		HD – Noted.
11	I am concerned about high staff turnover in KLM – the mayor who was driving climate change action once is no longer the mayor.	DJ	KwaDukuza Municipality	HD – Noted.
12	Town Planning is such an important function of the municipality because officials can control and prevent development in/adjacent to wetlands and coastlines which are critical resources.	DJ	KwaDukuza Municipality	HD – Noted.
13	Sugar and paper mills produce their own electricity. Why can't we do that for ourselves and be autonomous? I wil take this up with my provincial climate change committee.	TB	KwaDukuza Municipality	HD – Noted and agreed.
14	The Department of Mineral Affairs (DME) would oppose the above suggestion because there would be a loss of jobs in the coal mining sector.	DJ	KwaDukuza Municipality	HD – Noted.
15	The tunnels at Dube Tradeport have equipment that can read the electricity usage at any given point and they recycle their water on site.	DJ	KwaDukuza Municipality	HD – Suggested the Municipality ensure all new buildings in KDZ get green star ratings or similar to ensure energy efficiency as with Dube Tradeport. I myself wonder why solar technology has not taken off here yet – are we in the absence of good local solar

				technology?
16	Eskom needs to provide incentives around solar technology.	TB	KwaDukuza Municipality	HD – Agreed. That also speaks to the integration of the planning and partnerships theme.
17	Land swaps can and do happen – we should use that platform more often.	DJ	KwaDukuza Municipality	HD – Noted. We should also aim to identify hotspots for climate change adaptation and/or mitigation.
18	The Coastal Vulnerability index is very useful.	DJ	KwaDukuza Municipality	HD – Agreed.
19	There are nine rivers in iLembe and seven water treatment works on those rivers that are not functioning correctly. KLM need to ascertain the capacity of these installations before anymore development comes online. There also needs to be better enforcement.	DJ	KwaDukuza Municipality	HD – Agreed.
20	I am the Manager of Disaster Risk Management for iLembe and I will be the client and user of the building. Di, your concerns are being addressed by experts and the MM himself is giving it attention. We acknowledge that it is in a floodplain and your concerns are noted.	Sifiso Ngubane (SN)	DJ	Thank you.
21	It would set a bad example if it goes ahead.	Leon Groenveld	SN	Noted. We may look at better drainage and attenuation on site.
22	I am planning the Climate Change summit this year for iLembe. In addition, we have commissioned a ward specific risk assessment and are exploring climate change risk interventions. Please use me as a resource.	SN	Mott MacDonald/ KwaDukuza Municipality	Noted – thank you.
23	I'm concerned that the CCRS will be another tick in the box.	DJ		JB – We note your concerns. We have a wealth of information to build from (including the findings of our neighbor eThekwini's Cost-Benefit Analyses) and this will ensure that the document is relevant and that proposed strategies are achievable.

HD thanked everyone for attending and requested that they contact her or Mott MacDonald with any further queries. She also requested that any further comments should be submitted by the 8th March 2013 to;

Jessica Brislin Tel: 031-5664368 Email: jessica.brislin@mottmac.com

Pravina Govender Tel: 031-5664368 Email: pravina.govender@mottmac.com

Meeting was closed at 16h20.

KWADUKUZA CCRS PUBLIC MEETING: 26 FEBRUARY 2013 — **LOCATION:** Ballito

NAME	SURNAME	ORGANIZATION	DESIGNATION/ TITLE	ADDRESS	CONTACT NO		EMAIL ADDRESS
Leon	Groenveld	Ocean Gorge Accommodation	Owner	53 Ocean Drive Shaka's Rock	0325255760	0827983522	leon@oceangorge.co.za
MAUREEN	HOFTHOUSE	DOLPHIN COAST CONSERVANCY	TREASURER	9 Lords End, Ballito, Box 248, Ballito	0329460367	072 5198721	maureenterry12@gmail.com
T. BENGIS.		Premiers Council for Climate Change and Sus. Development	Council Adaptation + Mitigation	15 Delphi close Salt Rock.	0732497017	0325255600	kerrymbo@webmail.co.za.
P.G.	GUNNING	ANGLICAN DIOCESE OF NATAL	RECTOR OF MAIDSTONE	62 SAN JEREZ SEAWARD ESTATES POSTNET 106: PRIVATE BAG X001 BALLITO	083-441-1950	032-586-3380	saints111@telkomsa.net.
~~S~~ Sifiso ~~Ngubane~~	Ngubane	iLembe Disaster Management	Manager;	59/61 Mahatma Ghandi Street	032 437 9319	071 879 7155	sifiso.ngubane@ilembe.gov.za
Nomonde	Ndlela	kwa-dukuza	Admin-Town/P	GR117 Groutville	0329468082	073 308 151	nomonden@kwadukuza.gov.za
NOTHANDO	MSOMI	KDM Environ.	Enviro Intern	KWADUKUZA	0731166513		nothandomsomi@gmail.com
Nontando	Shandu	KDM	Enviro Intern	kwaDukuza	0784131424	032 946 8064	NtandoS@kwadukuza.gov.za
Amanda	Mbokazi	KDM	Outdoor Advertising Admin	KwaDukuza Municipality 10 Leonora Drive - Ballito	079 318 3033	032 946 8000	amandaM@kwadukuza.gov.za
PHUMLANI	SHAMASE	KDM BUILDING CONTROL	BUILDING INSPECTOR	KDM 10 LEONORA DRIVE - BALLITO	0835463211	032 946 8000	PHUMLANIS@KWADUKUZA.GOV.ZA
Sne	Msimang	KWADUKUZA MUNICIPALITY	Town Planner	10 LEONORA DRIVE - BALLITO	0827914874	032 9468000	snenhlanhlaM@kwadukuza.gov.za
Pravina	Govender	Mott MacDonald	Planning Consultant	Rydall Vale Park, Lahlaa	0824119853	031-5664368	pravina.govender@mottmac.com
Jessica	Brslin	MMSA	Env Consultant	" "	031 566 4368		jessica.brslin@mottmac.com

KWADUKUZA CCRS PUBLIC MEETING: 26 FEBRUARY 2013

LOCATION: Ballito

NAME	SURNAME	ORGANIZATION	DESIGNATION/ TITLE	ADDRESS	CONTACT NO		EMAIL ADDRESS
Nkopodi	Nkopodi	Tongaat Hulett	Development Executive	305 Umhlanga Rocks Dr, La Lucia, 4051	031 560 1949	083 448 4917	nkopodi.nkopodi@tongaat.com
SPHE	NGOBESE	KDM	communications	14 CHIEF ALBERT LUTHULI STR, STANGER 4450	032 437 5046	073 7847822	sphelelo.N@kwadukuza.gov.za
Di JONES	JONES	Dolphin Coast Conservancy Coastwatch	Environmental	Box 1586, Ballito 4420	032-3258160	083-6120859	dijones@iAFRICA.com
Dr David	Viner	MM	Principal Advisor CC	Demeter House Cambridge UK	+44 7500 605416		david.viner@mottmac.com

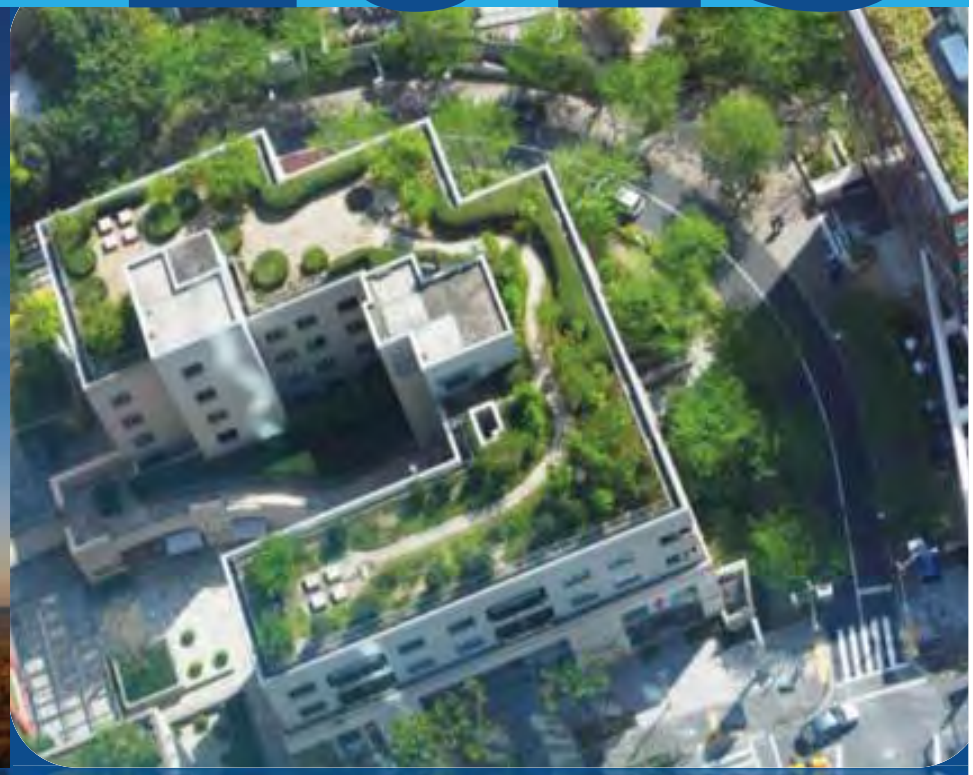
E.3. Example of Presentation Made

Annexure B

Sub Saharan Africa
Mott MacDonald

KwaDukuza Climate Change Response Strategy

2013



Stakeholder Engagement Workshop
26 February 2013

KWADUKUZA MUNICIPALITY

Mott MacDonald

Project Context

- Municipality acknowledges that it will face risks associated with climate change
- Need to plan better for the future in a precautionary manner
- Climate change a must be a key consideration in the long term, sustainable management of the Municipality's operations
- First step: development of a CCRS

Mott MacDonald

Adaptation and Mitigation

- Mitigation – preventing climate change, by reducing emissions of greenhouse gases (GHGs)
- Adaptation – living with climate change to minimise detrimental impacts

Mott MacDonald

Starting principles

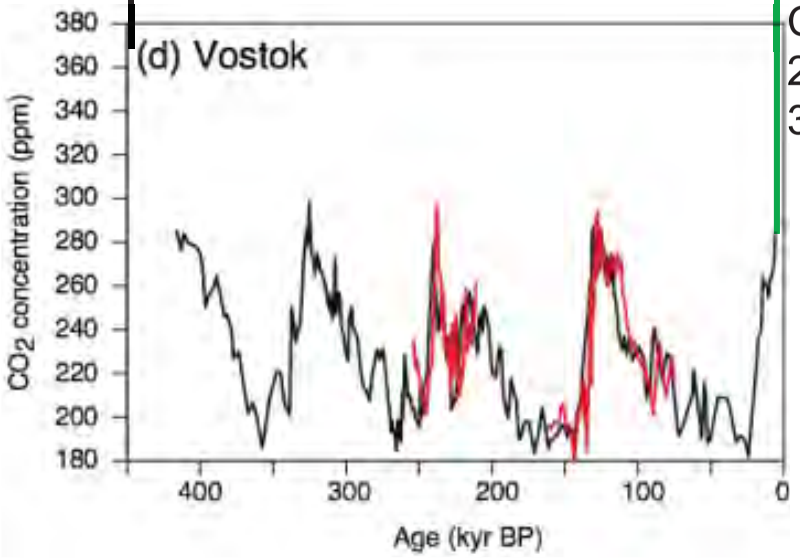
- Actions we can start now – not requiring new policy or legislation
- No regrets – they would be good things to do even if we did not face climate change
- Set the direction of change not the final destination

Mott MacDonald

21st C mid estimate 780

21st C high estimate

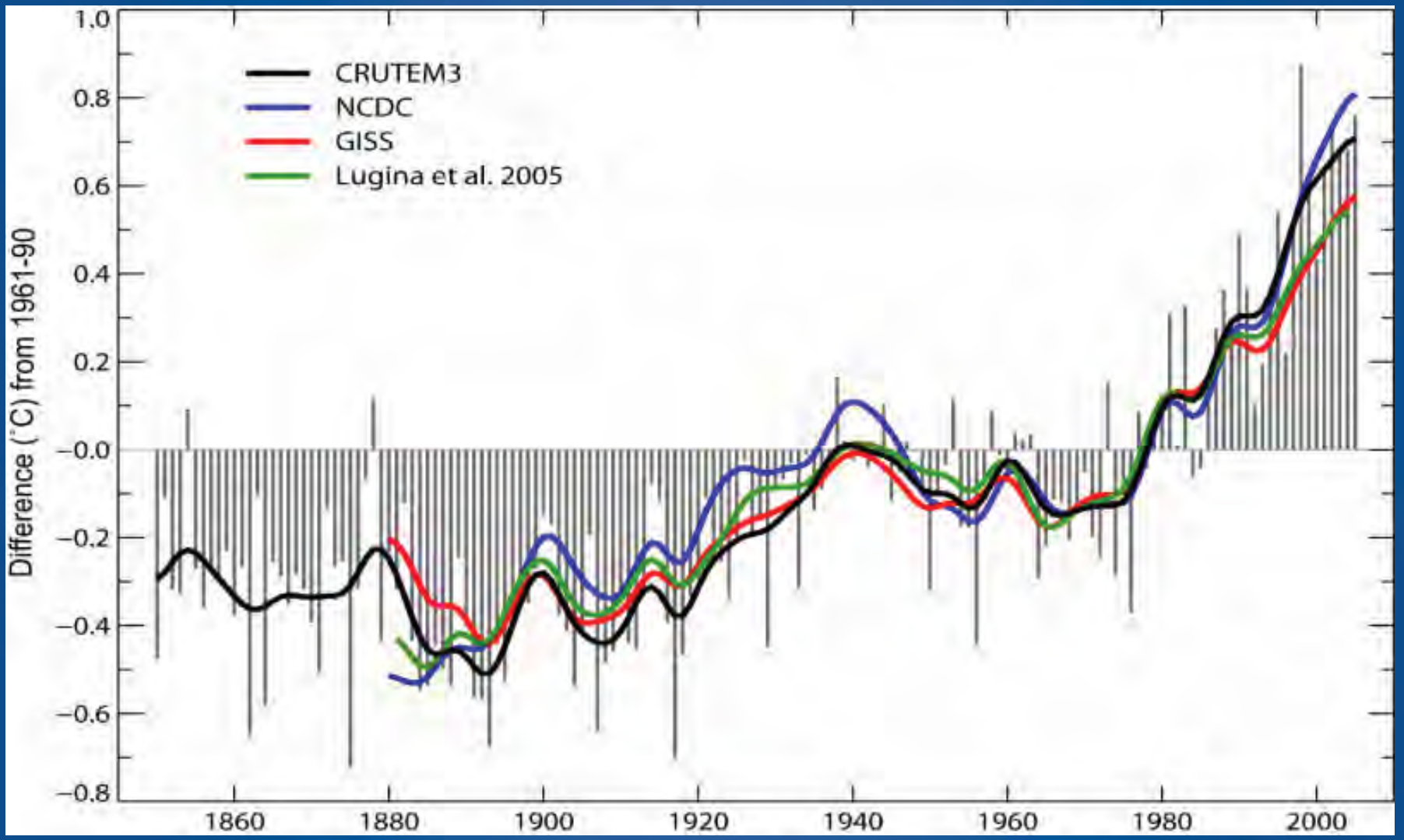
21st C low estimate 580



Current Level
2011 -
390.9ppm

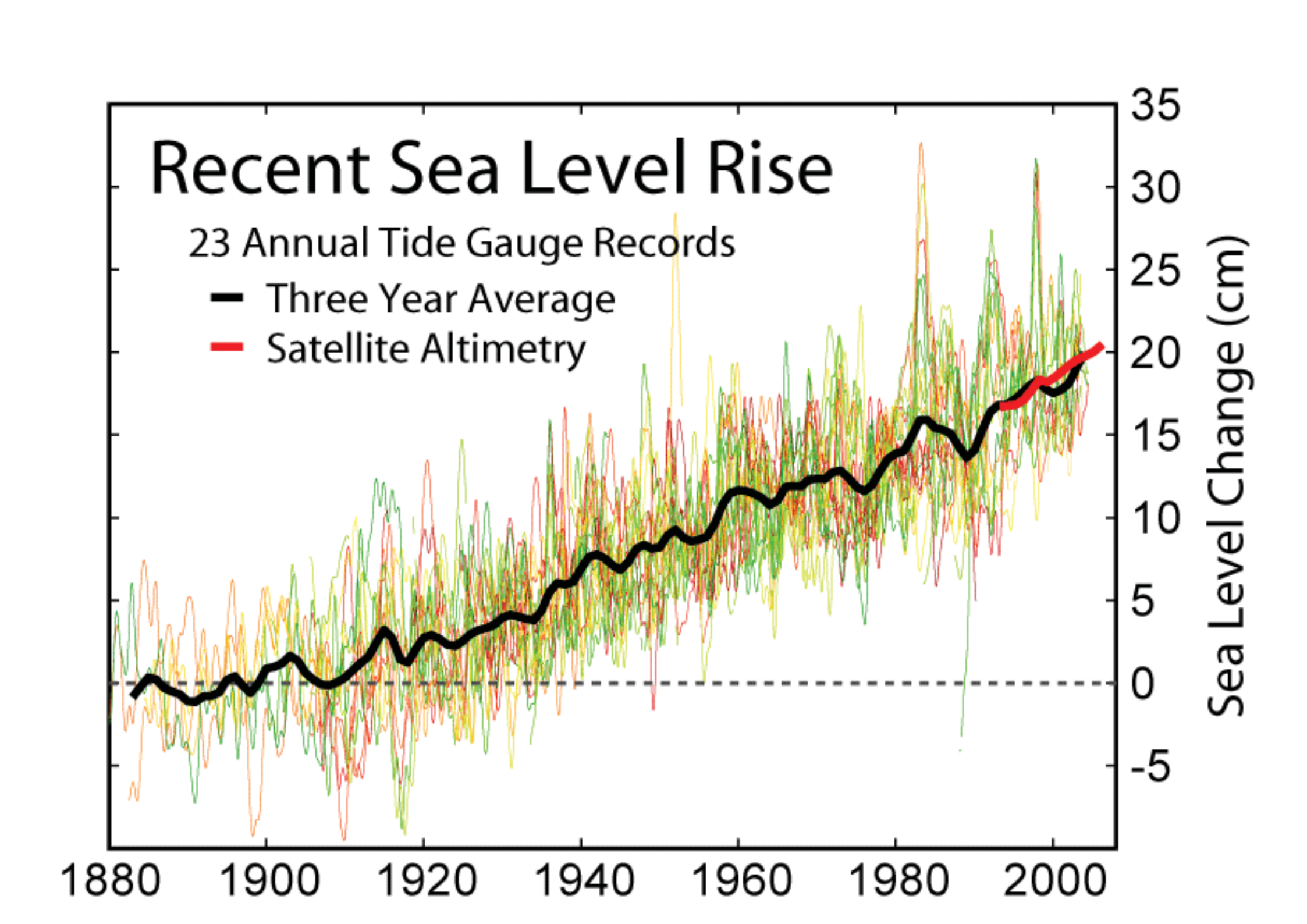
Current carbon dioxide concentrations are geologically incredible.

CRU work compared with other analyses of land-based temperatures



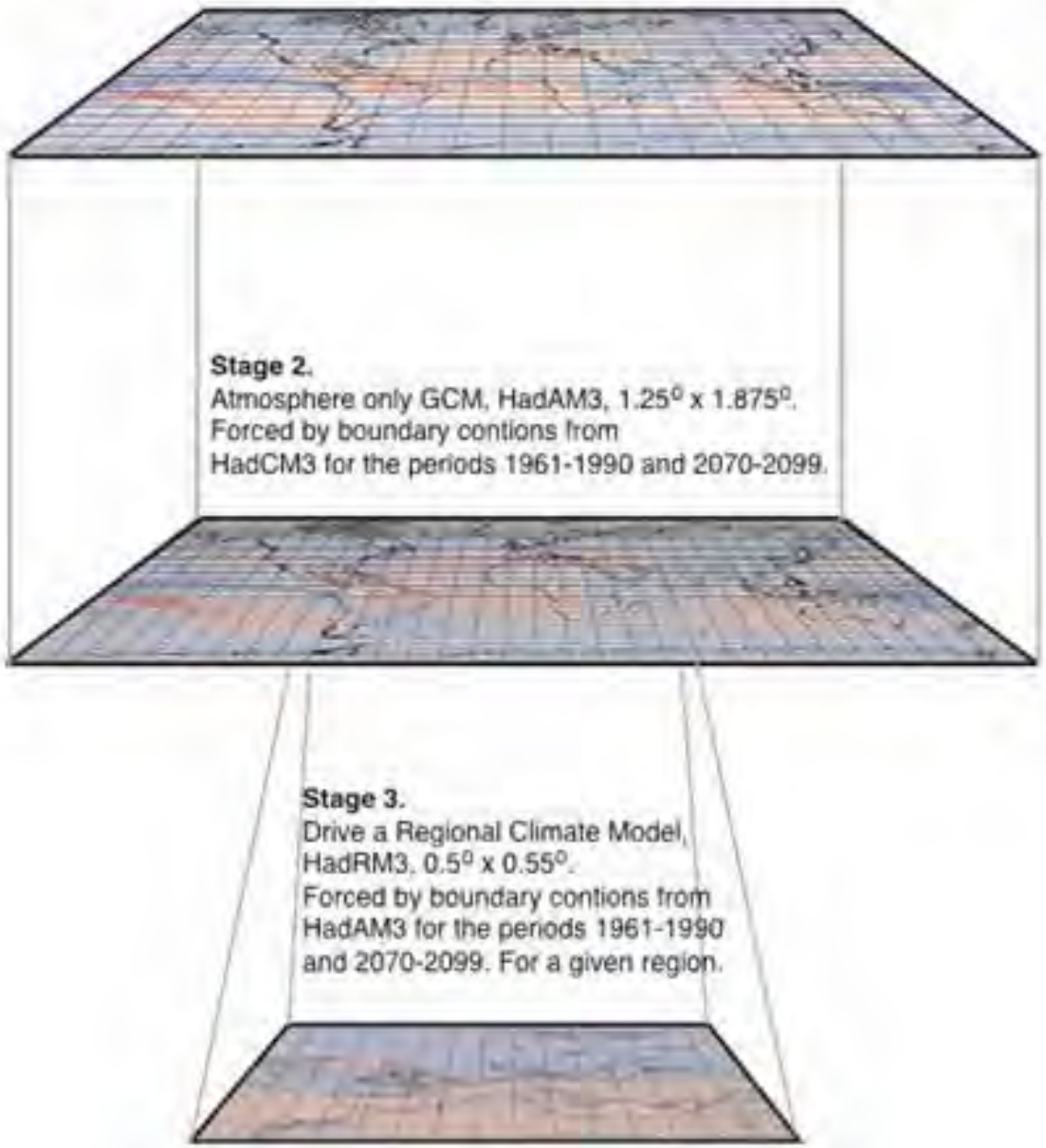
Annual anomalies of global land surface air temperature (°C), 1850 to 2005, relative to the 1961–1990 mean

Mott MacDonald


Recent Sea Level Rise
23 Annual Tide Gauge Records
Three Year Average
Satellite Altimetry
35
30
25
20
15
10
5
0
-5
Sea Level Change (cm)
1880
1900
1920
1940
1960
1980
2000

GCMs

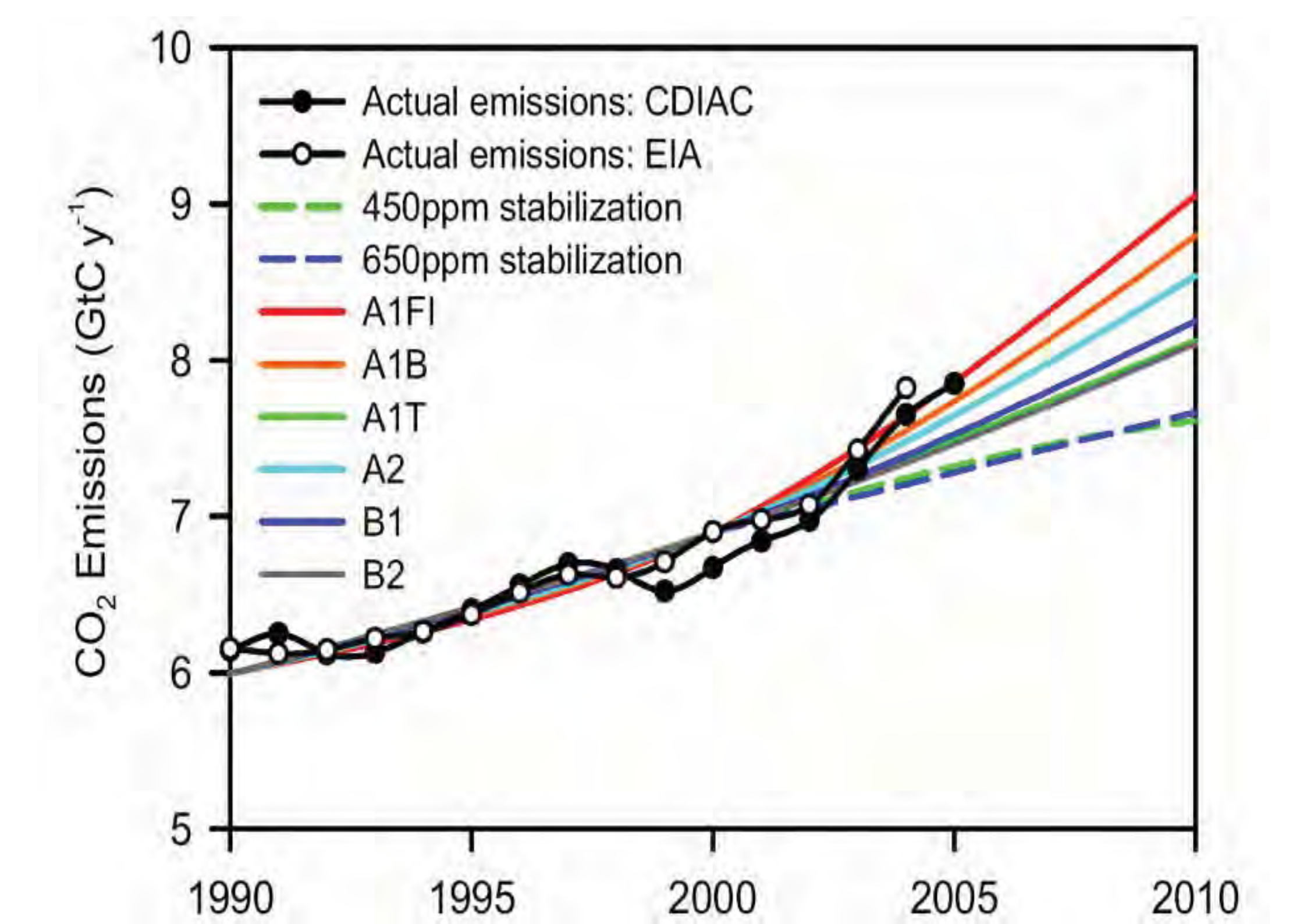
Stage 1.
Coupled ocean-atmosphere GCM,HadCM3 2.5^0 x 3.75^0, Historically forced from 1860-1990, then to 2100 with a future forcing scenario.



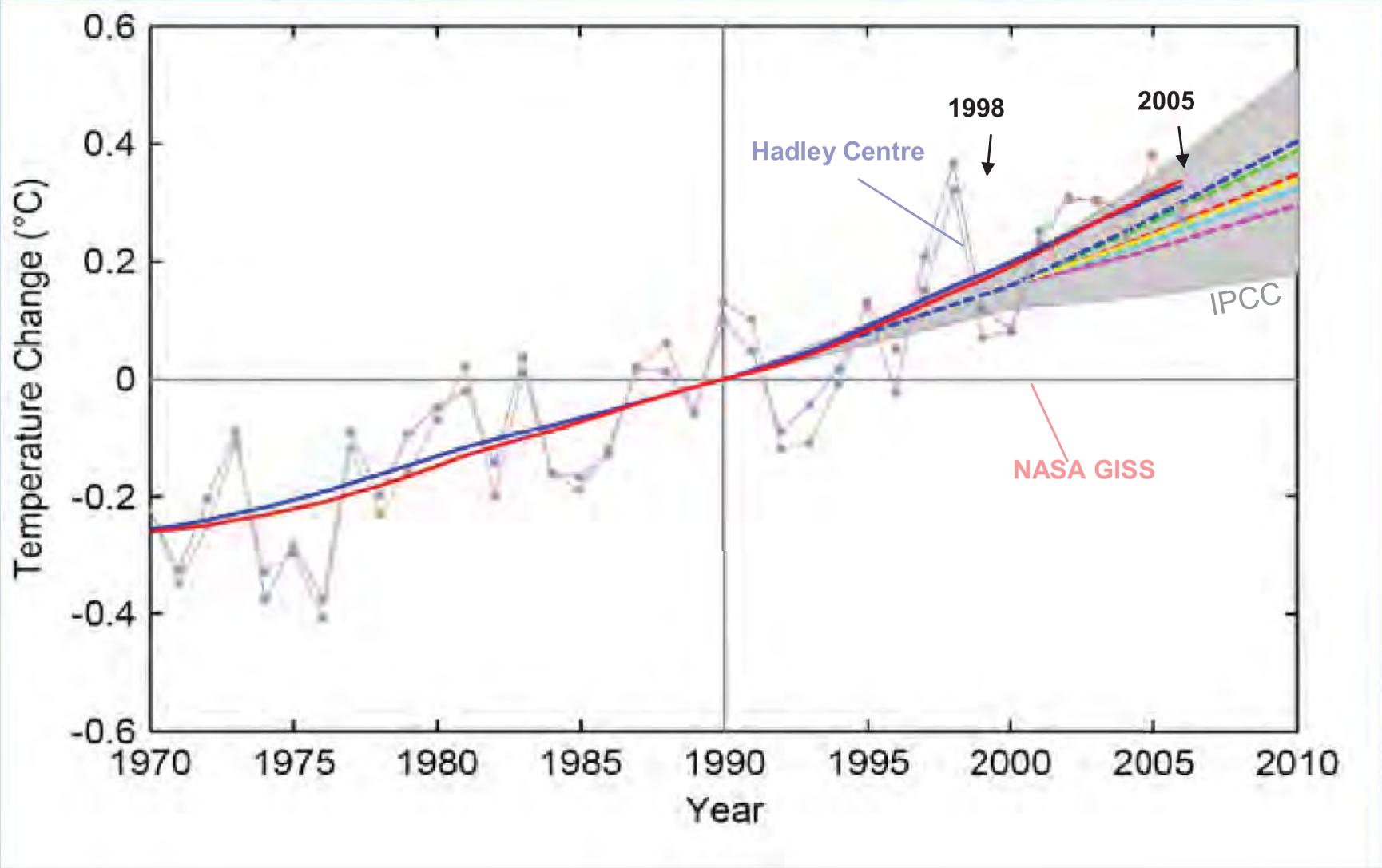
Stage 2.
Atmosphere only GCM, HadAM3, 1.25^0 x 1.875^0.
Forced by boundary contions from HadCM3 for the periods 1961-1990 and 2070-2099.

Stage 3.
Drive a Regional Climate Model, HadRM3, 0.5^0 x 0.55^0.
Forced by boundary contions from HadAM3 for the periods 1961-1990 and 2070-2099. For a given region.

Mott MacDonald


10
9
8
7
6
5
1990
1995
2000
2005
2010
CO_2 Emissions (GtC y^{-1})
Actual emissions: CDIAC
Actual emissions: EIA
450ppm stabilization
650ppm stabilization
A1FI
A1B
A1T
A2
B1
B2

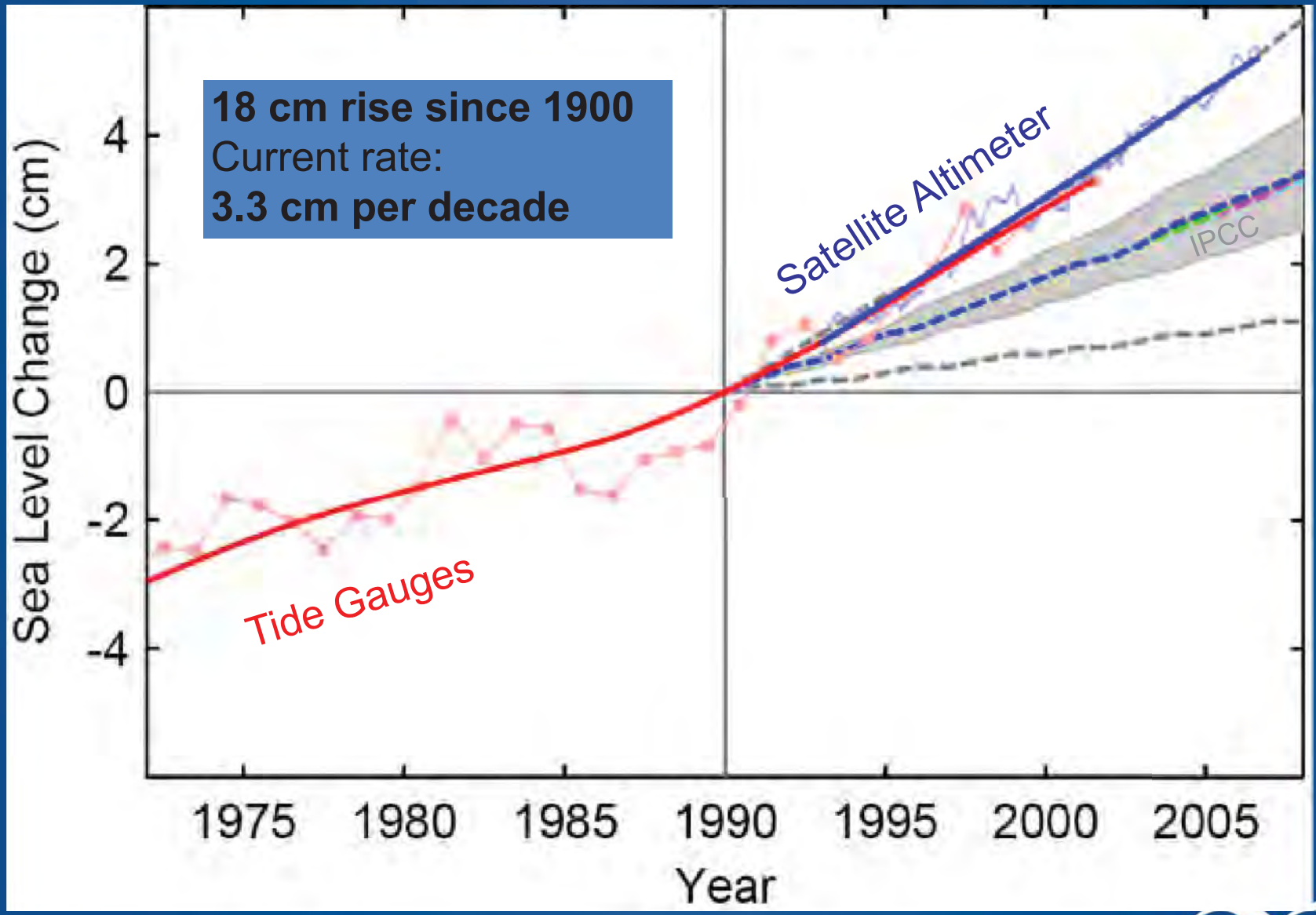
Observed Warming



Rahmstorf, Cazenave, Church, Hansen, Keeling, Parker and Somerville (Science 2007)

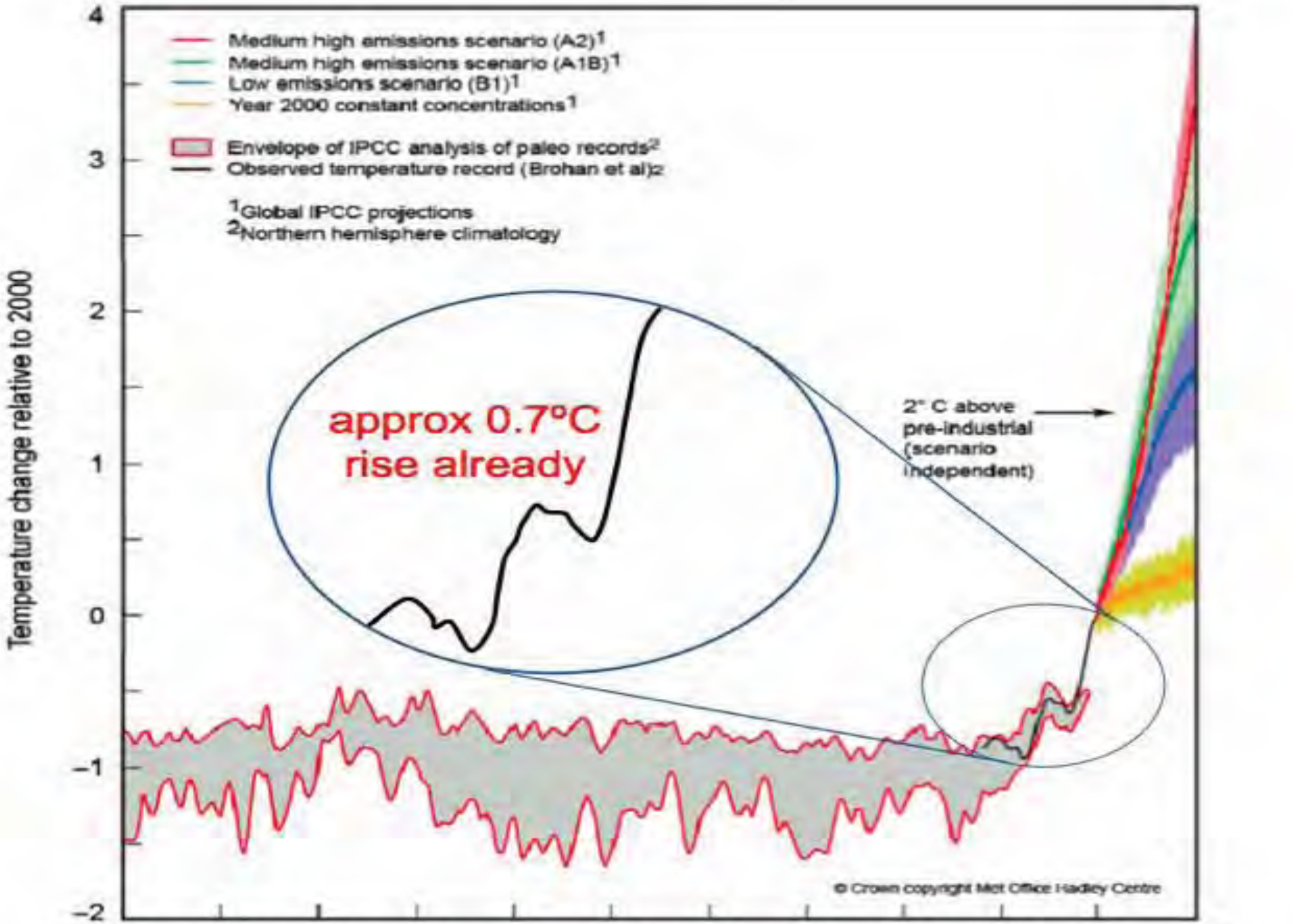
Mott MacDonald

Observed Sea Level Rise



Rahmstorf, Cazenave, Church, Hansen, Keeling, Parker and Somerville (Science 2007)

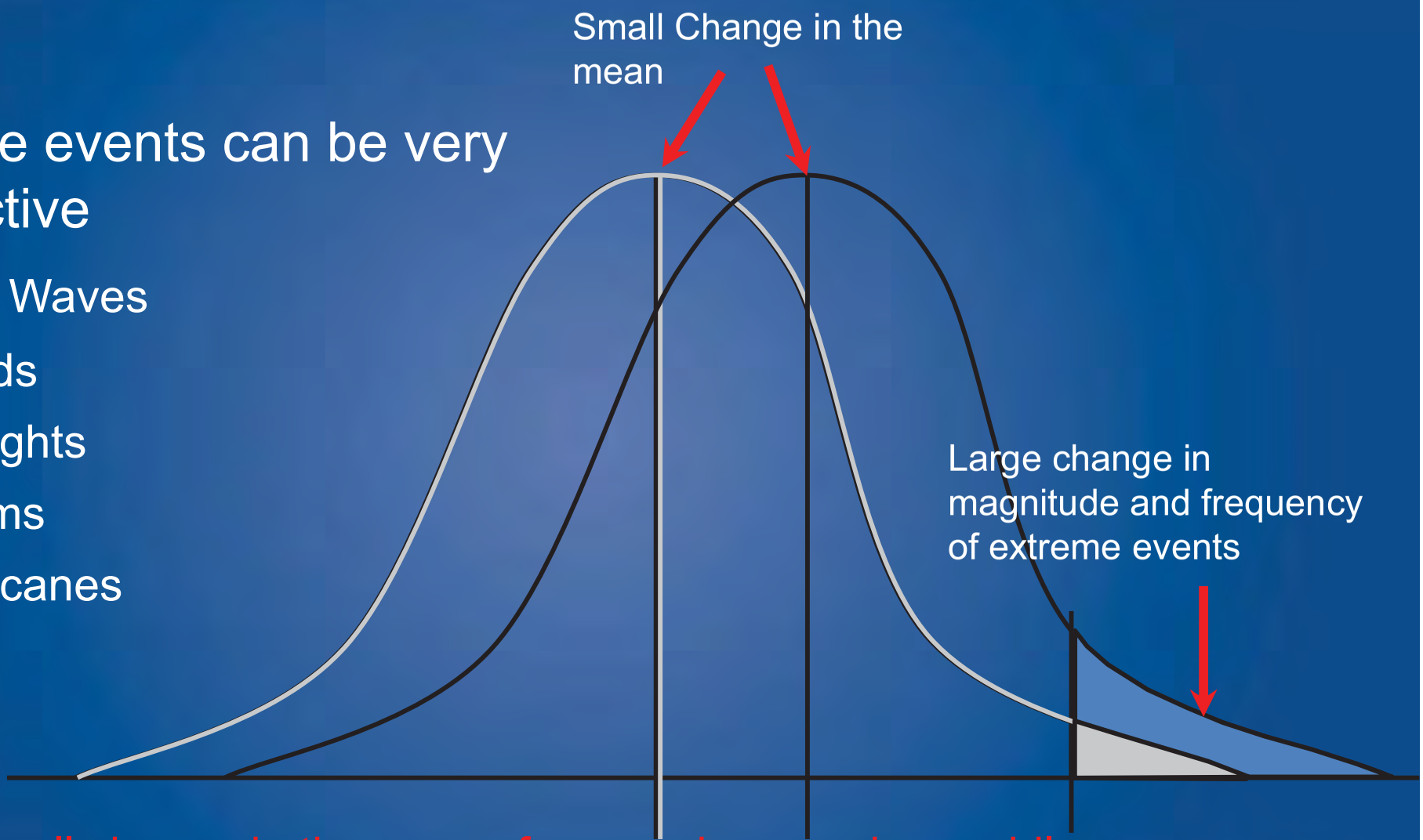
Mott MacDonald


Medium high emissions scenario (A2)[1]
Medium high emissions scenario (A1B)[1]
Low emissions scenario (B1)[1]
Year 2000 constant concentrations[1]
Envelope of IPCC analysis of paleo records[2]
Observed temperature record (Brohan et al)[2]
[1]Global IPCC projections
[2]Northern hemisphere climatology
approx 0.7°C rise already
2° C above pre-industrial (scenario independent)
Temperature change relative to 2000
4
3
2
1
0
−1
−2
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
© Crown copyright Met Office Hadley Centre

Changes in Extreme Events

Extreme events can be very destructive

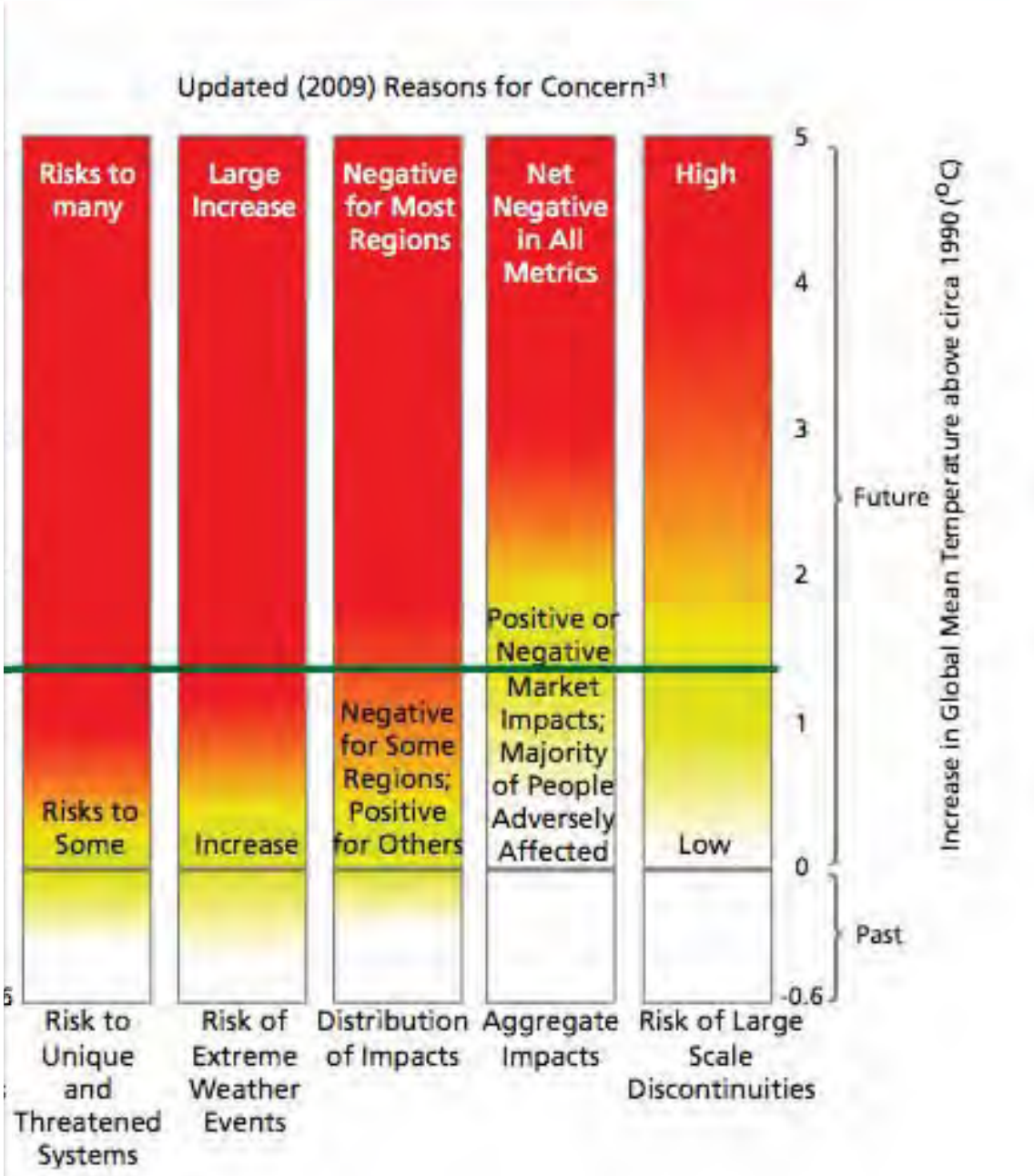
- Heat Waves
- Floods
- Droughts
- Storms
- Hurricanes



With a small change in the mean, frequencies can rise rapidly

Mott MacDonald

What level of climate change is dangerous



l impacts of climate change to the rise in global average temperature. Zero on the temperature scale corresponds approximately to 1990 average temperature, and the bottom of the istrial average temperature. The level of risk or severity of potential impacts increases with the intensity of red colour. The 2°C guardrail is shown for reference.

MacDonald

Importance of Local Planning



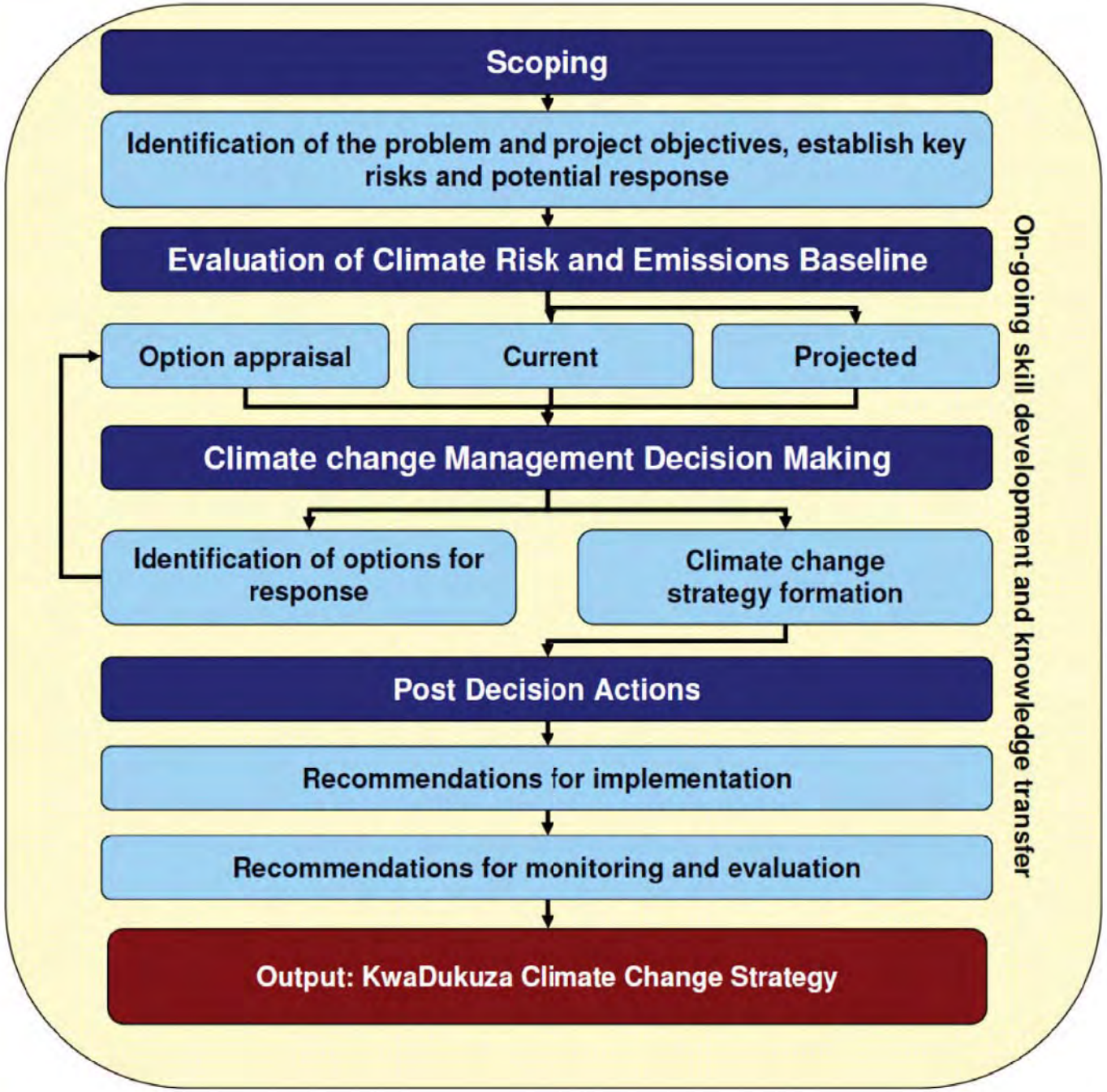
- Think Globally – Act locally

  "*Local government is where the rubber hits the road when it comes to responding to the human impacts of climate change*." - Margareta Wahlström, UN Secretary General for Disaster Risk Reduction

- White Paper places responsibility on Local Government to respond and act
- Aligns with iLembe District's goal of positioning itself as a green economy hub

Mott MacDonald

Methodology



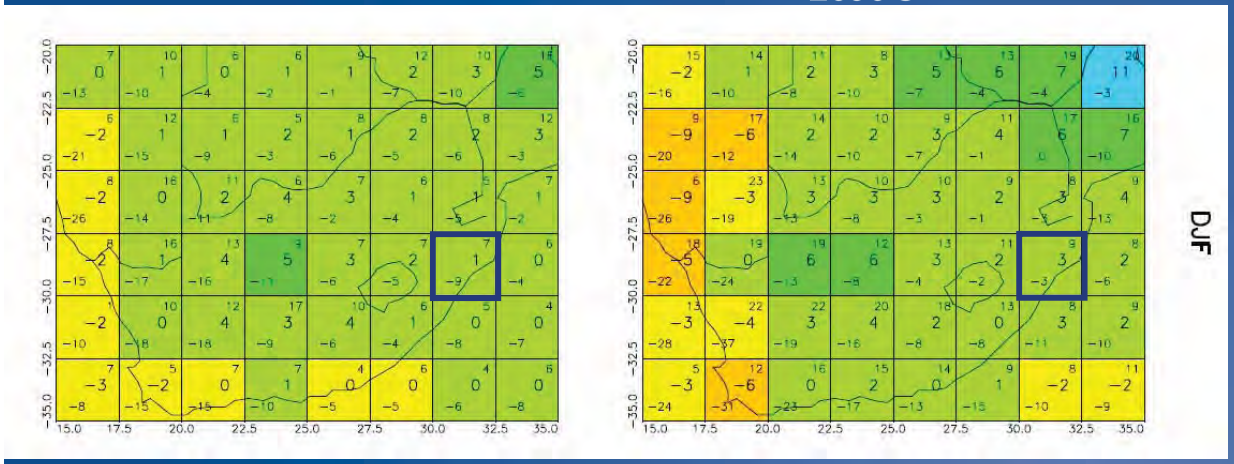
Stakeholder Engagement and Skills Transfer

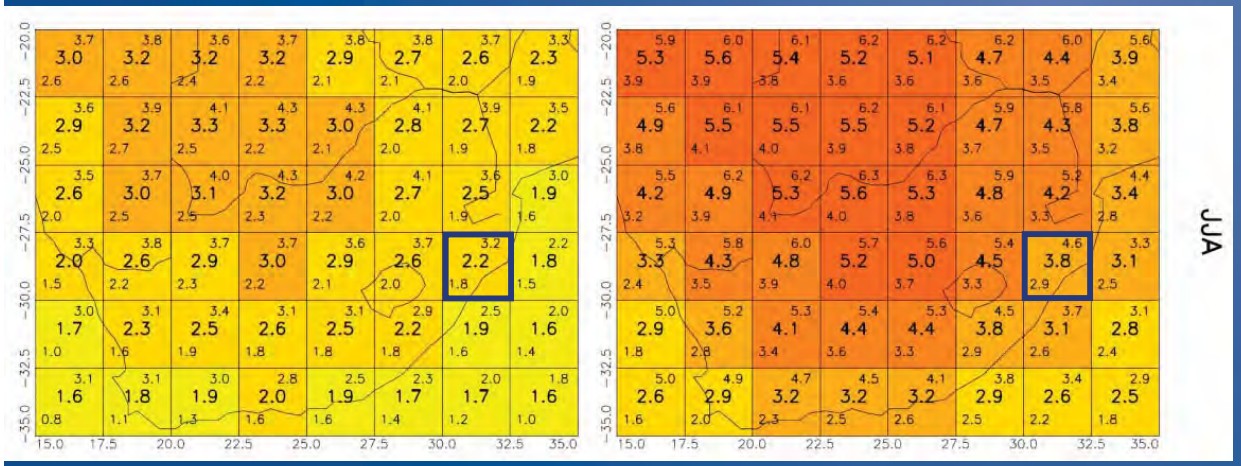
Mott MacDonald

Local Climate Change Predictions

2060's

2090's

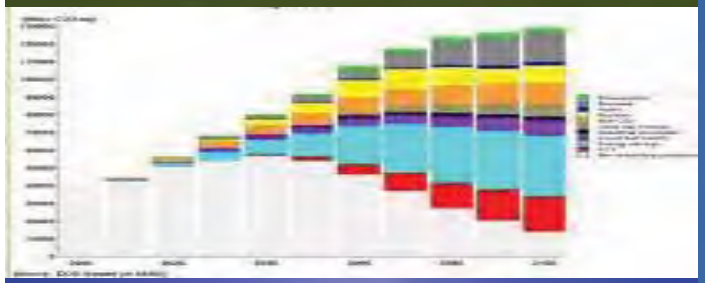




- % change in heavy rainfall events
- Change in mean temperature

Mott MacDonald

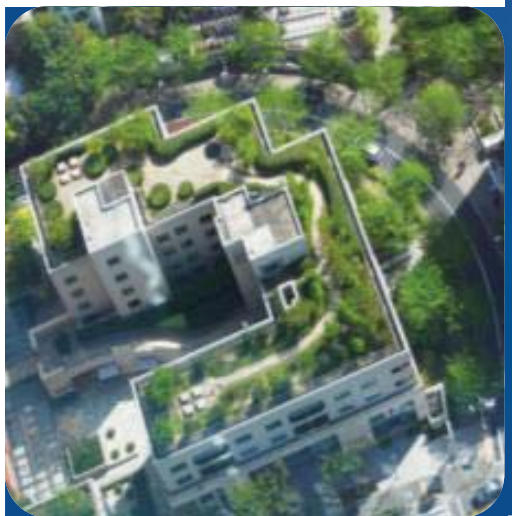
Mitigation



- National commitment to reduce GHG emissions by 34% by 2020 and 43% by 2025.
- Emissions from electricity use, transport and waste management the key local issues
- High dependence on fossil-fuel grid electricity which attracts high emissions
- Not all emission sources accounted for at present
- Land use could offer a carbon sink if managed properly

Mott MacDonald

Mitigation



- Risk on increasing emissions with economic expansion
- Need to link policies together to achieve reduction targets
- Support decentralised, renewable energy where possible to reduce electricity grid dependence
- Think locally, use the resources that come naturally to the area
- Effectively communicate and lead from the top

Mott MacDonald

Adaptation

- Capacity building
  - Early warning systems
  - Knowledge and skill development
  - Awareness raising
  - Integration of climate change into planning processes
  - Risk assessment
  - Policy
  - Partnerships and networks
- Adaptation actions
  - Theme specific
    - Operational
    - Maintenance
    - Planning and design

Mott MacDonald

Key Themes to be Assessed

1. Water
2. Coastal and marine
3. Agriculture
4. Biodiversity
5. Energy
6. Waste
7. Transport
8. Human settlements
9. Education awareness and capacity building
10. Human health and wellbeing
11. Working with business and tourism
12. Integration, planning and partnerships

- QUESTIONS -

- What are the expected trends and risks?
- Who/what is most vulnerable?
- Your insights and local knowledge?

Sub Saharan Africa
Mott MacDonald

Discussion & Questions

2013

E: jessica.brislin@mottmac.com
T: (031) 566 4368

KWADUKUZA MUNICIPALITY

Mott MacDonald

No.	THEME and PRELIMINARY RESPONSE OPTIONS	KEY PARTNERS	FUNDING MECHANISMS
1	**WATER**		
	General: ▪ Improve monitoring and forecasting systems for floods and droughts – develop links with water research institutes to ensure early preparation for drought or flood years ▪ Preservation of wetlands for current and future flood risk ▪ Water flow monitoring towards improved infrastructure planning and development **Demand Side:** ▪ Water tariff structures and/or restrictions: prepare plans to balance the needs of competing users when water availability is reduced (drought years, peak seasons) ▪ Awareness and Education campaigns for water conservation ▪ Encourage use of water conservation technologies such as low flush toilets and low flow showerheads ▪ Changes in agricultural management practices in line with water scarcity (e.g. changes in crop types, dry land farming) ▪ Planning approval to consider current and future water availability ▪ Improve sanitation to curb disease spread **Supply Side:** ▪ Rainwater harvesting for uses such as toilet flushing, car washing, irrigation ▪ Re-use of grey water or water from sewage treatment ▪ Reduction of leaks ▪ Response options for peak supply in drought years need further investigation (from cost benefit perspective and development approach), e.g.: increased storage capacity/widening of dams, trucking of water, desalination, development approvals.	▪ DWA ▪ Siza water (SembCorp) ▪ Umgeni Water ▪ KwaDukuza Water Services Unit ▪ KwaDukuza Environmental Services Unit ▪ KwaDukuza Environmental Services Unit ▪ Mondi Wetlands Programme(if operating in this area) ▪ Sappi CSI Team	
2	**COASTAL AND MARINE**		
	▪ Strict municipal planning and decision making around coastal activities, within 200m of the coastline (i.e. more stringent set-back lines) ▪ Consideration of Coastal Vulnerability Index (CVI) mapping of high and moderate risk areas as a red flag to any development which may exacerbate vulnerability ▪ Implementation of Council approved Coastal Management Plan ▪ Drafting of site specific shoreline management plans at key risk points ▪ Reinstatement of natural beach/dune vegetation/ increase of shoreline buffers to protect against increased runoff from more intense storms ▪ Research and monitor climate change impacts on fisheries ▪ Relocate existing development from coastal areas at high risk ▪ Reinforcement of beach infrastructure at areas of high risk (CVI and CMP to guide)	▪ KZN DAEA ▪ Kwadukuza Beach Management Unit ▪ KwaDukuza Development/Town Planning Unit ▪ KwaDukuza Environmental Services Unit ▪ Coastwatch	

3	BIODIVERSITY		
	▪ **Control of invasive alien vegetation (water savings and job creation too = WIN-WIN)** ▪ Vulnerability mapping and related management plans (e.g. shoreline management, informal settlement) ▪ Finalisation of KwaDukuza Biodiversity Open Space Management Plan ▪ Roll-out of Community Based Ecosystem Adaptation (CEBA) projects ▪ Protect and increase existing ecosystems and green spaces for flood risk management, reduction of heat island effect and agriculture and biodiversity support, notably: – wetlands – river courses – dunes – land care/erosion prevention – water sheds ▪ Monitor biomass used for energy – monitor if it is increasing or dwindling. If dwindling, contingency plans for energy provision need to be considered	▪ EKZNW ▪ KwaDukuza Environmental Services Unit ▪ KZN DAEA ▪ DEA ▪ SANBI ▪ WESSA ▪ Wildlands Conservation Trust ▪ Endangered Wildlife Trust	

4	AGRICULTURE		
	▪ Ongoing research and monitoring of climate change impact on vulnerable livelihoods, e.g. fisheries, agriculture and tourism ▪ Diversification of livelihood strategies (notably non-farm activities to cushion farming based livelihoods) ▪ Consider changes in crop types, dry land farming to diversify agricultural activities ▪ Work with the community on community-based adaptation projects (e.g. fruit tree growing)	▪ KZN DAEA ▪ Dept of Forestry ▪ Sappi ▪ Mondi ▪ Tongaat Hullet ▪ Illovo ▪ iLembe Economic Development ▪ Enterprise iLembe ▪ Ingonyama Trust ▪ Co-operative ▪ Cane Growers Association ▪ Chamber of Business ▪ SASA ▪ SASRI ▪ Wildlands Conservation Trust	

5	HUMAN SETTLEMENTS		
	▪ Identify, map and assess key risk areas/settlements and create an inventory of priority areas/communities ▪ Improve sanitation to inhibit disease spread ▪ Improve standard of social housing (new and retrofit of existing), particularly to include ceilings to improve thermal performance ▪ Work to reduce fire hazardous settlements (too close together) in informal settlements ▪ Disaster risk reduction measures in informal settlements, including improved infrastructure , planning and management ▪ Disaster response improvements for fires/floods in informal settlements ▪ Efficient appliance programmes (fridges, kettles, lights) to reduce energy poverty and reduce GHG emissions ▪ Green space in settlements to absorb intense rain runoff and improve sanitation (e.g. green roofs) ▪ Where possible, relocate and avoid settlement in flood prone areas – increase setback lines from watercourses ▪ Plan for disaster events (e.g. ensure road maintenance and storm water drainage maintenance and upgrade plans to cope with increased volumes and storm damage)	▪ Dept Human Settlements ▪ KwaDukuza Housing Unit ▪ KwaDukuza Disiater Risk Managament Unit ▪ KwaDukuza Environmental Services Unit (as informants) ▪ Department of Land Affairs ▪ Ingonyama Trust ▪ Tongaat Hullett (as key landowners)	

6	WASTE		
	▪ Landfill gas capture and conversion to energy and CDM project (understood to be currently underway) ▪ Embark on municipal pilot waste recycling schemes (e.g. domestic orange bag recycling programme rolled out in Durban) ▪ Recycling and 'buy back centre' development at various existing and/or new waste transfer locations ▪ Ensure proper disposal of waste and proposer reinforcement of new waste sites (rising water tables, flooding, coastal erosion can all impact badly on waste disposal sites) ▪ Establishment of a forum for engagement with construction, commerce and industry	▪ DCLM ▪ KwaDukuza Waste Managent Unit ▪ Dolphin Coast Waste Management ▪ Wildlands Conservation Trust ▪ Mondi (Recycling programme?) ▪ Sappi (Recycling programme?) ▪ KZN DAEA ▪ eThekwini (for best practice guidance/lessons learnt)	

7	ENERGY		
	Energy Supply and Electricity Service delivery: ▪ Pursue 100% electrification, including in informal areas ▪ Explore renewable energy development and procurement through PPAs, expeditious handling of EIA's. Options include wind power and landfill gas to electricity. ▪ Explore free basic alternative energy sources for poor non-electrified households ▪ Work to ensure low income housing is thermally efficient (put in ceilings) ▪ Solar water heater roll-out programmes **Regulations / Incentives:** ▪ Solar water heater by-law for all new buildings requiring at least 40% of water heating requirements are from a renewable energy source ▪ Implement thermally efficient housing delivery, e.g. legislate the provision of ceilings in government-delivered housing (ceilings a warmer house in winter; cooler in summer) ▪ Building regulation to ensure efficiency in all new buildings, e.g. require energy efficiency plans for building/development plan approval ▪ Provide incentives for energy efficiency when supplying new connections ▪ Use air management approval processes to leverage efficiencies **Behaviour / Awareness:** ▪ Focused behavior-change campaigns on energy use ▪ Commercial and/or industrial energy forums that provide information and learning exchange on energy efficiency within the sectors	▪ ESKOM ▪ KwaDukuza Electricity Services Unit ▪ Department of Education ▪ Treasury (REIPPP programme) ▪ DBSA ▪ DoE ▪ DWA ▪ DEDT ▪ DTI ▪ Private Investors ▪ NGOs (to be identified)	

8	TRANSPORT		
	▪ Effective transport planning and management towards encouraging a shift from private to public transport ▪ Roll out of bus rapid transport and school bus systems (an IRPTN is proposed for iLembe) ▪ Allocate road space to public transport vehicles ▪ Park and ride facilities to encourage private car users to use public transport ▪ Increase cost of private transport such as through road space charges ▪ Support walking and cycling modes, e.g. cycle lanes, etc ▪ Increase government vehicle fleet efficiency ▪ Engage with local business and logistics companies to encourage fleet efficiency/use of rail	▪ DoT ▪ Taxi Associations ▪ KwaDukuza Transportation Unit ▪ PRASA ▪ Transnet	

9	HUMAN HEALTH & WELLBEING		
	▪ Improved sanitation to curb disease ▪ Increased awareness on/ preparedness for climate related health threats (vector-borne diseases, heat, air pollution, floods) ▪ Pollution warning system ▪ Interventions to reduce air pollution ▪ Increase staffing and supplies (capacity support) for health facilities ▪ Nutrition programmes where climate impacts affect livelihoods and food security ▪ Policy and management planning to handle migrant-related issues	▪ Department of Health ▪ Department of Home Affairs ▪ KwaDukuza Environmental Health Unit ▪ NGO's (to be identified)	

10	WORKING WITH BUSINESS		
	▪ Run education programmes for local business awareness on greening supply chains, carbon and water footprinting ▪ Produce an inventory of heavy emitters in KwaDukuza ▪ Work with local business to reduce dependence on increasingly costly energy sources ▪ Encourage CSI projects that focus on community-based adaptation projects ▪ Establish a green business forum ▪ Address procurement to ensure it support efficient resource use and that tender specs, particularly for large infrastructure projects, incorporate the wide range of future climatic conditions	▪ KwaDukuza Economic Development Unit ▪ ilembe Economic Development Unit ▪ Enterprise iLembe ▪ Chamber of Commerce ▪ DTI ▪ DEDT ▪ KZN Department of Tourism	

11	EDUCATION AWARENESS & CAPACITY BUILDING		
	▪ Roll out practical, interactive education programmes at schools ▪ Perform plays for communities with a climate change-based story line ▪ Documenting, developing and sharing information on climate change, vulnerability and adaptation ▪ Encouraging local voluntary action for disaster management ▪ Sharing experiences and lessons, to inform others and future actions and policies	▪ Department of Education ▪ KZN DAEA ▪ NGO's (to be identified)	

12	INTEGRATION, PLANNING & PARTNERSHIPS		
	▪ The next IDP revision must factor in the findings of the CCRS and build it into Strategic Action Plans. ▪ Monitor and Evaluate success of various plans ▪ Iterations must take place with the usual IDP 5 year revisions, as new and more sophisticated information becomes available ▪ These IDP plans must filter down and cross-cut into all municipal plans and service departments ▪ Adequate climate change capacity at the local government level must be accommodated in the municipal structure ▪ With limited financial and human resources, it is difficult to divert resources from basic service delivery. In this regard it is critical to create partnerships with key organisations to respond to action plans	▪ KwDukuza IDP office ▪ KwaDukuza Town Planing and Building Control Unit ▪ KwaDukuza Environmental Services Unit ▪ KwaDukuza Special projects Unit ▪ All other relevant municipal Line Units ▪ ICLEI (for first IDP revision) ▪ NGOs ▪ Local Businesses ▪ Enterprise iLembe ▪ Chamber of Commerce ▪ National and Provincial Government	

Appendix F. Record of PSC Meeting

F.1. Minutes of Meeting

Record of Meeting

Project Title	**KWADUKUZA MUNICIPALITY CLIMATE CHANGE RESPONSE STRATEGY (CCRS)**	Division	Environment
Subject	Record of Project Steering Committee (PSC) Meeting	Project No.	302958
Location	KwaDukuza Municipal Library, Balcomb Street, KwaDukuza	Date of Meeting	28 February 2013

Recorded by	Distribution to PSC members.
Pravina Govender (PG)	

Item		Text	Action on
1.		**OPENING AND WELCOME** The chair, Ms Hazel Dlamini (HD) opened the meeting at 09h20 and welcomed everyone.	
2.		**ATTENDANCE** - as per attached register at Annexure A. **APOLOGIES:** Mava Ntanta – KwaDukuza Municipality (to join the meeting later) Omar Parak - DAEA Boyd Escott - EKZNW Sonitha Pooran - PRASA Nkopodi Nkopodi – Tongaat Hulett Developments	
3.		**BACKGROUND** HD provided the background to the KwaDukuza CCRS project and the project objectives. She then introduced the Mott MacDonald project team which was being led by Dr David Viner (DV) from the UK.	
4.		**INTRODUCTION TO PROJECT TEAM AND CLIMATE CHANGE** Dr Viner introduced Pravina Govender (Town Planning Consultant) and Jessica Brislin(Environmental Consultant) working on the project. He also mentioned other team members, James Dunham (adaptation specialist) and Terry Ellis (mitigation specialist) from the UK. Prof Schulze is the SA Climate Change (CC) specialist is also a member of the project team and has undertook the Climate Baseline and Assessment for KwaDukuza. DV gave an introduction and background to climate change is as per the slides attached in Annexure B.	
5.		**PRESENTATION ON THE KWADUKUZA CCRS** DV continued with his presentation and spoke to the project's intention, an explanation of what is adaptation and mitigation, the key themes identified and some of the preliminary findings. A copy of his slides is attached in Annexure B.	
6.		**DISCUSSION** Jessica Brislin (JB) managed the discussion item which dealt with: questions of clarity, discussion on sectoral risks and responses, prioritizing sectoral responses and an identification of key role-players/champions/budgets and funds available.	

Item		Text	Action on
		Discussion was based on points detailed under each of the identified Themes, as per pamphlet attached at Annexure C. **<u>Theme 1 : Water</u>** Mark Summerton (MS) of Umgeni Water informed the meetings as follows; - UmgeniWater (UW) have been studying the effects of Climate Change (CC) since 2006 - Developed models to determine the impacts of increased temperature on evaporation and rainfall and on catchments - Main issue being UW ability to ensure water availability and security into the future. - One needs to include effect of CC on dam building and existing dams ie. are they big enough to store increased volumes of water - UW also need to climate proof their operations. They did this by simulating 31 different scenarios and its impact together with the Water Research Commission (WRC). - MS warned against "maladaptation". Need to increase the level of certainty into the future. Thabo Mzimela (TM) of Department of Water Affairs (DWA) commented that' the 25 March 2013 is the start of Water week and related water awareness campaigns to encourage people to save water. JB commented that UW and DWA should undertake joint education programmes on water use reduction, as the cost to benefit ratio is high, compared to infrastructural upgrades for example. DV enquired if UW had experienced any dry periods and was not able to supply it's customers in the iLembe/ KwaDukuza Municipal (KDM) area. DV also enquired if SA has any legislation controlling rivers and water levels. MS responded that Umgeni River is the main supplier of water and there were no dry periods. DWA monitors, forecasts and controls water levels/ extractions. DV enquired how UW reduces usage during dry periods. MS responded that they target potable water first. They ask residents to reduce usage, e.g.to stop watering gardens, washing cars etc. They could also apply water restrictions. Pat Dorkin (PD) commented that DWA needs to implement a similar campaign as Eskom which has been very effective. There also needs to be a policy for every Local Municipality to ensure reservoirs are always kept at a certain level. Peter Woolfe (PW) added that DWA / UW need a good communication strategy. PD enquired who is monitoring river levels and impact of CC on flooding. Navindren Ramkisson (NR) of SAPPI stated that SAPPI do monitor water levels in Umgeni River. If it is low, they alert iLembe District, KDM and the community. PD enquired if there is a Provincial Initiative to monitor water levels in rivers. MS responded that there was no such initiative. UW are however, assured of water supply into the future as they have linked this to river flows. The next step for UW is to study 1:100 year floodlines and dam structures to test if they can manage the increased levels. UW have assessed their water works; traditional impacts and possible CC impacts. This will inform the future location of their water works.	

Item		Text	Action on
		DV enquired if there was any legislation that monitored and controlled the level of dams. PW informed the meeting that the Department of Human Settlement (DHS) is in the process of appointment a service provider to assess the impact of Climate Change on Rural and Urban Housing. This study will be GIS based. Once completed, this will be made available to Municipalities who can then use this to inform the location of new housing units and/or what measures need to be implemented to protect existing housing units. He advised that the Department has undertaken 8 pilots around KZN eg. Umzimkhulu, KwaMasane, Ladysmith, Hibiscus Coast etc. This has helped assist them to develop a model that they will now apply to this study. Samke Funde (SF) from DAEA reported that DAEA are currently undertaking an EMF for iLembe which will consider the various development pressures and make appropriate recommendations in terms of CC and relevant actions that need to be taken. HD added that in focusing on human settlements, KDM will be considering the impact of CC and the need for changes in materials and specifications thereof and the housing unit. KDM will appreciate the study being undertaken by DHS. DV enquired if road drainage design has been revised to take into consideration changes in weather patterns for eg. heavier rains. PD responded that standards have not been changed but this needs to be done. JB suggested that KDM engage with catchment management fora to increase knowledge of what's happening in this sector. **Theme 2: Coastal and Marine** JB informed that meeting that the CCRS will be using the Coastal Vulnerability Index (CVI) and the KDM Coastal Management Programme (CMP) to access CC impacts and relevant recommendations. It was acknowledged that it is fortunate that this level of information was readily available to inform this study. HD commented that it is easy to plan greenfields developments but KDM was concerned about built-up areas and the impact of CC on these developments. The 2007 storm surge was a case in point. KDM needs to develop appropriate policies and strategies to manage the impacts of CC on the coast that deal with issues such as retreat, expropriation, re-inforcement etc. JB suggested that budgets for coastal management at the local level be augmented to cope with imminent changes and adaptation requirements along the coastal zone. High risk areas must be prioritized (e.g. according to CVI and CMP). PD enquired if KDM was also going to consider the impact of CC on public infrastructure and what needs to be done to protect this. SS responded that his Department have started a process of assessing the state/quality of roads in KDM and implemented a programme to upgrade these roads. They are also looking at ways to improve the design of roads to withstand more extreme weather conditions. **Theme 3 : Biodiversity** SF spoke about the opportunities presented by the Expanded Public Works Programme to access funding around alien invasive species clearing couple with job creation benefits.	

Item		Text	Action on
		JB agreed and added that Biodiversity Open Space Map will provide direction on which areas are a priority and that will link into the Provincial Expanded Public Works Programmess. One would benefit from the creation of direct jobs and co-benefit jobs such as manufacturing/carving of wood products, manufacturing of biodiesel, ethanol, eco-system benefits and eco-tourism opportunities are created. PD enquired if the CCRS was looking at surrounding areas. JB responded that the time and budget constraints do not allow the project team to go into great detail on cross border alignment within the scope of this project specifically. **Theme 4: Agriculture** PW commented that in the KDM area, large tracts of agricultural land have been lost to gated estates. JB commented that there is a fine line between being food secure and ensuring a biodiversity rich future for KDM. Aalia Kajee of Eskom (AL) commented that Tongaat Developments have various development proposals for the area, which the team should consult. This is outlined in their 20 year plan. MS commented that one also needs to consider the impact of CC on rainfall and hence crops types for this area. CP mentioned synergy with Dube Tradeport and the idea of increased job creation with food growing and processing. JB mentioned the possibility of exploring co-generation for big and small agricultural industries (as is being done with sugar cane mills) **Theme 5: Human Settlement** JB mentioned that a lot of the themes are cross-cutting, particularly in the human settlements theme which has implications on water use, energy use and waste production. Human health and disaster management is also linked strongly to human settlements. HD commented that KDM was looking forward to the study being undertaken by DHS and its roll-out to Municipalities. She commented that there was also the need to undertake the training of Councillors and Amakhosi, to ensure support of the initiative. PW added that his Department will be partnering with the National Department to study informal settlements and their location and will categorise which ones need to be relocated/ protected. This will also include a feasibility assessment of new "pipeline" projects. The Department is trying to encourage the densification of rural settlements but this is being met with resistance. He added that Municipalities must incorporate these recommendations into their Human Settlement Plans. Ingonyama Trust Board is 'on board', but these relationships must be strengthened on an on-going basis. **Theme 6: Waste** HD provided the status quo in terms of waste management in KDM. She said that KDM were in process of implementing the Food for Waste Programme that is linked to a Waste Minimisation Strategy for KDM. She added that KDM are in the process	

Item		Text	Action on
		of filling the position of a Waste Management Officer (WMO) to manage this process. Furthermore, the KDM Landfill Site is currently acquiring a hazardous waste license. **<u>Theme 7: Energy</u>** AK commented that Eskom's supply to residents is limited to only 3 areas. Eskom supllies the bulk to KDM who are in turn responsible for reticulations to residents and business. She suggested that EIAs that dealt with solar farm applications should be expedited. Town Planning Schemes should also be amended to include Solar Farms. She added that the new building regulations stipulate the need for solar panels in buildings and energy efficiency in general. Sihle Sibiya (SS) stated that KDM has not explored this market fully. KDM needs to access funds from Department of Minerals and Energy for Solar Power Roll-out. KDM also needs to assess the viability of wind farms. They will also need to encourage the use of LED lighting to save energy. In general, more efficient and affordable technology needs to be found and/or developed. Consider prospects of local manufacturing of efficient technology? This links to the Chamber of Business. AK commented that studies on wind and solar potential for this area have been undertaken by Eskom and it was concluded that these will not generate adequate speeds/ energy to generate power. PD reminded the meeting that this alternate is not cheap to install. He also asked that KDM plan for vandalism and the stealing of units if they are implementing solar street lighting. SF commented that they would not be able to fast track EIAs, and rather that the EMF and plans for KDM should investigate and zone available/ suitable land for this purpose in order to fast-track applications. She added that the Provincial Department of Economic Development and Tourism (DEDT) were undertaking studies to indentify suitable areas for wind and solar energy. JB agreed that the DEDT study found the converse to that of the Eskom renewable energy potential study. Chimene Pereira (CP) commented that KDM should also explore energy that can be derived from ocean currents. **<u>Theme 8: Transport</u>** PD stated that the Department of Transport (DoT) does not support tolling. It has huge administrative costs. Any revenue does not result in a net benefit. Furthermore, any future carbon taxes must be ruing-fenced. He added that more work needs to be undertaken around capturing run-off and the use of this stormwater to irrigate farmlands. Energy could also be harvested from stormwater runoff. SS agreed and commented that KDM are looking for innovative projects such as these. JB mentioned that KDM should perhaps start by making their own fleet more efficient. Considered an 'easy win' as they are autonomous in this regard.	

Item		Text	Action on
		Theme 9: Health and Wellbeing HD mentioned the iLembe disaster risk study currently underway and KDM's dependence on its findings. KDM and iLembe to keep channels of communication open. There was nothing further to add to this theme. **Theme 10. Working with Business** PW informed the meeting that his Department are undertaking "Train the Trainer" programmes to enable the public to understand the outcomes and recommendations from the CC study. There was a need for KDM to undertake a similar initiative to ensure implementation of recommendations. HD responded that KDM are initiating educational programmes around environment issues. KDM have recognized the importance of this. DWA and DAEA are acknowledged as key partners in this initiative. PD commented that is was important to concentrate on capacity building and skills development in Governments and Municipalities around this sector. SF added that DAEA have initiated a "Waste Less" Programme in Mandeni. They will be looking for new projects. There is also an air emissions inventory being developed by DAEA for iLembe that concentrates on some of the big business. She added that the project team should contact the Simunye and SAPPI Environmental Groups that are very active in this regard. **Theme 11. Education Awareness and Capacity Building** HD mentioned that within KDMs Environmental Department they intend to continue rolling out internships which, in their experience thus far, is found to significantly up-skill young professionals in the area. Interns to be deployed to key communities/sectors to increase awareness. PW and DV suggested a communication strategy be developed. Alignment of KDM with education efforts by NGOs, DWA and UW to be increased and strengthened. **Theme 12. Integration, Planning and Partnerships** HD mentioned again that ICLEI will play a key role as a partner over the next three years. JB mentioned that the Chamber of Business can help drive change on the ground by businesses if they are better informed. DV suggested economic growth policies be linked to energy supply/savings policies. Similarly, this should be done with water saving policies.	
7.		**ALIGNMENT WITH OTHER INITIATVES** HD introduced Stephen Bland (SB), the project manager for the ICLEI - Urban LEDS project. SB provided a short introduction to the ICLEI Initiative (see attached pamphlet at Annexure D for background). In essence, KDM is one of 8 pilot cities selected by ICLEI to support programmes/projects/initiatives around low emissions. One such project will be to undertake capacity building and training of officials and Councillors around low emission cities. SB reported that ICLEI are very keen to	

Item		Text	Action on
		work with Mott MacDonald to ensure alignment of both the initiatives and implementation of some of the identified projects. HD advised that there were other initiatives being undertaken by KDM, but time did not permit further discussion.	
8		**NEXT STEPS** HD thanked everyone for their attendance. She advised that PSC members were welcome to provide further comments to the project team by the 8 March 2013. The CCRS document will be finalised early April 2013 and circulated for comment to PSC members and made available to various stakeholders and the public for comment. It is anticipated that the final document will be adopted towards the end of April 2013. **CLOSURE** HD thanked everyone for their attendance. The meeting closed at 11h45	

KWADUKUZA CLIMATE CHANGE RESPONSE STRATEGY PROJECT : PSC MEETING 28 FEBRUARY 2013 - KWADUKUZA LIBRARY

Annexure A

NAME	SURNAME		POSITION	CONTACT NO		EMAIL ADDRESS	SIGNATURE
				LANDLINE	MOBILE		
Mr N J	Mdakane	Kwadukuza Municipality	Municipal Manager	032 437 5000			
Sikhumbuso	Hlongwane	Kwadukuza Municipality	Exec Dir: Eco Dev & Planning	032 437 5000		SikhumbuzoH@kwadukuza.gov.za	
Mava	Ntanta	KwaDukuza Municipality	Dir: Development Planning	032 437 5000	0823010459	mavan@kwadukuza.gov.za	
Siyabonga	Khanyule	KwaDukuza Municipality	Dir: Special Projects	032 437 5000		SiyabongaK@kwadukuza.gov.za	
Mandla	Manzini	KwaDukuza Municipality	Exec Dir: IGR	032 437 5000		manzinim@kwadukuza.gov.za	
Ncamisile	Zwane	KwaDukuza Municipality	Dir: IGR	032 437 5000		NcamisileZ@kwadukuza.gov.za	
Sihle	~~Sibaya~~ Sibiya	Kwadukuza Municipality	Exec Dir: Technical	032 437 5000		sihles@kwadukuza.gov.za	
Nollie	Rabie	Kwadukuza Municipality	Dir: Technical	032 437 5000		NollieR@kwadukuza.gov.za	
Hazel	Dlamini	KwaDukuza Municipality	Senior Environmental Control Officer	032 9468000	0736192693	hazeld@kwadukuza.gov.za	
Masupha	Mathenjwa	KwaDukuza Municipality	Environmental Officer	032 9468000		MasuphaM@kwadukuza.gov.za	
Ntando	Shandu	KwaDukuza Municipality	Environmental Intern	032 9468000	0784131424	ntandos@kwadukuza.gov,za	
Che'	Gopi	KwaDukuza Municipality	Manager: Parks and Recreation	032 9468000		cheg@kwadukuza.gov.za	
Cecil	Viramuthu	KwaDukuza Municipality	Exec Dir: Municipal Services	032 437 5000		CecilV@kwadukuza.gov.za	
Themba	Dube	KwaDukuza Municipality	Dir: Human Settlements	032 437 5000		ThembaD@kwadukuza.gov.za	
Nhlakanipho	Biyela	KwaDukuza Municipality	Dir: Electricity	032 437 5000		NhlakaniphoB@kwadukuza.gov.za	
Njabulo	Ngwane	KwaDukuza Municipality	Dir: Operations	032 437 5000		NjabuloN@kwadukuza.gov.za	
Pamela	Mkhwanazi	KwaDukuza Municipality	Deputy Dir: Operations	032 437 5000		PamelaM@kwadukuza.gov.za	
Mike	Newton	iLembe District Municipality/Enterprise iLembe	Acting MM/Head Economic Development	032-4379300	0833015278	mike.newton@ilembe.gov.za	
Dumisani	Khoza	iLembe District Municipality	Dep Dir: Planning and Development	032-5518772/8713	0835628398	dumisanik.khoza@ilembe.gov.za	
Trenley	Tilbrook	iLembe Chamber of Commerce, Industry&Tourism	CEO	0877278630	0824962169	ceo@ilembechamber.co.za	
Linda	Mncube	iLembe District Municipality	Chief Planner: DPSS	032 947 9801	084 663 0398	linda.mncube@ilembe.gov.za	
Bongumusa	Buthelezi	DEAT: Environmental	Environmental Support	032 947 9807	082 407 5506	bongumusa.buthelezi@ilembe.gov.za	
Thulani	Bhengu	COGTA	Manager: Strategic Planning	031-2041711	0828827145	thulani.bhengu@kzncogta.gov.za	
Mandisa	Zungu	COGTA	Manager: Spatial Planning	031-2041711	0827788793	mandisa.zungu@kzncogta.gov.za	
Gerald	Dlamini	DAEA	iLembe District Manager/DD Agriculture	0324377500	0824547321	gerald.dlamini@kzndae.gov.za	
Nombulelo	Zungu	DAEA	iLembe District Manager/DD Environment	0324377500	0823126605	nombulelo.zungu@kzndae.gov.za	APOLOGY
Samke	Funeka	DAEA	Environmental Officer: Municipal Support	032 437 7500	0825896122	s.funeka@kzndae.gov.za	
Mdu	Zondo	DAEA	CEO:Sustainable Development Planner (EMFs/SEAs)	033 355 9532		mdu.zondo@kzndae.gov.za	
Omar	Parak	DAEA	Coastal Management Unit	033 3559438	0823302136	omar.parak@kzndae.gov.za	
Jay	Pakree	DAEA	Cimate Change	033 3559100		puckreej@kzndae.gov.za	
Mr Michael	Singh	DWA	DD:Water Regulaion and Use (South)	031-3362763/48	0833212901	singhm@dwa.gov.za	
Pravitha	Jairam	DWA	AD: Catchment Management:- Institutional Development	031-336 2700		JairamP@dwa.gov.za	
Mr Shyam	Misra	SEMBCORP Siza Water	Managing Director	032-9462148		shyam.misra@sembcorp.com	
Alka	Ramnath	Umgeni Water	Planner	033-411111	0833034548	alka.ramnath@umgeni.co.za	
Sindi	Luthuli	Umgeni Water	Manager: Environmental Services	033 341 1407	079 899 6880	sindi.luthuli@umgeni.co.za	
Mr Peter	Woolf	Department of Human Settlement	Senior Manager: Integrated Planning ~~& HMST~~	031 336 54~~00~~ 04	08256774~~00~~ 22	peter.woolf@kzndhs.gov.za	
Ms Tahira	Tarmahomed	Department of Economic Dev.	Area Manager:LED: Ilembe District	033 2642551	082 301 0193	tarmahomedt@kznded.gov.za	
Aalia	Kajee	Eskom	Planner 033 395 3851 / 0844044437	~~031 2790424 / 204 1600~~	0844044437	kajeea@eskom.co.za	
Mr Tasco	Mbinda	Department of Energy		031 335 9600 /33	082 7824609	tasco.mbinda@energy.gov.za	
Moleboheng	Sekhonjana	Department of Mineral Resources				moleboheng.sekhonjana@dmr.gov.za	
Sonitha	Pooran	PRASA	Regional Planner : KZN	0318130273	0834177260	spooran@prasa.com	
Pat	Dorkin	Department of Transport	MANAGER: STRATEGIC POLICY & PLANNING	033 3538705	0836281472	pat.dorkin@kzntransport.gov.za	
Vincent	Bulunga	SASA		032-5525246		vincentb@sasa.gov.za	
~~Priscilla~~ Steven	~~Rowswell~~ Bland	ICLEI	Project Manager - ~~Ice~~ Urban - LEDS		0786276056	~~priscilla.rowswell@iclei.org~~ steven.bland@iclei.org	
Dr David	Viner	Mott MacDonald	Principle Advisor : Climate Change/ Team Leader	031-5664368		david.viner@mottmac.com	
Jessica	Brislin	Mott MacDonald	Environmental Scientist	031-5664368	0843172662	jessica.brislin@mottmac.com	
Pravina	Govender	Mott MacDonald	Development and Planning Consultant	031-5664368	082 411 9853	pravina.govender@mottmac.com	
Dr Boyd	Escott	EKZNW		033-8451257	0843249314	escottb@kznwildlife.com	
Mr Lionel	van Schoor	EKZNW	Manager: Ballito District		0825592847	vschoorl@kznwildlife.com	
Andy	Blackmore	EKZNW				blackmorea@kznwildlife.gov.za	
Di	Jones	Coast Watch		032-5258160	0836120859	dijones@iafrica.com	
Anwar	Madhanpall	SA Sugar Association	GM: Land Reform and Rural Development	031-5087000/7383		tasha.govender@sasa.org.za	
Dr Marilyn	Govender	SA Sugar Association	Natural Resources Manager	031-5087000/7024		marilyn.govender@sasa.org.za	
Chris	Fitzgerald	Illovo Sugar	Communications Manager	031-5084464		cfitzgerald@illovo.co.za	
Mahomed	Alli	Tongaat Hulett				mahomed.alli@thdev.co.za	
Nivendren	Ramsamy	SAPPI	Enviro Supt	032437 2266	0826040328	Nivendren.Ramsamy@sappi.com	

KWADUKUZA CLIMATE CHANGE RESPONSE STRATEGY PROJECT : PSC MEETING 28 FEBRUARY 2013 - KWADUKUZA LIBRARY

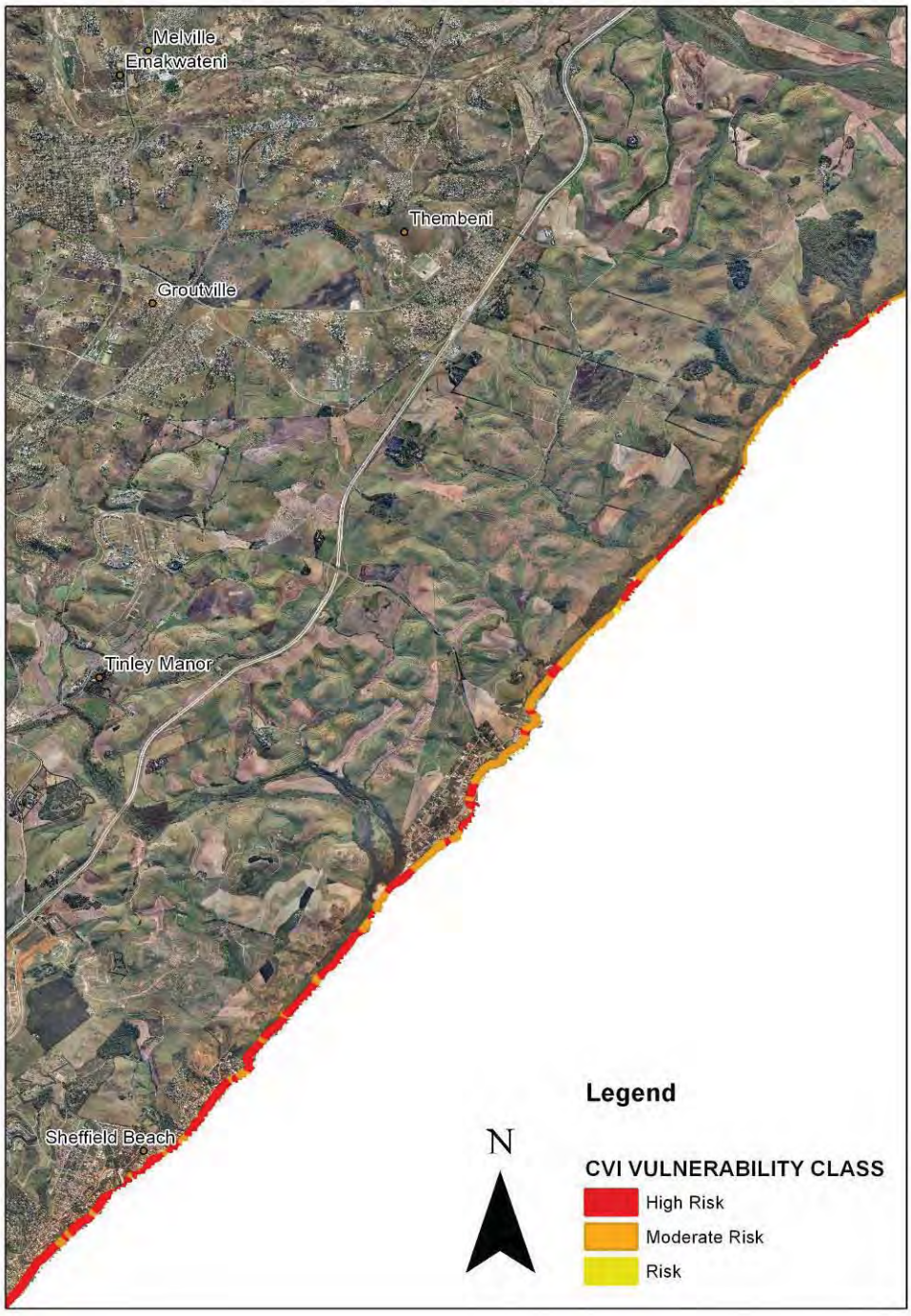
NAME	SURNAME	ORGANISATION	POSITION	CONTACT NO		EMAIL ADDRESS	SIGNATURE
				LANDLINE	MOBILE		
THEMBEKA	MTHULI	KWADUKUZA MUNICIPALITY	ENVIRONMENTAL OFFICER	032-946 8000	0763314306		
NOTHANDO	MSOMI	KWADUKUZA MUNICIPALITY	ENVIRO INTERN	032 946 8000	0731166513		
Chimene	Pereira	KDM	Chief Planner: DPSS	0324375066	0835653784	chimenep@kwadukuza.gov.za	
Mark	Summerton	Umgeni Water	Planning Analyst	033-3411265	0833091073	mark.summerton@umgeni.co.za	
Thabo	Mzimela	DWA	SDE	031-3362852	0828057594	mzimela96@dwa.gov.za	
SHUMENDREE	GOVENDER	DWA	SDE		0825976037	gpenters@dwa.gov.za	
SPHELELO	NOOBESE	KDM	communications	0324375046	0737847822	SpheleloN@kwadukuzagov	

Appendix G. Coastal Vulnerability Index findings for KwaDukuza Coastline

G.1. Frame 1: Zimbali to Sheffield Beach

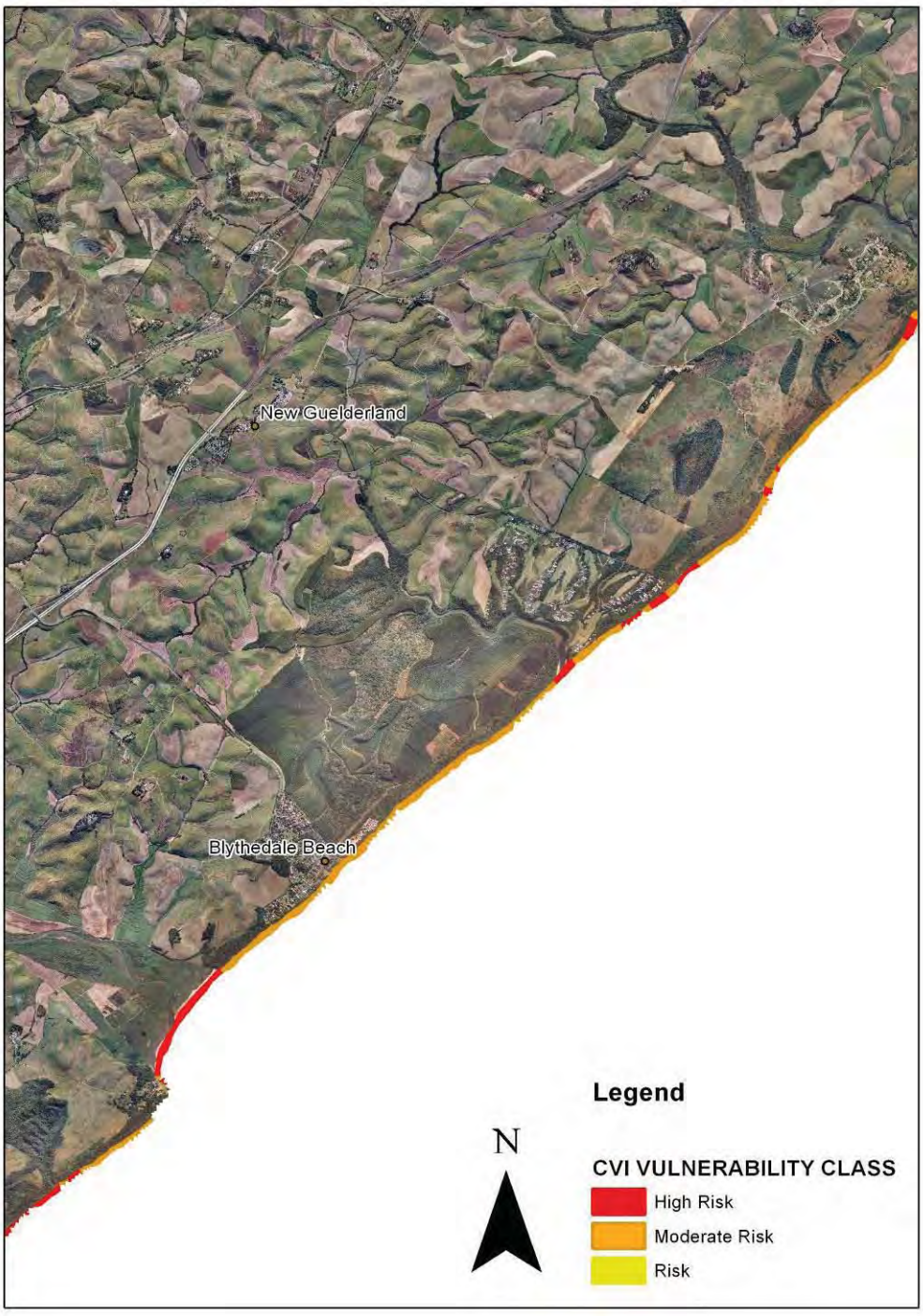
Source: ORI (2013)

G.2. Frame 2: Sheffield Beach to south of Blythedale Beach



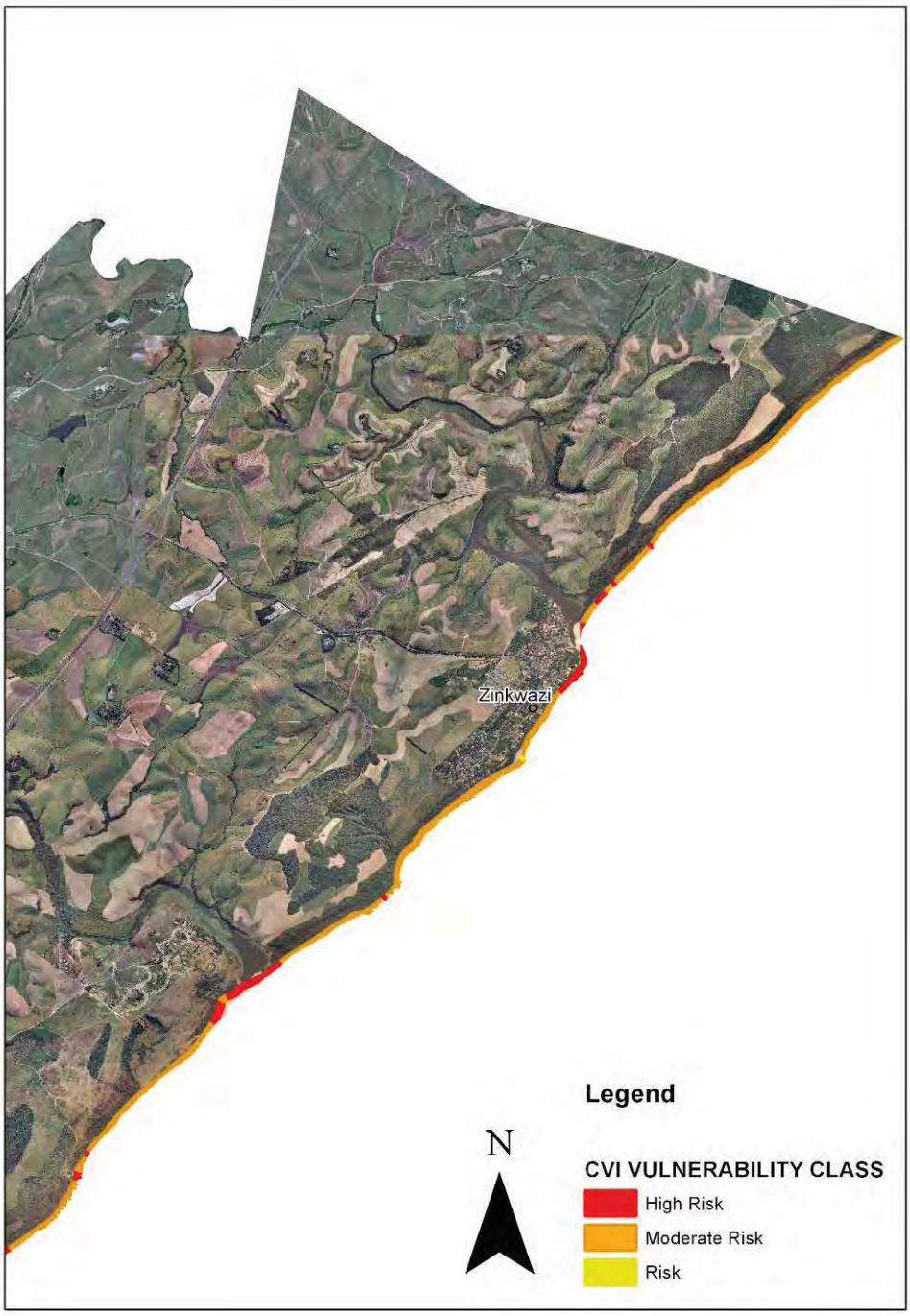
Source: ORI (2013)

G.3. Frame 3: Blythedale Beach and north of Blythedale Beach



Source: ORI (2013)

G.4. Frame 4: South of Zinkwazi to south of Tugela River



Source: ORI (2013)

Appendix H. CVI Fact Sheet for the iLembe District

agriculture
& environmental affairs
Department:
Agriculture
& Environmental Affairs
PROVINCE OF KWAZULU-NATAL

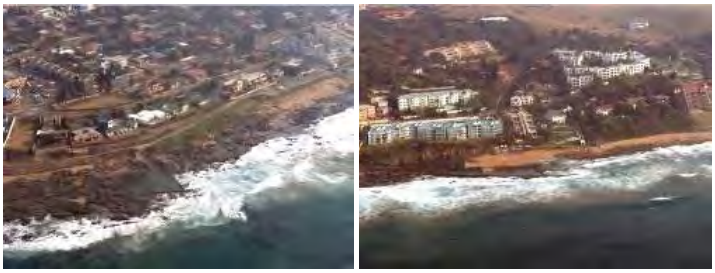
CVI FACT SHEET

ILEMBE DISTRICT MUNICIPALITY

iLembe is the smallest of the province's Districts, covering approximately 3269km^2 stretching from the northern boundary of eThekwini Metro to just north of the Tugela River mouth, bordering the uThungulu District. The area supports a population of 606,809 (Statistics South Africa, 2011).

iLembe's 79 kilometre coastline has significant urban development. The area is popular for tourism and leisure activities.

Within iLembe there are two coastal local municipalities, KwaDukuza and Mandeni respectively.



Coastal Vulnerability

The iLembe District has a mean CVI score of 18, meaning that it is considered to be at *Moderate Risk.* This section has moderate vulnerability to the effects of coastal erosion and sea-level rise damage. This can be attributed to the good distance of vegetation behind the back beach (mean 186m). However, the vulnerability is increased due to the poor dune width (mean 16m) and relatively low beach width (mean 61m). A breakdown of the District's coast shows that 28% of this coastline is at *High Risk*, 55% is at *Moderate Risk* and 17% is at *Risk*.

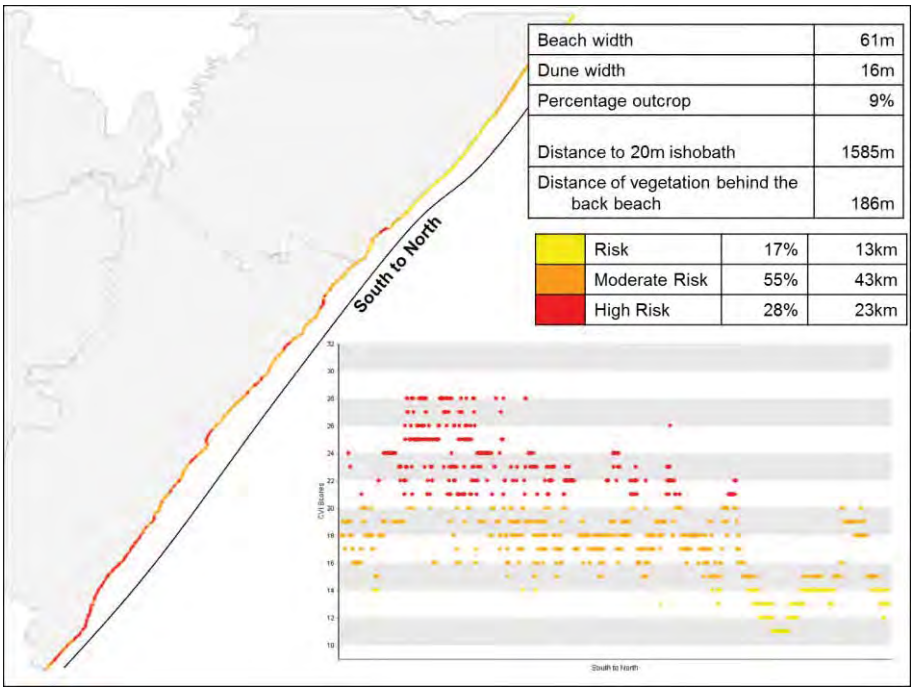


Figure 1: Physical vulnerability of the iLembe District

CVI FACT SHEET
ILEMBE DISTRICT MUNICIPALITY

Figure 2 shows the relative risk of the local municipalities in iLembe District. KwaDukuza Municipality has many *High Risk* areas (43%), while the Mandeni Municipality has lower vulnerability with only 4% being at *High Risk* and 52% and 44% being at *Moderate Risk* and *Risk* respectively.

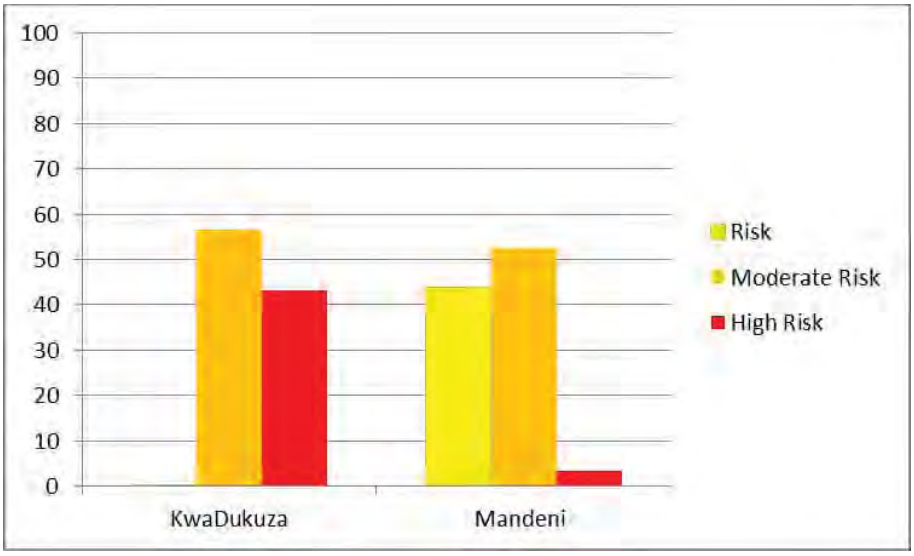


Figure 2: Percentage of each local municipality that falls into each of the risk categories (High Risk, Moderate Risk and Risk)

Social, Economic and Ecological Resources

Figure 3 shows the percentage of indicator resources located within the iLembe District. It also shows the proportion of these which are located within or adjacent to cells of *High Risk*. There is a high proportion of KZN's recreation and leisure activities located in the iLembe District, with 40% of golf courses and 31% of fishing hot spots found here. Subsistence harvesting is also dominant with 30% found in the iLembe District.

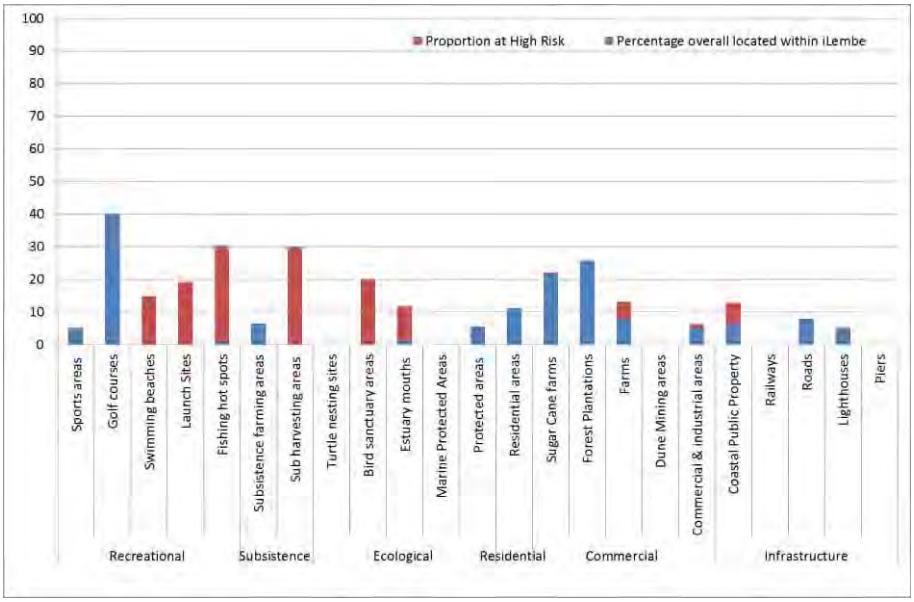


Figure 3: Social and Ecological Resources in the iLembe District and percentage at risk

CVI FACT SHEET
ILEMBE DISTRICT MUNICIPALITY

In terms of potential risk, the district should be concerned about its recreational facilities with swimming beaches, launch sites and fishing hot spots being located in areas of *High Risk*. Subsistence harvesting sites are also at risk and from an ecological aspect estuary mouth areas and bird sanctuary areas are of concern. Overall, the KwaDukuza Municipality has the largest proportion of *High Risk* areas in the district and given the recent pace of growth experienced, must be wary about locating infrastructure and development in vulnerable areas. New developments should be set-back sufficiently to ensure that they are not damaged.

High Risk areas include (alphabetically) Ballito, Salt Rock, Shaka's Rock, Sheffield Beach and Zinkwazi.

Figure 4 shows the proportion of indicator resources for the province located within each local municipality. It is evident that most of the economic and recreational activities in iLembe are located in the KwaDukuza Municipality, while farmlands are located in the Mandeni Municipality.

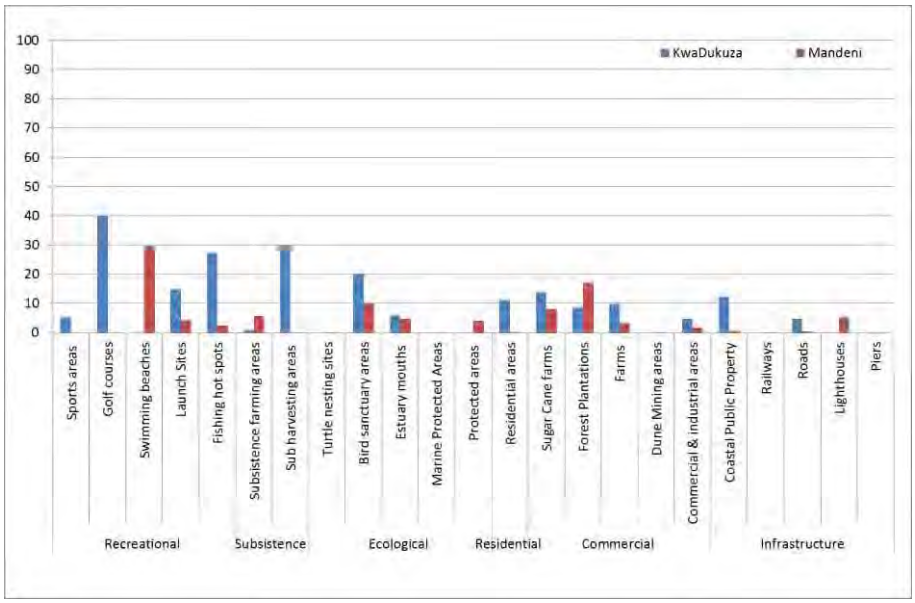


Figure 4: Social and Ecological Resources per local municipality in iLembe

For more information contact:
The Coastal and Biodiversity Management Unit
KwaZulu-Natal Department of Agriculture and Environmental Affairs
Private Bag X9059
Pietermaritzburg 3200
SOUTH AFRICA
Tel: +27 (0)33 355 9434/8
Email: alfred.matsheke@kzndae.gov.za or omar.parak@kzndae.gov.za

Appendix I. Greenhouse Gas Emissions

I.1. Introduction

The principle driver of climate change is continued emissions of greenhouse gases (GHGs). There are a wide range of GHGs, but six gases make up the 'basket' of GHGs that are the focus of international legislation: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs) and hydroflurocarbons (HFCs).

A large proportion of GHG emissions originate from two principle sources: energy use and land use. Energy-related emissions are classed as combustion-related activities only. A large amount of activities and sectors require energy use at some point in a given value chain. The use of land can act as a source and sink of GHG emissions depending on its use, part of the natural carbon cycle. Smaller quantities of GHG emissions arise through non-energy activities – for example the use of specific gases in industrial processes, transformation processes (such as the production of cement which naturally released CO_2) and leakages of natural gas from gas pipes or insulating gases that may be contained in some kinds of high-voltage electrical equipment.

This section of the scoping report describes the current level of emissions observed nationally and locally as far as possible, and identified the key priority areas for KwaDukuza for mitigating GHG emissions. It also begins to identify relevant policies that may be affecting GHG emissions or have the potential to affect GHGs in the future. Finally, it also identifies any knowledge gaps in the data and discusses how these could be addressed.

Each GHG has a different 'warming effect'; that is to say that some gases absorb radiation more efficiently than the same amount of another gas. The amount of radiation a gas absorbs can be compared to the amount of radiation absorbed by CO_2, and this is known as the 'global warming potential' (GWP) of that gas. CO_2 is the most prevalent GHG by mass in the atmosphere and has a GWP of 1. Methane has a GWP of 23 which means that 1kg of methane traps the same amount of radiation as 23kg of CO_2. For simplicity, emissions of GHGs are often presented in units of CO_2 equivalents (CO_2e), which takes in to account the wide range of GWPs of gases. The GWP factor also means that compared to CO_2, relatively small amounts of gas emissions can have considerable contributions to total CO_2e emissions. For example, a 1kg release of SF_6 has a GWP equivalent to 23,900kgCO_2.

This section describes the principle emission sources based on published national GHG inventory data as well as locally sourced activity data in the absence of a full, local GHG inventory. The description is also supplemented with a discussion of general trends observed in other local GHG inventories.

I.2. National GHG Inventory

South Africa submitted its Second Communication (SC) under the UNFCCC in November 2011 which provides an inventory of GHG emissions throughout South Africa. The SC provides an inventory of emissions in the year 2000 as well as an overview of sector specific issues relevant to those emissions. A summary is presented in Table I.1.1. The majority of the GHG emissions were in the form of CO_2 (79%), with the remainder being mostly methane (16%). Methane emissions had risen 74% since 1994 in the 2000 inventory.

Table I.1.1: South Africa Year 2000 GHG Inventory, Excluding Land Use Emissions

Sector	$MtCO_2e$ (yr 2000)	%	% change from 1994
Energy	380,988	83	+28
Industrial Processes	32,081	7	+6
Agriculture	38,716	8	+9
Waste	9,393	2	-43
Total	461,178		+21

I.3. Local Activity Data

Typically, a Municipality's activities account for only 1-2% of GHG emissions. However, they are important target areas for 'quick wins', leading by example and thus advocacy around climate change projects.[58]

To date, KwaDukuza and iLembe has not produced an inventory of GHG emissions for municipal and community activities. Therefore, as part of this literature review proxy data has been used to infer how the local emissions profile might relate to the national GHG inventory. Local development plans and the policy context have been considered to assess how the various potential sources of GHG emissions identified within the national inventory might apply to KwaDukuza specifically. It is understood that an inventory will be undertaken as part of the partnership KwaDukuza is forming with the ICLEI-Africa.

As mentioned above, KwaDukuza will experience above-average economic growth of between 3 and 5% per annum over the next 20 years. Strategically speaking, it is well-located on the N2 corridor between the Ports of Durban and Richards Bay, as well as its proximity to the King Shaka Airport and Dube Trade Port. As such, much development is expected in the KwaDukuza region in future and populations are expected to rise from 600 000 to approximately 1.1 million by 2030 and 1.9 million by 2050, based on a fairly conservative 3% annual economic growth rate.[59]

Therefore, the general trend of GHG emissions is expected to rise, particularly owing to energy consumption associated with higher population numbers over land use practices such as agriculture.

In addition to the targets iLembe Regional Spatial Development Plan,[60] the KwaDukuza Integrated Development Plan (IDP),[61] sets a trajectory of developing KwaDukuza into a modern city with a strong

[58] DEA. 2012. Let's Respond: A Guide to Integrating Climate Change Risks and Opportunities into Municipal Planning. Sustainable Energy Africa and Palmer Development Group, Pretoria.

[59] iLembe DM. 2012. iLembe Regional Spatial Development Plan Phase Three: Towards a Regional Plan. iLembe District Municipality, Umhlali.

[60] iLembe DM. 2012. iLembe Regional Spatial Development Plan Phase Three: Towards a Regional Plan. iLembe District

economy by 2030. Sustainability is one of the key objectives of the IDP alongside economic and social development and governance. The IDP also looks to protect and expand on its agriculture in the area, as well as its tourism network. The requirement for infrastructure development is made clear and the development priorities of housing and tourism expansion also mean that an increase in energy demand is inevitable. Enterprise iLembe is also proving to be a catalyst of increased economic opportunity and thus growth in KwaDukuza, as they market the North Coast as a prime investment destination.

While low-carbon growth is not elaborated on within the IDP framework, it is important to note that KwaDukuza's District Municipality, iLembe, is positioning itself as a green economy destination, with an aim to attract investment in renewable energy. With this in mind, it is quite possible that over the next 20 year horizon, GHG emissions could rise at first with the continuation of primarily Business as Usual (BAU) scenarios and then level out once a green economy is fully underway.[62]

I.4. Emissions-related Data Provided by KwaDukuza Municipality

KwaDukuza Municipality provided some estimates of fuel usage in their own vehicle fleets for the two most recent years available. These are presented in Table I.1.2. From the information provided, a baseline of 850 tCO_2 of fuel consumed per annum by the municipal fleet.

Table I.1.2: Fuel Consumption by KwaDukuza Municipal Fleet

Year	Fuel	Amount	tCO_2e
2010/11	Petrol	97710	223
	Diesel	243428	655
	Total		**878**
2011/12	Petrol	87822	201
	Diesel	241025	649
	Total		**849**

Source: KwaDukuza Municipality, 2013

I.5. Other Local Regions

In the absence of an emissions inventory it is considered necessary to look at neighbouring municipalities in terms of their municipal and, where possible, community emissions profiles, as well as any past trends.

The main dataset available is from eThekwini which has developed and published an inventory for the year 2010. This covers both the Municipality operations-related GHG emissions as well as the wider community GHG emissions. This data is summarised in the table below. It should be noted that eThekwini is a significantly larger, more populous, metropolitan Municipality but that the **types of emissions** are comparable and it is for this reason that it is referenced here.

Municipality, Umhlali.

[61] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

[62] iLembe DM. 2012. iLembe Regional Spatial Development Plan Phase Three: Towards a Regional Plan. iLembe District Municipality, Umhlali.

Table I.1.3: Summary of the eThekwini GHG Inventory

Source			
Municipality		**Community**	
Buildings	196,622	Residential	3,711,378
		Commercial	2,684,324
Facilities	185,257	Industrial	9,198,222
Transport	36,799	Transport	5,267,210
Waste	132,010	Waste	168,298
Wastewater Treatment & Discharge	19,188	Wastewater Treatment & Discharge	
Other Emissions	505,006	Other Emissions	
F-Gases		F-Gases	
Other Industrial Emissions		Other Industrial Emissions	
Agriculture, Forestry & Land use		Agriculture, Forestry & Land use	65,384
Fugitive Emissions		Fugitive Emissions	

Source: eThekwini Municipality, 2010

In the eThekwini Inventory, the majority of Municipality-related emissions apart from transport are associated with electricity use across the various departments. Renewable energy only accounts for a small fraction of the electricity consumed, the rest being supplied by Eskom. The 'other' category refers to losses of electricity in the transmission network. Emissions from waste management are also significant at the Municipality level, and include methane emissions from landfill operations.

At the community level, industrial and transport emissions are the greatest contributors, while residential and commercial related emissions are also important.

I.6. ICLEI-Africa

ICLEI-Africa has become an implementing partner of a European Commission (EC) - funded project, run in conjunction with United Nations (UN) -HABITAT, which aims to enable cities to lower their emissions as they develop and expand. As mentioned in Section 1 above, KwaDukuza Municipality has formed a two year co-operation with ICLEI-Africa on what is called an Urban Low Emission Development Strategy (Urban-LEDS) project in order to further develop their capacity to implement actions to tackle climate change, focusing particularly on reducing GHG emissions, but with a view to also promoting climate resilient development practices.

The Urban-LEDS process fits under the broader Green Climate Cities methodology developed by ICLEI-Africa. This methodology has been created to devise and prepare to implement a low-emissions development strategy. Their methodology is intended to be cyclical and thus iterative in nature.

ICLEI-Africa has over 60 members across Africa and 18 in South Africa, and has experience and knowledge across its four work streams, including: energy and climate change, biodiversity and integrated urban water management,

The Urban–LEDS process will ensure that KwaDukuza receives "one-on-one tailored technical support service, including strategic advice and planning, technical capacity building and technical and financial

support for mainstreaming, integration and implementation, in order to develop and begin to implement urban low emission development strategies".[63] It is currently in its inception phase, and the findings of the CCRS are intended to form a high-level baseline with which to inform further baselining activities and development of the Municipality's low emission development actions and capacity needs.

I.7. Key Sectors

I.7.1. Energy and Power

GHG emissions from the Energy sector are further elaborated in the Second Communication (SC) under the UNFCCC which provides an inventory of GHG emissions throughout South Africa (submitted November 2011). These are summarised in Table I.1.4. The energy industries sub-sector contributes 58% of the total energy-related GHG emissions. Transport and manufacturing account for approximately 10% each. Fugitive emissions account for a combined 19% of the total energy related emissions.

South Africa has abundant coal resources, and coal power provides the majority of grid supplied electricity by Eskom. A significant amount of coal is also exported. Off all fossil fuels, the combustion of coal leads to the greatest amount of GHG emissions on a unit basis. The SC (2011) estimates that Eskom provides 96% of generated electricity, with municipalities providing 1% and the balance by private utilities. In total this serves just over 80% of the population. Some renewable energy sources are present, and biomass forms an important part of the primary energy balance especially in the residential sub-sector.

Table I.1.4: South Africa Year 2000 Energy Related GHG Emissions

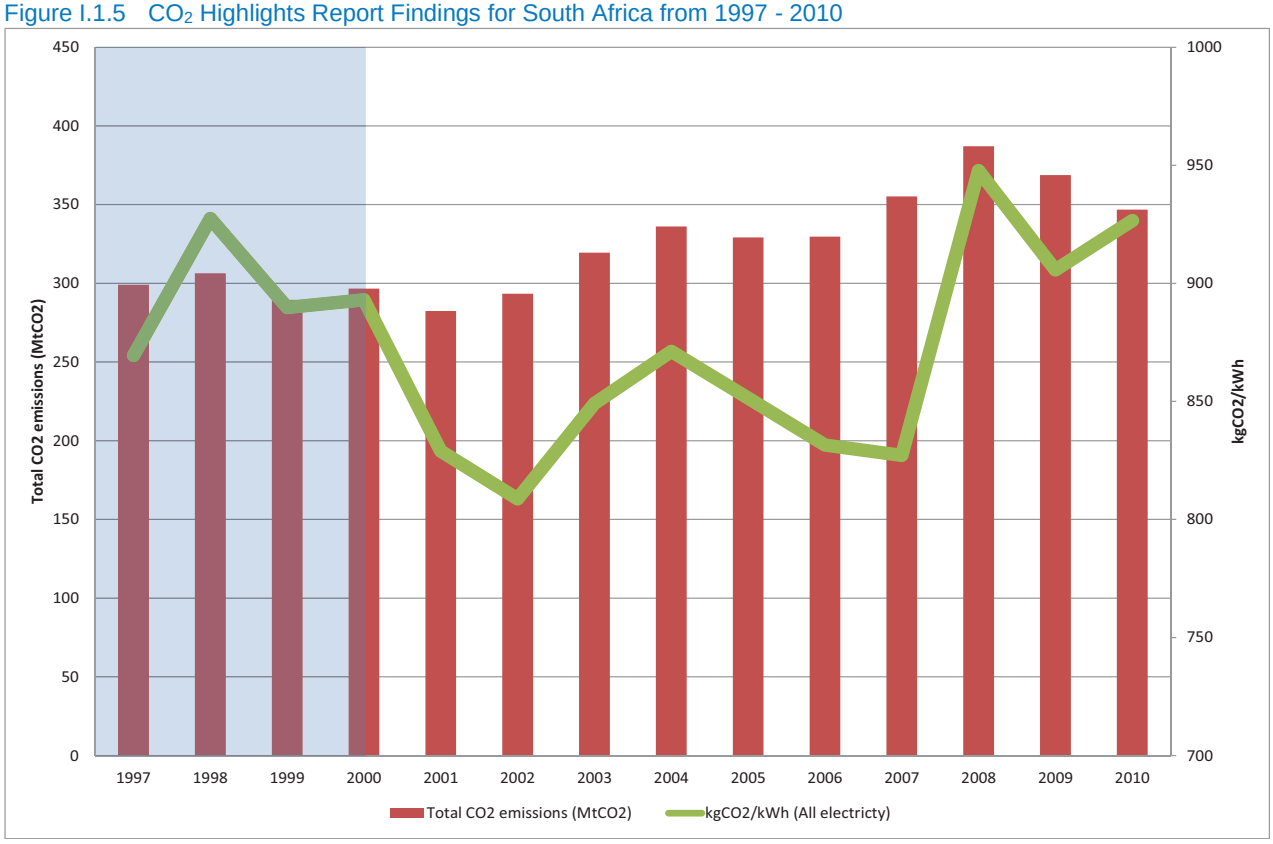
Type	Sector	$ktCO_2e$	
Fuel combustion	Energy Industries (power generation)	219491	58%
	Manufacturing industries and construction	39091	10%
	Transport	39511	10%
	Commercial	1911	1%
	Residential	5928	2%
	Agricultural	3718	1%
	Other	161	0%
Fugitive emissions	Solid fuels	40391	11%
	Oil and natural gas	30786	8%
Total		**380988**	

While the inventory in the SC is limited to the year 2000, other data sources have estimated the energy related GHG emissions. The International Energy Agency (IEA) has published data in its 'CO_2 Highlights' report that tracks its estimate of energy related GHG emissions from all countries up to 2010. For South Africa, this shows that energy-related GHG increased from 2000 to 2008 from around 295MtCO_2e to 385MtCO_2e, before declining in 2009 and 2010 to 345MtCO_2e (likely to be related to the economic downturn). Data is also presented by the IEA on the kgCO_2 per kWh of energy produced; this metric provides a rough indication of the technology mix and efficiency of the electrical generating plant. In 2000, a figure of 893kgCO_2/kWh is presented, and has fluctuated down to a low of 809kgCO_2/kWh in 2002 before

[63] Urban Earth. 2013. ICLEI-Africa launches urban low carbon emission development project. Available from http://urbanearth.co.za/articles/iclei-africa-launches-urban-low-carbon-emission-development-project

rising to a high of 948kgCO_2/kWh in 2008 and was above 900kgCO_2/kWh in 2009 and 2010. This measure suggests that coal use has not declined in a notable way and the overall efficiency of the electricity generating system has not improved since 2000.

Figure I.1.5 CO_2 Highlights Report Findings for South Africa from 1997 - 2010



Recognising the high dependence on coal, the Integrated Resource Plan (IRP)[64] recommended a diversification strategy for electricity supply provision up to 2030. Under the IRP, the share of coal in electricity generation would shrink from 90 to 65%, while nuclear generation would increase from 5 to 20% and renewable energy sources accounting for 10%. This is set against an increase in overall generating capacity of 260TWh in 2010 and a forecast of 454TWh in 2030. While net emissions would potentially still increase, the diversification would reduce the carbon-intensity of electricity generation. However as noted in the National Climate Change Response White Paper, there is a lead time in deploying such technologies and in the short-term and at a local level, the main routes to reducing GHG emissions from the energy sector are demand-side management and energy efficiency.

The IDP notes that KwaDukuza's predominant energy source is from electricity, with the second most prominent source being from candles. This illustrates that the local power network is not yet fully developed in certain (more remote) areas where communities have chosen to settle, such as informal settlements. They thus rely on alternative energy sources to that of electricity.

[64] Department of Energy, South Africa (2011), Pretoria

A number of power upgrades are identified that will help to provide additional capacity and resilience in the network to support the significant increase in demand. However there are currently no plans to develop a generating plant in the area, which means electricity will be sourced from the national grid and therefore follow a similar profile of emissions. However, nationally, there are distinct moves to incorporate a greater mix (and thus proportion) of renewable energy through the REIPPP programme mentioned in Section 5 above. It is unclear whether any of the potential bidders intend operating within KwaDukuza as yet (in the Solar, Hydro or Wind Energy space). Furthermore, within the Integrated Waste Management Plan, there is provision to develop some form of waste to energy recovery plant – this would be able to produce a low-carbon electricity supply and would avoid emissions associated with landfill.

Transport accounts for about 13% of total national GHG emissions and 25% in the eThekwini community related GHG inventory. The SC notes that total emissions in the transport sector increased 25% between the 1990 and 2000 GHG inventories. In general this reflects increase economic activities and improved living standards. A recent Regulation (R. 671 of Petroleum Products Act, 2012) has introduced new requirements for biomass blending in transport emissions to a minimum of 5% which will provide some level of mitigation in this sector, whereby the number of private car owners is ever-increasing, in line with economic growth. This will remain at least until a formal public transport network such as the IRPTN is in place and operating successfully throughout the KwaDukuza and greater iLembe region.

Since there is no utility-level power generation within KwaDukuza, the most relevant direct energy-use emission sources are likely to be from transport and commercial energy use. Residential energy use may also be a relevant consideration. Since there is a large dependency on electricity and there is little control on the emissions associated with the supply of that electricity, increases in emissions associated with electricity use are likely to rise with population group unless there are interventions in energy efficiency or local power generation development, particularly renewable energy.

Fugitive emissions contribute 19% of the total national energy-related emissions. These emissions result from mining and refining operations around fuel processing. These emissions have trended an increase according to the SC and reflect the high level of activities in fuel extraction industries in South Africa. The main GHG in this category is methane as a result of coal mining activities. These emission sources are likely not reflective of activities that take place within KwaDukuza which has a limited resource industry.

That said, large quantities of biomass energy are generated on site at the Tongaat Hulett sugar mills in the study area as a means of co-generation, which to a large extent prevents these prominent industries from being ‘net-contributors’ to the carbon cycle (i.e. not using fossil carbon to fuel their operations). A recent study undertaken by Tongaat Hulett found that the burning of cane merely negates the sequestration that occurred during its growing season, and therefore that the burning of cane is not necessarily adding to net atmospheric carbon levels. While the ICLEI-Africa Urban LEDS process is likely to assist with the curbing of future emissions, it will be only marginally in the 2013-17 planning cycle.

I.7.2. Industry

The national GHG inventory reporting the SC breaks down the key sectors that contribute to the non-energy related industrial GHG emissions. The predominant contributor is from metal production which accounts for over three quarters of the industrial process emissions, followed by mineral products and finally the chemical industry. There was a 4% rise in these sources of emissions between 1990 and 2000.

KwaDukuza is characterised by only light industry and does not fit the national profile for industrial emissions with an absence of large mines and power plants which are significant contributors to CO_2

emissions. The IDP identifies the key industries to include engineering, wood products, paper and packaging. The majority of this industrial activity is likely to be dependent on the energy supply (electricity and transport fuels), however, paper and packaging products can lead to direct GHG emissions depending on the method used from process chemicals. All manufacturing processes can also be linked to land use emissions from the resource use and contribute to waste.

Key emitters in KwaDukuza are: Industrial and manufacturing operations in KwaDukuza including, the Stanger Sappi Paper Mill and Sugar Mills in Darnall and Gledhow (mentioned above). Smaller scale light industrial activities exist north of Ballito and in the Groutville area.[65] However, no quantitative/definitive emissions data was either recorded or made available by these industries at the time of this study.

I.7.3. Land use

Emissions from land use and land use change arise due to changes in the biogenic carbon sinks associated with the land. During plant growth CO_2 is absorbed by the land in both the biomass and the soil components.

Agriculture, forestry and land use emissions were estimated as having a combined net emission of 20,022MtCO_2e, which comprised of a sink of CO_2 emissions of 20,750MtCO2e and emissions of 40723MtCO_2e of methane and N_2O. The majority of emissions produced at the national level were due to enteric fermentation, manure management and biomass burning. However, it is noted in the Second Communication of 2011 that the estimates of land use and agricultural emissions was limited and a revised inventory will be produced on these emissions in due course.

Apart from biomass burning, these sources of emissions identified at the national level are not likely to be representative of the situation within KwaDukuza since the agriculture in the area is predominantly based on sugar cane and forestry. Sugar cane cultivation and forestry are more likely to be acting as sinks unless they are being used as a fuel.

Since agriculture comprises a relatively large part of the local economy, sources and sinks of emissions from this sector may be more important to KwaDukuza than indicated at the national level.

I.7.4. Waste

Waste disposal contributes to only a small part of the total national GHG inventory thought it is relevant since is it ostensibly a local issue. The majority of emissions associated with waste in 2000 were associated with methane gas emissions from landfills, totalling 86% of GHG emissions. In anaerobic environments methane is released as the organic fraction of the waste decomposes. The rest of the emissions were associated with waste water handling. The SC notes that the estimate of emissions from waste only take in to account managed waste facilities – a proportion of emissions is therefore unaccounted for. Similarly, the waste water inventory only included domestic (residential) waste water and not waste water from industrial sources.

Landfill gas can account for as much as 10% GHG emissions in a municipal region.[66] KwaDukuza is currently serviced by two privately owned landfill sites following the decommissioning of a municipal-owned

[65] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza.

[66] DEA. 2012. Let's Respond: A Guide to Integrating Climate Change Risks and Opportunities into Municipal Planning. Sustainable

facility. The Integrated Waste Management Plan notes that currently landfill is the predominant method of disposal for solid waste and therefore follows the national norm. No energy recovery currently takes place within the Municipality. Almost half of the population do not have access to regular waste collection services and use communal collection points or dispose of waste in some other way[67]. Locally, it is estimated that the organic fraction of waste represents 55% of the total waste volume but there are no formal policies for waste separation, recycling or minimisation. GHG emissions from the waste sector can be assumed to be close to worst case and there is potential to reduce them with better management. Given the growth aspirations and increase in population in the area, it is likely that GHG emissions due to waste will increase without intervention.

I.8. Co-benefits of Climate Change Mitigation and reducing GHG Emissions

While we have made commitments as a country to reduce GHG emissions, there are other important reasons why moving towards a lower carbon environment is a sensible course for municipalities.

A lower carbon environment can:

- reduce the vulnerability of the local economy to carbon taxes and trade barriers;
- create relatively cheap electricity distribution capacity on overstretched distribution grids through energy efficiency;
- insulate against oil price shocks in the future (with public transport and compact cities) as the world moves towards 'peak' oil;
- create jobs in new energy sectors, such as solar water heating (SWH), installations and manufacturing;
- improve energy security with local energy sources with the production of local renewable energy;
- reduce poverty, create awareness and boost resilience; and
- reach development objectives in a sustainable way.[68]

In line with the national targets for emission reductions in the country, and as a growing economy, KwaDukuza will have to achieve above-average reduction targets on a per capita/ per GDP basis. Because organisation cannot manage what it does not measure, a GHG inventory will first be required. Thereafter, GHG reduction targets will need to be set for the Municipality.

Energy Africa and Palmer Development Group, Pretoria.

[67] Integrated Development Plan (IDP). 2012/17. KwaDukuza Municipality. Ballito, KwaDukuza

[68] DEA. 2012. Let's Respond: A Guide to Integrating Climate Change Risks and Opportunities into Municipal Planning. Sustainable Energy Africa and Palmer Development Group, Pretoria.

Appendix J. Climate Impacts

J.1. Introduction

This chapter considers how key climate variables and the impacts associated with these variables are expected to change over time.

J.2. KwaDukuza's Climate

The following sections provide an overview of the characteristics of KwaDukuza's current climate and how this is expect to change over time.

J.2.1. Temperature

Temperatures can vary greatly due to the seasons as well as the country's geography. Summer temperatures can often rise over 32°C in the summer and can drop several degrees below 0°C at higher elevations in the winter months. The east coast of the country also tends to be about 5°C warmer than areas at same latitudes along the west coast due to the presence of the warm Agulhas current that sweeps southward along the Indian Ocean coastline in the east, and the cold Benguela current that runs northward along the Atlantic Ocean coastline in the west.[69]

Between 1960 and 2006, the mean annual temperature for South Africa rose by 0.6˚C (average rate of 0.14˚C per decade). Daily temperature extremes have also become more frequent; from 1960 to 2003 the annual number of "hot" days[70] has increased by 19 (an additional 5% of days) as well as the number of "hot" nights by 16 (an additional 4.3% of nights). The increase in "hot" days and nights is most prominent in the months of March, April and May.

The mean annual temperature for KwaDukuza is projected to increase between 1.7 and 2.7˚C by 2060's and 3.0 to 4.5˚C by the 2090's. This warming is expected to be similar throughout the year, although it will be more pronounced inland compared to the coastal regions. The number of "hot" days and nights will also continue to increase: "hot" days are projected to occur between 19 and 40% of days by the 2060's and 31 to 57% of days by the 2090's (from a baseline of 11% between 1970 and 1990); and "hot" nights are projected to occur between 17 and 31% of days by the 2060's and 32 to 49% by the 2090's (from a baseline of 11% between 1970 and 1990).[71]

The months of December, January and February are projected to see the most rapid increases in both the number of "hot" days and nights occurring in a season. Conversely, the frequency of "cold" days and nights[72] are projected to decrease as average temperatures rise.

[69] UNDP Climate Change Country Profiles – South Africa. Available at http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/

[70] The temperature threshold for a 'hot day' in any region or season is defined by the daily maximum temperature which is exceeded n the 10% warmest of days/ nights in the standard climate period (1970-99) fall. The number of "hot" days/ nights is then defined as the frequency with which daily maximum temperature exceeds this threshold in any month, season or year.

[71] Schulze, R (2013). Technical Information Pack for KwaDukuza CCRS. UKZN, Pietermaritzburg.

[72] The temperature threshold for a 'cold day' in any region or season is defined by the daily maximum temperature below which the 10% coldest of days/ nights in the standard climate period (1970- 99) fall. The number of "cold" days/ nights is then defined as the frequency with which daily maximum temperature falls below this threshold in any month, season or year.

J.2.2. Precipitation

Rainfall is considered to be the most important climatic feature in South Africa, which drives not only agriculture and the hydrological system but economically, the limitations in water availability can impede the development of the country. South Africa experiences a rainy season from convective rainfall in the summer months from November through to March although the southwest region receives mostly mid-latitude frontal rainfall in the winter months (May through August). Rainfall varies considerably from west to east which can be attributed to the ocean currents and the general anticyclonic circulation over the subcontinent: while the north-western region of the country receives less than 200mm rainfall per year; eastern parts receive over 500mm of rainfall. The 250mm isohyet is generally accepted as being the geographical boundary for rain fed agriculture. Since 1960, mean rainfall over South Africa has decreased by 3.7% per decade (1.5mm per month).

The KwaDukuza area is fortunate to have relatively high annual rainfall, with a relatively low inter-annual variability. For the 50 year period of 1950 to 1999, the driest year per decade saw between 663 and 762mm of rainfall, with an average inter-annual variability of 237mm. The area therefore did not fall under the 250mm isohyet for rain fed agriculture.

KwaDukuza is projected to experience a slight increase in precipitation (the greatest change is for “dry” years compared to “median” or “wet”), apart from the months of June, July and August when it is projected to decrease. The inter-annual variability of rainfall is therefore predicted to increase slightly due to this divergence. The amount of rainfall associated with heavy rainfall or maximum 5-day rainfall events is only projected to change very slightly. More detailed information on these predictions can be found in Appendix F.1.

Overall the projected increases in rainfall for the KwaDukuza area bode well from a water resources availability perspective and from that of potentially increased crop yields, especially in drier years and in the drier months. On the negative side are possible increases in flooding and sediment yield as well as inundation of agricultural lands adjacent to rivers.

J.2.3. Potential Evaporation

Potential evaporation is a climatic variable with relatively little difference from location to location within the KwaDukuza Municipality, with an annual median between 1,335 and 1,650mm. There is comparatively little variation between cool and median as well as warm and median years (between 2 and 5%), and with most catchments displaying a slight reduction in potential evaporation towards the ocean (i.e. the lower Quinaries) due to an increase in humidity. A breakdown of these figures can be found in Appendix F.2.

The monthly potential evaporation is predicted to increase by 8 to 12% over the next 40 or so years. This increased evaporation is likely to impact water bodies such as dams, wetlands and rivers which already see relatively high evaporative losses (roughly 1,500mm per year), sugarcane irrigators as they will have to purchase more water for their crops, and dryland (rainfed) farmers who will see their soils dry out more frequently.

J.2.4. Storm Surges

The south eastern coastline of southern Africa, comprising South Africa, Mozambique, Tanzania and Kenya, is regularly affected by cyclonic and other significant weather events that have the ability to unleash large wave events along the coast. Most cyclones that affect the region form over the eastern Indian Ocean, to the East of Madagascar, move south west towards the continent and then continue in an arc towards the southeast (south of Madagascar). Cyclones that remain semi-stationary south of Madagascar are the systems that create the biggest swells in the region.[73]

In contrast, cut-off lows are generated in the Southern Oceans when an anti-cyclonic depression occurs as a result of strong upper ridge advancing south-eastwards and separating a cold upper air pool. They are characterized by a convex shaped surface high-pressure system along the southern Cape coast. Well-formed cold fronts can generate significant swell and the passage of this type of system results in gale force winds and high seas. [74]

When these weather systems coincide with spring high tides they can result in flooding and coastal erosion, such as in March 2007. The March 2007 storm was caused by a cut-off low pressure system coinciding with tides at the high point in their 18 year cycle. The storm generated waves of 8.5m in addition to tides that were 0.2m above the usual spring-high tide levels.[75] The cost of repairs following the widespread flooding and coastal erosion was put at R400 million although this figure does not include foregone tourism revenue.[76]

Climate change may lead to an increased frequency and magnitude of storm surges through sea level rise (this ensures that water levels are higher to begin with), and increasing ocean temperatures which is likely to intensify cyclone activity. Larger storm surges will lead to greater future destruction as they can move further inland and therefore threaten a larger area than in the past.[77]

Coastal erosion negatively impacts the tourism industry which is reliant on the coast as well as roads and properties in the area.[78] [79]

[73] Mather, A. and Stretch, D. (2012) *A Perspective on Sea Level Rise and Coastal Storm Surge from Southern and Eastern Africa: A Case Study Near Durban, South Africa*. Water, vol. 4, 237-259

[74] Mather, A. and Stretch, D. (2012) *A Perspective on Sea Level Rise and Coastal Storm Surge from Southern and Eastern Africa: A Case Study Near Durban, South Africa*. Water, vol. 4, 237-259

[75] Mather, A. 2008. *Coastal erosion and sea-level rise: are municipalities ready for this*? Internal Document, eThekwini Municipality, KZN, South Africa.

[76] Mather, A. 2008. *Coastal erosion and sea-level rise: are municipalities ready for this*? Internal Document, eThekwini Municipality, KZN, South Africa.

[77] Susmita Dasgupta *et al*. 2009. "*Climate Change and the Future Impacts of Storm-Surge Disasters in Developing Countries*." CGD Working Paper 182. Washington, D.C.: Center for Global Development.

[78] Smith, A., Guastella, L., Bundy, S. & Mather, A. (2007) *Combined marine storm and Saros spring high tide erosion events along the KwaZulu-Natal coast in March 2007*. South African Journal of Science 103: 274.

[79] Environmental Resources Management South Africa (2009) Climate Change: Municipal Adaptation Plan Health and Water.

J.2.5. Sea Level Rise

Changes in sea level rise have already been observed on the KZN coastline which has been estimated at 2.7mm per year along the eastern South African coastline.[80]. Many low lying local coastal areas are at risk of sea level rise, which can impact industries, transport hubs, coasts and beaches, agriculture, and ecologically important areas. The tourism industry is developing along the coast which will be particularly vulnerable.

While past rates of sea level rise can be deduced from tidal gauges and past data sets, predicting future sea level rise involves a degree of uncertainty. Although there is a general consensus that sea levels are rising, different models use different values for changes in temperature (leading to thermal expansion of the oceans) as well as rates of glacial and ice sheet melt.[81]

Potential direct impacts of sea level rise include saline intrusion which will reduce the quality of freshwater, an increased likelihood of coastal flooding, and increased coastal erosion rates and an increased frequency of storm surges. Some of the main areas affected will be biodiversity (damage to estuaries), human safety and tourism. The cost of managing this to mitigate consequences will be high, especially when ecologically important areas such as coral reefs and mangroves are particularly vulnerable.

J.2.6. Gale and Wind Storms

KwaDukuza experiences moderately windy conditions on average, with stronger wind gusts along the coast. Wind storms and gales present risks to buildings, infrastructure and the natural environment. Those living in low-cost housing or informal settlements are the most vulnerable as their construction will be least resilient to extreme weather.

Projected increased wind speeds will increase the rate of coastal erosion. In the event of fires in winter, caused either by arson or lightning strikes, strong winds could impact more greatly on settlements and commercial or industrial enterprises. Increase in mean wind speed and gusts could also be problematic for cane farmers in the region, who operate on a controlled burn basis before harvesting cane. On natural remaining landscapes, fire is not considered problematic to ecological systems as it is a natural occurrence in the wild – however, a change in the frequency can impact on ecological dynamics.

[80] Mather, A. (2007) *Linear and nonlinear sea-level changes at Durban, South Africa*. South African Journal of Science, vol 103, no.11-12

[81] Warrick, R and Oerlemans, J (1990) IPCC Chapter 9 – Sea Level Rise. Available at: http://www.ipcc.ch/ipccreports/far/wg_I/ipcc_far_wg_I_ chapter_09.pdf

J.2.7. Lightning

Lightning is a regular occurrence in KwaDukuza during heavy rainfall and cyclonic events. It presents risks to buildings, infrastructure, agriculture, forestry, livestock and human lives. With more intense rainfall and storms likely to occur in future, it could be inferred that lightning strikes would increase in number and intensity during these events – but not necessarily in total, as these weather events may be less frequent over an annual period. Hotter and drier conditions (particularly in winter) may render veld and agricultural areas as being areas of higher risk to fires caused by lightning strikes. If fire breaks and emergency response teams are not in place, this could severely reduce yields, and put human settlements/business at higher risk.

J.2.8. Anomaly Events

El Niño Southern Oscillation events and sea-surface temperature anomalies in the Indian and South Atlantic Oceans significantly affect rainfall variability in the country[82]. However changes in the amplitude and frequency of future El Niño events are uncertain due to disagreeing model predictions. Projections for the future climate variability are therefore uncertain.

J.3. Impacts on Natural Systems (Theme One)

J.3.1. Water

Water is a central and a critical input to many of the KwaDukuza's economic activities with regard to;

- Needs for the industrial and domestic sectors;
- Sustaining terrestrial and aquatic ecosystems, including estuaries;
- Providing water to the agriculture sector, both for irrigation and rain-fed farming, for commercial and subsistence farmers, for crops and for livestock;
- Recreational purposes; and
- Meeting the increasing demands and expectations of an expanding population in order to improve peoples' standards of living.

Climate change poses a risk to the water sector by increasing future demand for water as well as reducing the availability of water at the same time. Water usage tends to increase in warmer weather, which is also when evapotranspiration rates are at their highest. This will be compounded by other factors such as population growth and land use changes, when actual water availability is decreasing. The increase in projected rainfall may have benefits if services can provide purification and supply which may result in higher maintenance costs and the need for more resources

[82] UNDP Climate Change Country Profiles – South Africa. Available at http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/

An increase in the number of intense rainfall events can also result in increased flooding events as well as higher erosion rates. While floods can disrupt wastewater treatment processes, higher erosion rates can also lead to the reduced quality of water bodies through increased siltation in runoff. Table J.1.1 summarises the key climate change risks and opportunities for the water sector.

It is clear that present and future hydrological responses need to be assessed so that impacts of climate change can be prevented or addressed as soon as possible. Appendix F.3 provides an overview of the hydrological network in the KwaDukuza Municipality. Is important to allow adaptive measures to be produced and acted upon, conserving as much water as is feasible.

Table J.1.1: Key climate risks and opportunities for water systems

Risks
• **Supply/demand** – demand for water is projected to increase over the coming decades at the same time as the amount of water available for public supply decreases • **Reduced water quality** - Water quality depends to a large extent on water volume and is therefore influenced by river flows. For example, pollutants are less likely to be diluted by lower summer flows. Higher water temperatures may also contribute to changes in water quality • **Erosion rates and siltation** – increased numbers of intense rainfall events will lead to higher erosion rates and therefore siltation in water bodies
Opportunities
• None

J.3.2. Coastal and Marine

The coastal and marine environment provides essential resources and contains critical infrastructure assets. Changes in sea level rise have already been observed on the KZN coastline. The 2007 storm cost the KwaDukuza vast amounts of money in the restoration of its beaches. The recorded sea level rise in Durban (south of KwaDukuza) has been 2.7mm/year (from 1970-till present) and studies reveal that there will be continued measurable changes in sea level rise in KwaZulu-Natal.[83] Some of the main areas affected will be biodiversity (damage to estuaries), human safety and tourism.

Marine industries are used to dealing with uncertainty and variability in the weather by providing natural barriers to coastal flooding. However, the potential impacts of climate change on this sector could be intensified in the future and there are strong interdependencies with other sectors (e.g. energy, health and business, tourism, industry and services) which could compound impacts.

The cost of managing this to manage the consequences will be high, especially when ecologically important areas such as coral reefs and mangroves are particularly vulnerable. Storm damage will have similar consequences.[84]

[83] KZN DAEA. 2010. The Province of KwaZulu-Natal and Policy Direction for Climate Change (online). Available from http://www.kzndae.gov.za/Portals/0/COP17/THE%20PROVINCE%20OF%20KWAZULU%20and%20CC_policy.pdf

[84] Environmental Resources Management South Africa (2009) Climate Change: Municipal Adaptation Plan Health and Water.

Table J.1.2: Key climate risks and opportunities for marine and coastal systems

Risks
• **Declining marine water quality -** Sewage discharges are a major source of marine pollution. Contamination due to storm-tank and sewer overflows and runoff from agriculture are significant and an increased frequency of intense rainfall events may increase sewer spill frequency and increase such risks. • **Changes in fish catch latitudes -** Rising sea temperatures may lead to a shift in the distribution patterns of some species of fish and shellfish. This is expected to impact fishing industry as a result of greater fuel costs for vessels that continue to target these resources or offer new fishing opportunities from other species becoming more abundant. Climate change will also affect the 'year-class strength' (the number of fish or shellfish of a given age group that survive from egg production to be exploited by fisheries having a negative impact on some species but a positive effect on others. • **Ocean acidification -** By absorbing carbon dioxide (CO2) from the atmosphere seas are becoming more acidic. A range of species and ecosystems are vulnerable to this acidification, with particularly serious economic implications for commercial shellfish species. • **Disruption form extreme events -** If the magnitude and frequency of extreme events change, there may be more frequent disruption activities to the society, environment and economy. • **Flooding and coastal erosion –** Climate change may result in more flooding, due to higher river flows (caused in particular by an increase in the quantity and intensity of rainfall) and rising sea levels. Rising sea levels may accelerate coastal erosion and the deterioration of coastal flood defences. Coastal erosion occurs naturally, although climate change may lead to an increase in the rate of erosion. Locally this may have significant implications for communities and habitats. • **Impact on marine biodiversity** - Climate change is expected to impact the function of marine ecosystems disrupting food-webs and potentially fisheries. Similarly, an increase in eutrophication may disrupt marine food webs. A number of species, including certain seabirds as well as non-native plants and animals, may establish themselves in the UK for the first time, while others may disappear. Rising sea temperatures have been associated with increases in illness associated with these organisms.
Opportunities
• **Changes in fish catch latitudes –** See above

J.3.3. Biodiversity

The biggest threats to biodiversity to date have been posed by habitat loss, fragmentation and degradation due to water and air pollution and land-use changes. Biodiversity and ecosystem services are sensitive to gradual changes in climate (e.g. increasing temperatures) and to more abrupt changes caused by extreme weather events (e.g. droughts, floods and storm surges). Climate change is already having a direct impact on biodiversity and is generally acting as a further stress on ecosystems already under pressure. Biodiversity has many and close interdependencies with other sectors (e.g. agriculture, water, marine and fisheries). Actions in these sectors may intensify the threats from climate change, but also may offer opportunities for biodiversity and ecosystem services.

Table J.1.3: Key climate risks and opportunities for biodiversity systems

Risks
• **Reduced soil and water quality** - Climate change may significantly affect the biological, physical and chemical processes underpinning soil quality. Drier summers leading to increased soil moisture deficits may result in increased release of greenhouse gases such as carbon dioxide and methane. Heavy rainfall, especially if following a dry period, may increase the chance of soil erosion. The effect of pollution on water quality may be exacerbated by climate change due to lower flows in rivers and a resulting increase in concentration of pollutants. Temperature changes may affect nutrient cycling and decrease oxygen supplies available for water habitats. During droughts, the risk of irreversible ecological change may increase. Changes to water levels, quality and temperature could have negative implications for fish stocks and freshwater species.
• **Pests, Diseases and Invasive Non-native Species** - Climate change may aid spread and persistence of pest and diseases causing damage to biodiversity, agriculture, forestry and aquaculture. Invasive non-native species could find it even easier to out-perform native species and habitats as the climate changes
• **Habitat loss and reduced biodiversity** – If a species cannot move to adjust to changes in its climate space (often as a result of habitat loss, fragmentation and loss of landscape diversity) it becomes more vulnerable to local extinction. Climate change may also favour 'generalist' species (those able to thrive in a wide range of environmental conditions) and alter some migration patterns, either at departure or destination sites or on migration routes. For some species, this may provide new opportunities; for others, it may introduce new risks to their existence.
• **Wildfires** - Although the majority of wildfires are started by humans, either accidentally or deliberately, climate change may increase the likelihood of their occurrence. For ecosystems particularly sensitive to fire (e.g. woodland and grassland), an increase in the number of large fires would lead to significant loss of biodiversity and of ecosystem services such as carbon storage.
Opportunities
• **Arrival of alien, non-invasive species** – As the climate shifts, new species may arrive in the area that have not previously done so and are not in direct competition with other native species

J.3.4. Agriculture

Many of the challenges facing the agriculture sector can be linked to socio-economic, environmental and technological trends and issues, with climate change being an exacerbating factor, rather than necessarily the driving force of change. Rising temperatures and changing rainfall patterns, changes in sunshine levels and in concentrations of atmospheric carbon dioxide (CO_2), and increasing frequency of weather events currently considered extreme would all have an impact on operations, productivity and the range of products offered by the sector. This may lead farmers to review the products that they produce, as well as consider diversifying their activities. Appendix F.4 provides an example of potential impact on sugarcane crops.

Changes in rainfall patterns and water availability can have a wide range of implications for farmers in the region. Although increased rainfall will lighten the pressure of water demand on farmers, flash floods and extreme rainfall events will ruin crops, reduce food production and harm livestock. Periods of warmer temperatures can create fires and drought as weather patterns become more extreme, which may put farmers under further strain for already limited water resources. These temperatures may even counteract any possible increases in rainfall due to increased evapotranspiration rates.

Plantations have been located in areas where timber yields are viable in suitable temperature and humidity conditions, which have in turn created specific routine runoff patterns which are integral to catchment level water management. The wider area must therefore also be considered when changing land management practices to adapt to a changing climate.

Table J.1.4: Key climate risks and opportunities for agricultural systems

Risks
• **Dryer soils** - Projected changes in rainfall and evapotranspiration would increase aridity levels and increase demand for extra irrigation • **Water availability** - Rising agricultural water demand due to a drier climate, coupled with rising water demand from other sectors could coincide with less water being available for agriculture. • **Flooding** - Agricultural land is projected to face an increased risk of flooding from rivers and the sea. Some of this land may become unsuitable for the agricultural activities it is currently used for. • **Reduced yields** – Unsuitable temperatures and soil moisture, as well as pests and extreme weather events can all result in reduced yields from crops • **Heat stress** - Livestock may be particularly vulnerable to heat stress, while transportation of animals during heatwaves may pose major risks to their health and welfare. • **Pest and disease** – Changes in climate change increase the prevalence of pests and disease, with evidence showing possible increased infestation of pests such as Eldana worm (affecting cane) • **Extreme events** – Storms and floods can destroy crops themselves as well and soils (e.g. saline intrusion) which will take years to recover • **Water quality** - Changes in the frequency of intense rainfall events, particularly following periods of dry weather, could contribute to increased nutrient runoff from agricultural land, which may affect local water quality. As well as harming biodiversity and ecosystems, this may affect the quality of water abstracted downstream.
Opportunities
• **New crops** - There could also be opportunities to introduce new crops or to expand existing crops that are currently only grown in small quantities • **Reduced occurrence of frost** – this can increase the scope for crop production in the area • **Diversification** – diversifying from only farming crops (e.g. to lodging for tourism) may lead to a more stable income as it is spread over various sources

J.4. Impacts on Built Systems (Theme Two)

Climate change is expected to pose a number of risks to the built environment. Extreme events and the changes in the magnitude and frequency of events such as flooding, storms, heat waves and drought are a primary concern for the sector. However, long term changes in climate such as increasing average temperatures and sea-level rise will become increasing concerns overtime. As well as the direct risks posed by climate change to the built environment these are expected to be further compounded by the sector's interdependencies with other sectors and the increasing risks posed to thee sectors such as interruptions to energy supplies and increasing pressure on water supplies.

J.4.1. Human Settlements

Population growth and the planning system have a significant influence on the built environment and its evolution, including how it adapts to climate change. It is therefore vital that predicted changes in climate are taken into account during the planning process to prevent mal-adaptation. Increased temperatures and population growth may, for example, increase indoor cooling needs which will lead to an increased use of air conditioning units (and increase electricity consumption) if buildings are not adapted to higher temperatures.

Human comfort/discomfort plays an important role in KwaDukuza for the comfort of tourists (especially during the holiday seasons) and in the comfort of manual labourers in the sugarcane industry, particularly during the harvest season from April to December. More detailed information on this can be found in Appendices E and F.

Table J.1.5: Key climate risks and opportunities for human settlements

Risks
• **Overheating** – Higher temperatures may increase the risk of buildings becoming too hot and uncomfortable. Overheating may also affect economic productivity through loss of staff hours, if workplaces become too hot. This may also increase energy demands and associated costs in response. Due to the Urban Heat Island effect (where the temperature at the centre of a large town or city remains several degrees higher than in surrounding rural areas) urban areas may be particularly vulnerable. Green space and 'blue' infrastructure (e.g. rivers and ponds) can help reduce the Urban Heat Island effect; however more frequent and prolonged dry spells can reduce the effectiveness or crease the costs associated with these measures. • **Subsidence** – Changes in temperature and rainfall patterns can increase the risk of subsidence affecting properties. The level of risk is dependant on the depth of foundations and soil type. • **Flooding** – An increasing number of residential and non-residential properties are expected to become at risk to flooding during. This may have a large economic impact and may lead to a substantial rise in insurance payouts for flood damage. The potential social impacts of flooding and coastal erosion are substantial. As well as the immediate physical and mental effects, the resettling of those affected can be disruptive and traumatic. The consequences will be felt disproportionately by vulnerable groups, such as the elderly, disabled and the economically disadvantaged. Businesses may sustain more direct flood damage to buildings and assets as well as increased disruption. Supply chain disruption, for instance, may result in reduced sales and share prices. The business sub-sectors most vulnerable to flooding are wholesale and retail, finance, insurance and manufacturing. • **Water availability** - Changes in water availability, particularly during dryer months, may lead to less reliable supplies, more frequent restrictions and potential water shortages in the longer term, unless more measures are taken to reduce demands and develop supplies.
Opportunities
• **Knowledge transfer** – there is the opportunity to learn best practice from other countries who are currently experiencing climates that the KwaDukuza Municipality is predicted to experience in the future

J.4.2. Waste

The primary impacts in the waste sector will be similar to those in the rest of built systems as the sector is reliant on assets and transport to these assets. Please refer to the human settlements, energy and transport sections for relevant issues.

J.4.3. Energy

Primary issues for the energy sector is energy security and climate change mitigation, however adaptation is an increasing important issue as the sector is vulnerable to extreme weather events from current climate. These risks are expected to be intensified by interdependencies with other sectors such as disruption to transport infrastructure affecting supplies of some fuels.

Climate change impacts may include changes in energy demand due to rising temperatures; increasing flood risks to energy infrastructure due to more intense rainfall and rising sea levels; and constraints on water availability for power station operations. In terms of the current climate, the sector is most vulnerable to extreme weather events that have an immediate impact on the ability to supply energy.

Flooding may pose an increasing threat to critical infrastructure. As a result, transport networks, water supplies and sewage treatment, energy supplies, hospitals, and schools, for example, may face growing challenges in their ability to operate efficiently, service the economy and meet important social needs.

Table J.1.6: Key climate risks and opportunities for the energy sector

Risks
• **Energy demand -** Higher summer temperatures may result in a rise in energy demand for cooling. • **Flooding** - The main risk posed by flooding in this sector is to power stations and electricity transmission and primary distribution substations. Substations are at greater risk of river flooding, while power stations are at greater risk of tidal flooding. There may be opportunities to increase resilience to flooding as current energy infrastructure reaches the end of its lifetime and is replaced, but this will depend strongly on the design and location of new infrastructure. • **Extreme temperature** – High temperatures can exacerbate pre-existing network faults or older infrastructure. Industry design standards should ensure that infrastructure is capable of withstanding high temperatures. Higher air temperatures may make it necessary to 'de-rate' reduce the amount of electrical current passing through transmission networks to ensure that the equipment does not overheat. De-rating will reduce the risk of power outages although will decrease the transmission capacity, which may be significant as demand increases. • **Water availability –** Water is used cool power plant components in electricity generation. Climate change may reduce the amount of water available for abstraction for inland power stations. Higher temperatures are also expected to increase the temperature of water abstracted reducing efficiency.
Opportunities
• **Knowledge transfer** – there is the opportunity to learn best practice from other countries who are currently experiencing climates that the KwaDukuza Municipality is predicted to experience in the future

J.4.4. Transport

Weather and climate can significantly influence the transport sector. Weather event such as high winds, extreme temperatures and heavy rain can cause damage and disruption to road/ rail/ marine networks themselves and also put people using these networks in danger. Impacts on transport networks can have significant knock-on effects on other networks as well as other sectors due to their interlinked nature.

Over time the magnitude, duration and/ or frequency of these risks will change which will require a response from the sector. Climate change adaptation responses will need to take account of major challenges for the sector including changing demand for transport, population growth and other socio-economic issues. Technological changes will also be key in shaping future transport networks, while balancing the need reduce greenhouse gas emissions.

Table J.1.7: Key climate risks and opportunities for the transport sector

Risks
• **Flooding** - Transport infrastructure may face an increased risk from flooding. Flooding may occur more frequently and affect a larger area, with infrastructure located in floodplains most at risk. Municipalities, using their planning powers, can ensure that critical infrastructure is no longer built on floodplains and that current infrastructure is assessed in terms of climate risk. • **Landslides** – The risk of these events is heavily dependent on the underlying geology, soil type and soil moisture. Increasing severity and length of dry periods and frequency of storms or heavy rainfall can raise the risk of landslides. A risk assessment on existing infrastructure coupled with underlying geology can help highlight infrastructure in high risk areas which can in turn become priority areas. • **Temperature extremes** - Warmer temperatures will increase the risk of damage to road surfaces and rail buckling and reduced passenger comfort. This is will be particularly a problem for older infrastructure, local infrastructure with lower design specifications or infrastructure that is less maintained. There is an opportunity for the Municipality to use its planning powers to ensure that projected scenarios are taken into account during the planning and design stages of a project, or even include such issues into design standards. • **Scour** - Increased heavy rainfall events and higher river flows can lead to more damage to road and rail bridges. In addition to scour (the washing away of foundations), bridges can be weakened during floods by impact from floating debris and the washing-out of material from poorly maintained assets. This is expected to be a significant issue for older assets, as new assets are expected to from improved design and a better understanding of risks.

Opportunities
• **Knowledge transfer** – there is the opportunity to learn best practice from other countries who are currently experiencing climate that the KwaDukuza Municipality is predicted to experience in the future

J.5. Impacts on Socio-Economic Systems (Theme Three)

J.5.1. Human Health and Wellbeing

Climate change will present a number of challenges to the health sector, which will be further compounded by social and economic factors and inter-linkages with other sectors such as agriculture or the built environment.

The potential social impacts of flooding and coastal erosion are substantial. As well as the immediate physical and mental health effects, the resettling of those affected can be costly, disruptive and traumatic. There is also the possibility for the water to collect in stagnant pools where disease vectors such as mosquitoes can breed once the event is over. Flood events will also put additional pressure on response services such as temporary shelters and food and have the potential to disrupt local transport lines and links which are vital for imports and exports of goods.

In future, the impacts of flooding and coastal erosion may be felt by an increasing number of people, with the consequences felt disproportionately by vulnerable groups, such as the elderly, disabled and the economically disadvantaged.

Higher temperatures can also lead to a variety of risks in urban and especially rural populations. Higher evaporation rates lead to an increased demand for potable and clean water when availability is low, and increased numbers of wildfires lead to increased levels of air pollution which can make health issues worse.

Table J.1.8: Key climate risks and opportunities for human health and wellbeing

Risks
• **High temperature** – Heat waves and high temperatures account for a number of deaths and admissions to hospital every year, with rising temperatures these rates are expected to increase particularly from cardio-vascular and respiratory conditions. This will particularly affect vulnerable groups such as the elderly. Healthcare provisions could also be affected affecting both patient recovery and the performance of staff.
• Warmer temperatures can also raise the risks of water-borne and food-borne diseases as well as diseases carried by insects and parasites. Increasing temperatures may lead to a rise in the number of deaths and hospital admissions resulting from respiratory conditions aggravated by ground-level ozone.
• Higher temperatures can encourage people to spend more time in the sun. This has benefits in terms of higher levels of vitamin D in the body, but may also increase exposure to ultra-violet (UV) radiation and increase in the incidence of skin cancer.
• **Flooding** - Flooding can have a significant impact on physical and mental health, causing anxiety and depression, which can be long-lasting. Flooding and other climate risks can also disrupt healthcare and emergency response services when they are in most demand.
Opportunities
• **Reduced cold**– higher temperatures can lead to a reduced number of days when it is uncomfortably cold.

J.5.2. Working with Business

The business sector is highly vulnerable to weather and changes in climate due to a dependence on large fixed or natural assets and on complex supply chains. The international nature of investments, supply of products and materials, and markets for goods and services leave the sector to climate impacts on an international scale. Climate change may lead to an increase in existing risks, however may also present new opportunities for the sector in terms of innovation.

Few institutions incorporate climate risk and adaptation considerations into their governance and risk management processes, although climate impacts can result in reduced financial performance, damage to reputation, investor pressures fore resilience, legal liabilities and missed opportunities.

A growing number of residential and non-residential properties may become liable to flooding during the course of the 21st Century. This may have a large economic impact and may lead to a substantial rise in insurance payouts for flood damage. Supply chains are also vulnerable to disruption and may result in reduced sales or share prices, for example. The business sub-sectors most vulnerable to flooding are wholesale and retail, finance, insurance and manufacturing.

Table J.1.9: Key climate risks and opportunities for working with businesses

Risks
• **Financial sector** - Climate change presents significant threats to organisations operations (damage to buildings and infrastructure) and market-related risks (investment performance and lending portfolios). The insurance industry has seen growth in weather related impacts. Property owners (and occupiers) may find it difficult to obtain insurance. • **Business continuity -** Higher temperatures and extreme weather may present a range of risks to business continuity from disruption to supply chains and transport links, interrupted supply of essential and damage to assets and lost productivity (reduced staff time, etc.). • **Water availability -** The amount of water that can be abstracted for public water supply, agriculture and industry may shift having the potential to have significant impacts on industry. • **Tourism** – Warmer temperatures can encourage expansion of existing tourist destinations and lead to the establishment of new ones. However, climate change can also present risks to the sector. Assets are vulnerable to extremes events such as flooding. In addition, as the climate changes areas can decline in suitability for tourism over time. The seasonality of tourism is also expected to change with during summer months becoming less suitable (increased discomfort levels), with winter months increasing in suitability.
Opportunities
• **Tourism** – See above. • **Innovation** – If businesses can create products or services to resolve or avoid climate impacts, there is the potential for that business to enter new markets and expand.

J.5.3. Education, Awareness and Capacity Building

Developing a successful response to climate change risks will depend on individuals and organisations from different sectors preparing for a changing climate, not only in the long term but also in the short and medium term. This requires a strong unifying vision, scientific understanding, and openness to face challenges and develop solutions, stakeholder involvement, and a commitment at the highest level. Adaptive capacity building can provide the base from which these decisions can be made. However, this requires recognition of the necessity to adapt, knowledge about available options, the capacity to assess them, and the ability to implement the most suitable ones.

Stakeholders and decision-makers need to develop their understanding of the aspects of climate change that affect their sector or areas of work. Individuals and organisations do not necessarily need to be experts in climate change science and adaptation to have the capacity to implement effective adaptation decisions. An understanding of the key issues, limits and barriers, and opportunities can adequately inform decision-makers to incorporate climate change adaptation into policies, plans and programmes within their own sector.

In order to provide decision-makers with the capacity to adapt to climate change the scientific and research community is also required to develop and communicate climate change science in an accessible way that directly informs policymaking. However, there are also barriers to developing such capacity. As identified by the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report (AR4), informational and cognitive barriers complicate the issue and further limit to climate change adaptation responses.

Awareness of issues, knowledge, personal experience, and a sense of urgency of being personally affected can constitute a necessity to respond, but alone are considered insufficient to support the implementation of changes in policy and decision-making.[85] Perceptions of risk, vulnerability, motivation and capacity to adapt can support response to climate change risk. However, these perceptions can vary among individuals, groups, and organisations.

Table J.1.10: Informational and cognitive barriers to climate change adaptation

Knowledge of climate change causes, impacts and possible solutions does not necessarily lead to adaptation
• There is an assumption that providing individuals with scientifically sound information will result in information assimilation, increased knowledge, action and support for policies based on this information. Individuals' interpretation of information is mediated by personal and societal values and priorities, personal experience and other contextual factors. As a consequence, an individual's awareness and concern either do not necessarily translate into action, or translate into limited action.

[85] Adger et al, 2007: Assessment of adaptation practices, options, constraints and capacity. Climate Change 2007: Impacts,

Perceptions of climate change risks differ
• Climate change can induce different responses influenced by trust in others such as institutions and collective action resulting in adaptive, non-adaptive, and maladaptive behaviours. Individuals also prioritise the risks they face, focusing on those they consider – rightly or wrongly – to be the most significant at a particular point in time. Furthermore, a lack of experience of climate-related events may inhibit adequate responses. Although concern about climate change is widespread and high amongst UK society, it is not 'here and now' or a pressing personal priority for most people, in comparison to issues such as the economic recession. Strong instinctive reactions towards the risk of climate change are needed to provoke adaptive behavioural changes.
Perceptions of vulnerability and adaptive capacity are important
• Those who perceive themselves vulnerable to certain environmental to risks also perceive themselves to be more at risk from other environmental hazards of all types. Furthermore, perceptions of those vulnerable to risks of the barriers adaptation limit adaptive actions, even when there are capacities and resources to adapt.
Appealing to fear and guilt does not motivate appropriate adaptive behaviour
• Appealing to fear and guilt does not succeed in fostering sustained engagement with the issue of climate change. There is also public confusion when scientific arguments are contrasted in a black-and white, for-and-against manner. Calls for effective climate-change communication have focused on conveying a consistent, sound message, with the reality of anthropogenic climate change at its core. This, coupled with making climate change personally relevant through messages of practical advice on individual actions, helps to embed responses in people's locality. Visualisation imagery is being increasingly explored as a useful contribution to increasing the effectiveness of communication about climate change risks.

Source: Adger *et al*. (2007)[86]

J.6. Climate Impacts on Governance (Theme Four)

J.6.1. Integration, Planning and Partnerships

Climate change governance requires governments to take an active role in shifting perceptions in favour of an active climate change mitigation and adaptation policy regime.[87] Municipalities are well placed to drive and influence emissions reductions in their wider areas through the services they deliver, their role as social landlords, trusted community leaders and major employers, and their regulatory and strategic functions.[88]

Importantly, municipalities must focus on allocating a higher proportion of the annual municipal budget to climate change mitigation related projects and processes.

[86] Adger *et al*, 2007: Assessment of adaptation practices, options, constraints and capacity. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 717-743.

[87] World Bank (2009) Climate Change Governance http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2009/05/19/000158349_20090519144015/Rendered/PDF/WPS4941.pdf

[88] Committee on Climate Change (2012) How local authorities can reduce emissions and manage climate risk. Available at: http://archive.theccc.org.uk/aws/Local%20Authorites/1584_CCC_LA%20Report_bookmarked_1b.pdf

However there are a number of challenges to take into consideration:

- **Societal change**: The transformation of existing production and consumption patterns is required to reduce emissions and adapt will require significant change. Steering such societal adjustment is unprecedented.
- **Scientific uncertainty**: Although there is much understood about climate change and its implications, there still remains sources of uncertainty sourcing impacts and appropriate responses
- **Distributional and equity linkages**: Climate change and responses will impact different groups in different ways. Some of these impacts can be anticipated, others remain uncertain.
- **Long time frames**: Long term issues fit poorly with political cycles.
- **Global implications**: Climate change is an international issue requiring a collective response, yet coordinating international efforts on such a scale is a major challenge.

Appendix K. Climate Modelling

K.1. Climate Change Scenarios

A *climate change scenario* is the difference between a climate scenario and the current climate. *Climate scenarios* are plausible and often simplified representations of the future *climate*, investigating the potential consequences of anthropogenic climate change, often serving as input to impact models. Or, *Climate Projections,* which often serve as the "raw material" for constructing climate scenarios (Schulze, 2013). With accessibility to climate change scenarios, then the risks and consequences can be analysed and thus the mitigations, to prevent any major catastrophic events which may happen as a result of climate change.

K.1.1. Climate Change Scenario Modelling

For this particular study, certain climate scenarios were produced, provided by the Climate Systems Analysis Group (CSAG) from The University of Cape Town. These scenarios were formed from five Global Climate Models (GCM) and downscaled selectively for this assessment.

Scenarios of daily rainfall were produced by CSAG (2008) at 2 642 southern African stations, while daily maximum and minimum temperature scenarios were produced at 440 and 427 stations, respectively.

Regional climate change scenarios were developed for "present", "intermediate future" and "more distant future" climates represented by the following time periods, the latter two of which were defined by the IPCC:

- present climate: 1971 - 1990 (from a possible 1961 - 2000),
- intermediate future climate: 2046 - 2065, and
- more distant future climate: 2081 - 2100.

There are a few limitations which impacted this small assessment, such as:

- Failure to simulate individual convective rainfall events, owing to the coarse spatial resolutions of GCMs, this being important over the KwaDukuza area where convective rainfall is an dominant form of precipitation;
- Difficulty in simulating the intensity, frequency and distribution of extreme rainfall (IPCC, 2007);
- Tending to simulate too many small rainfall events (< 2 mm/day) and generally too few heavy rainfall events (> 10 mm/day), whilst maintaining a fairly realistic mean precipitation (IPCC, 2007); and
- Poorly representing major drivers of climate variability, such as the El Niño - Southern Oscillation phenomenon (Hulme *et al*., 2001), with which are associated years of generally high flows and low flows throughout southern Africa.

The control period 1971 – 1990 potential evaporation derived from the individual GCMs' climate outputs mimics that derived from observed climate variables very closely, implying relatively high confidence in any projections of this important hydrological and agricultural driver. The *average* of the GCM derived potential evaporation follows seasonal patterns of the observed very closely, with a very slight over-estimation in winter and spring months June to October.

Projections of rainfall from climate models are made with considerably less confidence than temperature or temperature derived variables such as potential evaporation. With the outlier values of GSS and subsequent notification from its developers that in this part of South Africa an error in rainfall estimation had been detected, results from GSS were omitted from further rainfall related analyses in KwaDukuza Municipality. The GCMs do, however, display similar seasonal trends of rainfall. When using the average of the GCM rainfall outputs in KwaDukuza it becomes evident that the climate models tend to over-estimate autumn rainfall while the late winter to early summer rains tend to be under-estimated. This will need to be borne in mind when interpreting future trends not only of rainfall, but even more so when projections of stream flows or irrigation water demands or municipal water allocations or dam operating rules are assessed.

Mainly as a consequence of the excessively heavy multi-day downpours from tropical cyclones Domoina and Imboa in the months of January and February of 1984 and the rains resulting in the September 1987 floods, which distort the standard deviations of observed rainfalls in those months, the GCMs used in this study appear not to capture this variability of rainfall very well in the KwaDukuza area, with the averaged output from the GCMs presenting a more benign picture of rainfall variability from year to year than observations do.

This verification study has shown

- first, the value (indeed the necessity) of using results from multiple GCMs, as any individual GCM generally does not mimic observed input or derived hydrological output as representatively as that from multiple GCMs;
- secondly, that temperature derived hydrological variables, such as potential evaporation, are mimicked well by the GCMs used in this study in the KwaDukuza area, with rainfall (a secondary output of GCMs) simulated somewhat less well and stream flow (a higher order derivative of rainfall) mimicked even less well;
- thirdly, with some seasonality shifts evident between GCM derived and observed monthly values of potential evaporation as well as of rainfall; and
- fourthly, that GCMs do not always capture the month-by-month variability of the observed extremes of hydrological inputs (e.g. of rainfall) nor of resultant derived hydrological outputs (e.g. of stream flows).

Appendix L. Detailed Outputs of Climate Change in KwaDukuza

L.1. Precipitation

The KwaDukuza area is fortunate to have relatively high annual rainfall, with the range in the 12 Quinaries making up the Municipality for the 50 year period 1950 – 1999 in the driest year in 10 being 663 – 762 mm, in a median year 922 – 1071 mm and in the wettest year in 10 being 1159 – 1471 mm. The inter-annual variability of rainfall, expressed through the standard deviation is also low by South African conditions, ranging from 221 – 255 mm and averaging out for all Quinaries at 237 mm (Schulze, 2013).

Average rainfall over South Africa is projected to decrease slightly, although changes in precipitation will vary widely across regions. Projected mean annual rainfall for the 2090's lie between -17% and +7% for the country. KwaDukuza is projected to experience s slight increase in precipitation, apart from the months of June, July and August when it is projected to decrease. The amount of rainfall associated with heavy rainfall or maximum 5-day rainfall events is only projected to change very slightly.

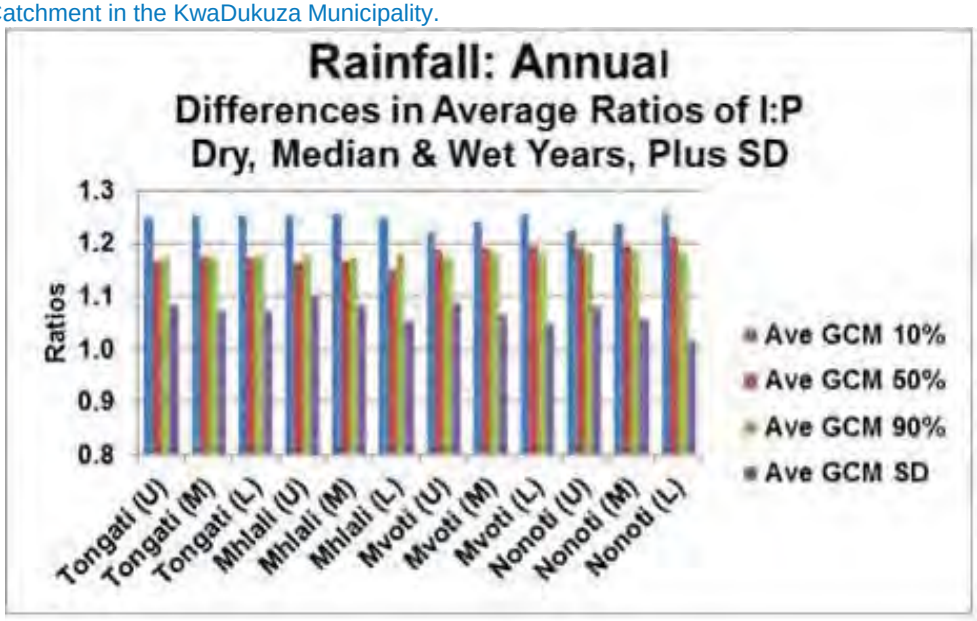
Projecting future forecasts of rainfall for the country incorporates certain monitoring and patterns of rainfall for assessing;

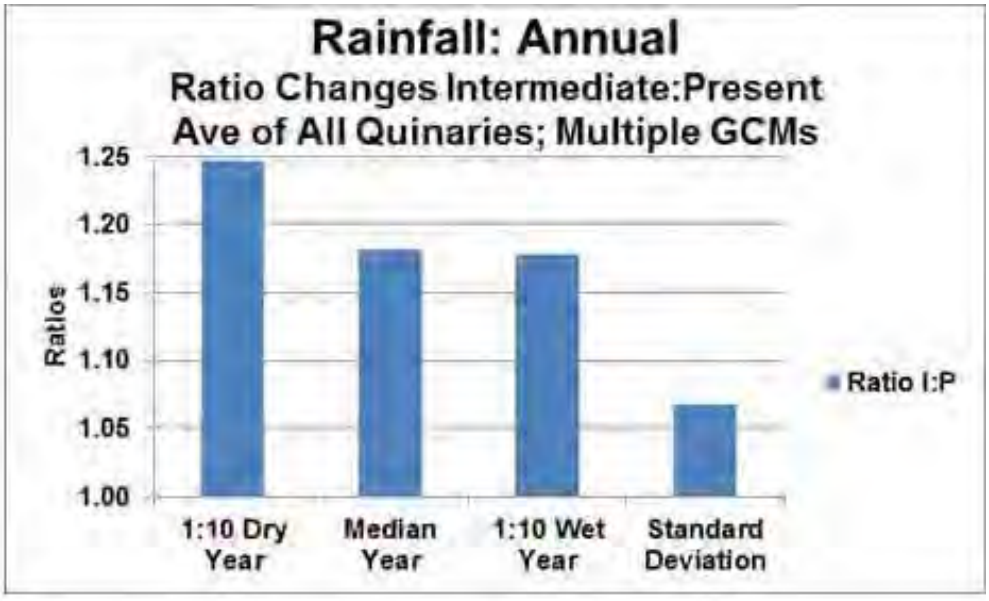
- how much it rains (on average),
- where it rains (its spatial distribution),
- when it rains (its seasonal / temporal distribution),
- how variable the rainfall is from year to year, or for a given month, and
- how rainfall varies from the expected amount in the driest and wettest year in (say) 10, as an indicator of droughts and flood conditions (Schulze, 2013).

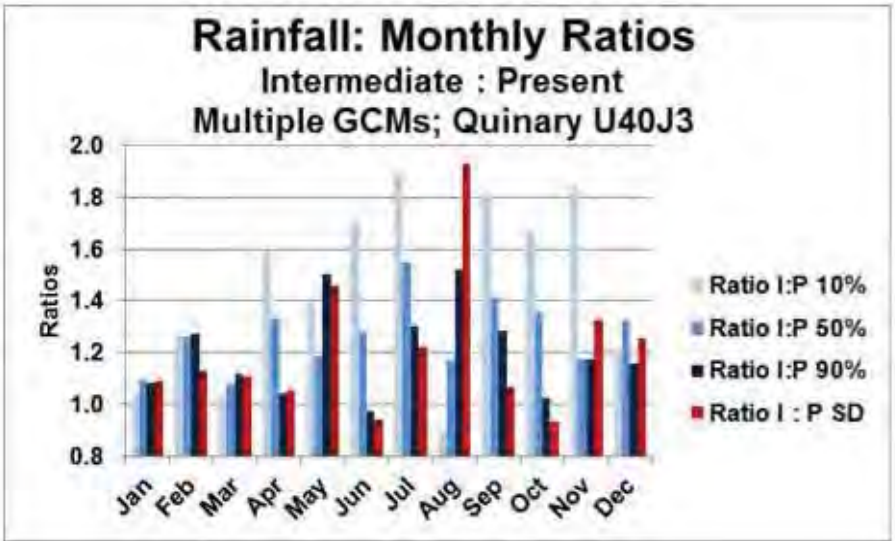
Projected changes in annual rainfall statistics into the intermediate future (2046 – 2065) show increases in all Quinaries according to the outputs from the GCMs used in this study (Figure 6.3). What is a significant trend in Figure 6.3 is that the ratios of change into the intermediate future are consistently higher in dry years (1.25 or 25 % for driest year in 10) than for median and wet year amounts (~ 1.18), and also that there is a very slight increase in the inter-annual variability of rainfall (Schulze, 2013).

For individual months the positive ratios of change in projected rainfall show considerably higher values for drought years in the late rainy season (April – May) through the dry season (June – September) and into the early rainy season (October – November), with monthly rainfalls also projected to increase in the generally drier months in more average years (Figure 6.3) (Schulze, 2013).

Figure L.1.1: Projected changes into the intermediate future (2046 – 2065) in annual rainfall statistics, derived from multiple GCMs, for dry, median and wet conditions, as well as changes in inter-annual variability, per Quinary Catchment in the KwaDukuza Municipality.





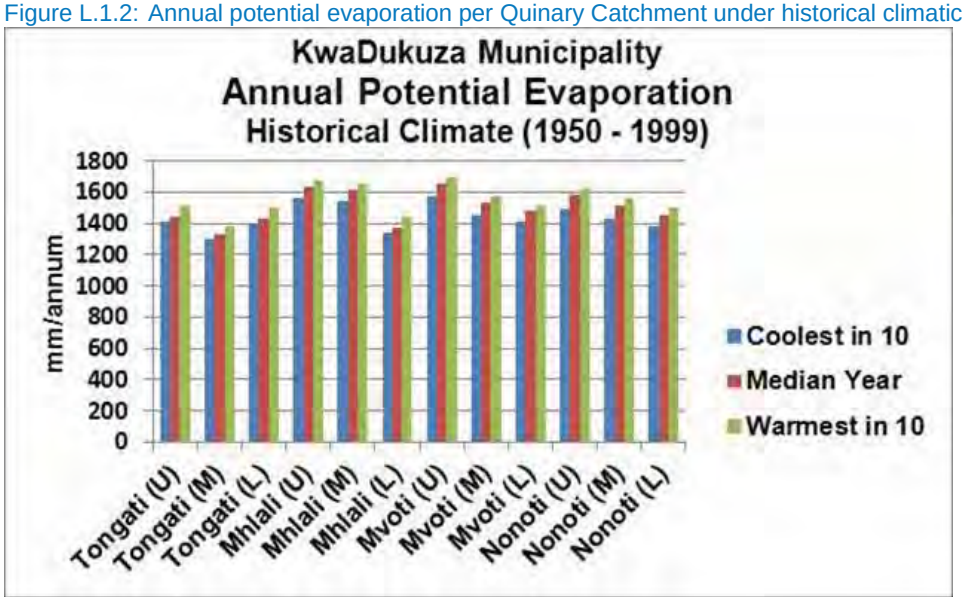


Source: Schulze, 2013

L.2. Potential Evaporation

While potential evaporation is a conservative climatic variable with relatively little difference from location to location within the KwaDukuza Municipality, Figure 6.1 nevertheless shows that for historical climate conditions median annual e_r at 1 335 – 1 650 mm is relatively moderate by South African conditions (cf. Schulze, 2008), with comparatively little variation between cool and median as well as warm and median years (in either case around 2 – 5 %), and with most catchments displaying a slight reduction in potential evaporation towards the ocean (i.e. the lower Quinaries) through the moderating influence of higher relative humidity there.

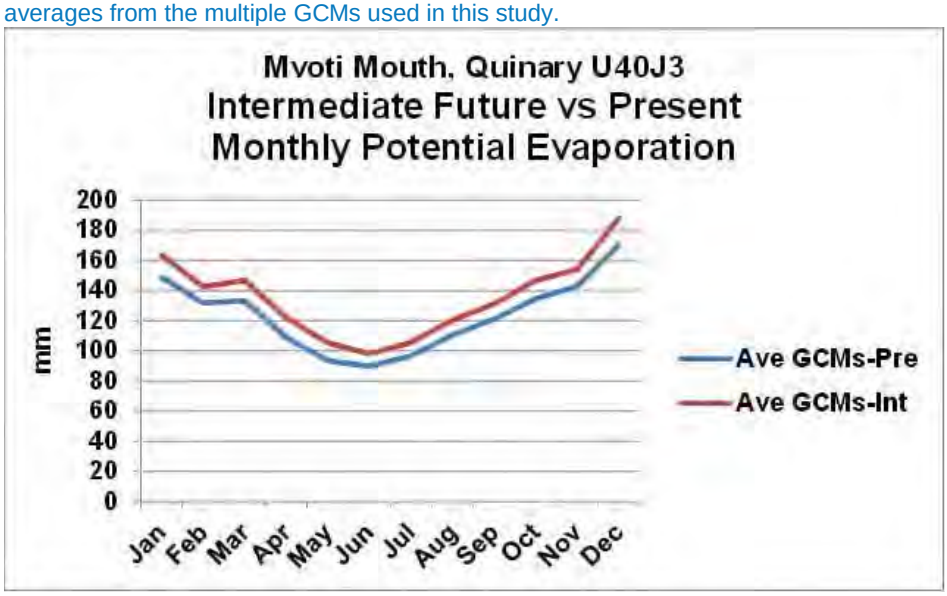
Figure L.1.2: Annual potential evaporation per Quinary Catchment under historical climatic conditions



Source: Schulze, 2013

Projections into the intermediate future 2046 – 2065 based on results from multiple GCMs, shown for each month of the year in Figure 6.2, point to increases in e_r over the next 40 or so years of ~ 8 to 12 %.

Figure 5.4: Comparison of mean monthly potential evaporation for Quinary Catchment U40J3 (mouth of the Mvoti system) for the intermediate future period (2046 – 2065) vs. that of the present (1971 – 1990), with all values based on averages from the multiple GCMs used in this study.



Source: Schulze, 2013

The projected increases of 8 – 12 % in monthly potential evaporation into the intermediate future 2046 – 2065 shown in Figure 6.2 are likely to have important implications;

- to additional evaporative losses from water bodies such as dams, wetlands and river channels, the evaporative losses from which are already of the order of 1 500 mm per annum
- to sugarcane irrigators, especially given that water prices are set to increase into the future
- to dryland (rainfed) farmers, with soils drying out more rapidly than under current climatic conditions.

L.3. Hydrological Systems

In assessing the present and future hydrological responses, impacts derived from Climate Change can be prevented and mitigated as best as possible. Understanding the hydrological network in the KwaDukuza Municipality is important to allow adaptive measures to be produced and acted upon, conserving as much water as is feasible.

Annual hydrological statistics per Quinary Catchment in the KwaDukuza Municipality under historical climate conditions for dry, median and wet years, as well as inter-annual variability, are shown in Figure 6.4.

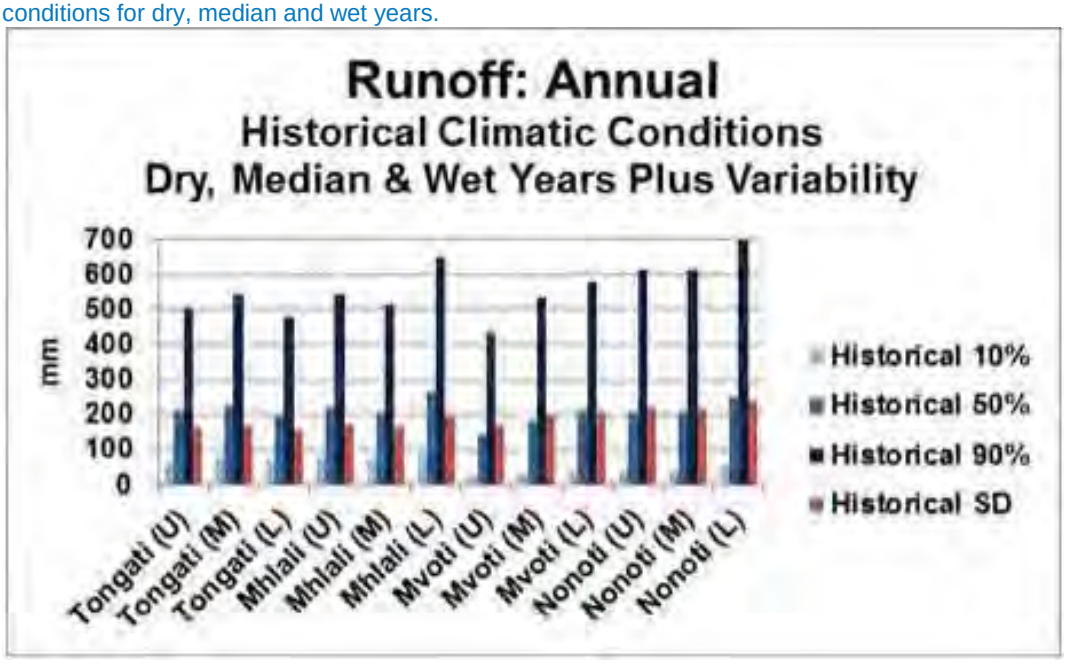
Key features include;

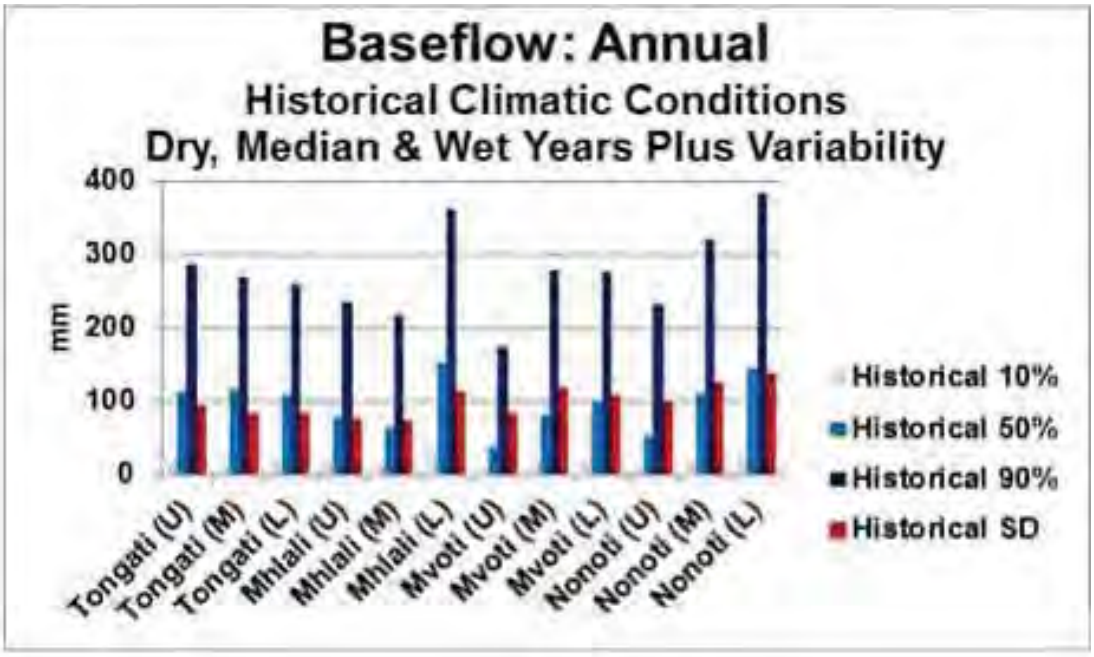
- Differences in responses between the various Quinaries are greatest for baseflow and sediment yield and less for accumulated streamflows (with the moderating influences of upstream flows) than for runoff from individual Quinaries (Figure 6.4).

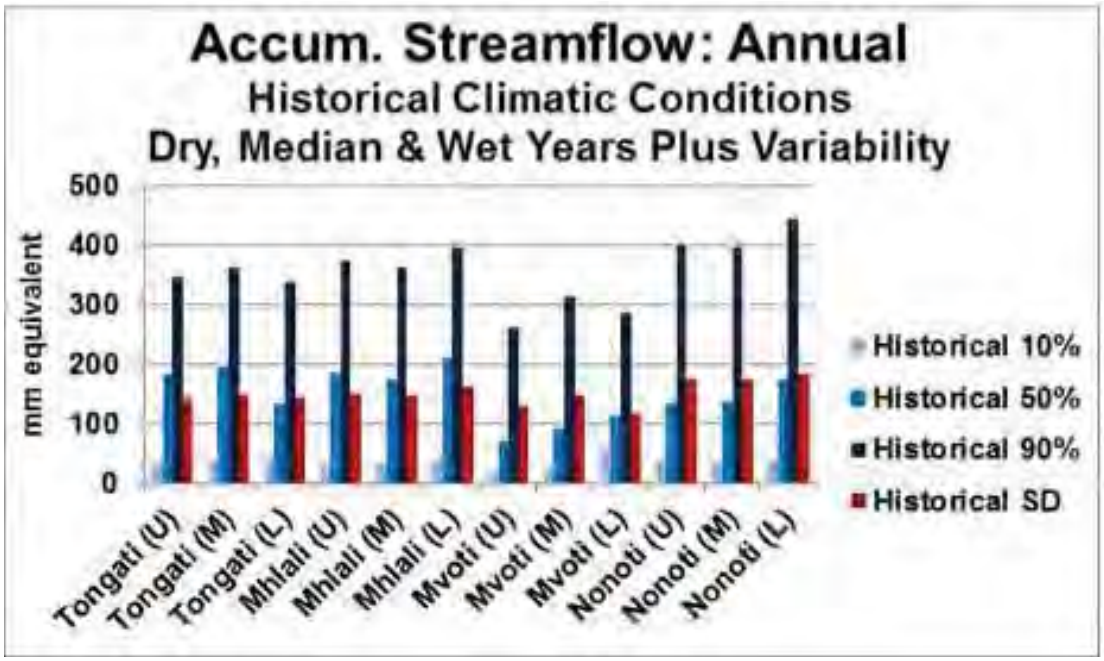
- the range of the averages of all Quinaries between the driest and wettest year in 10, which is only a factor of 1.9 for annual rainfall (cf. Figure 6.4), has now been amplified to vary by a factor of ~ 10 for runoff and streamflow, but by a factor of 15 for baseflow and 26 for sediment yield. This illustrates not only the amplification which occurs when rainfall is converted to hydrological responses, but also the different sensitivities of the various responses to fluctuations in rainfall (Schulze, 2013).

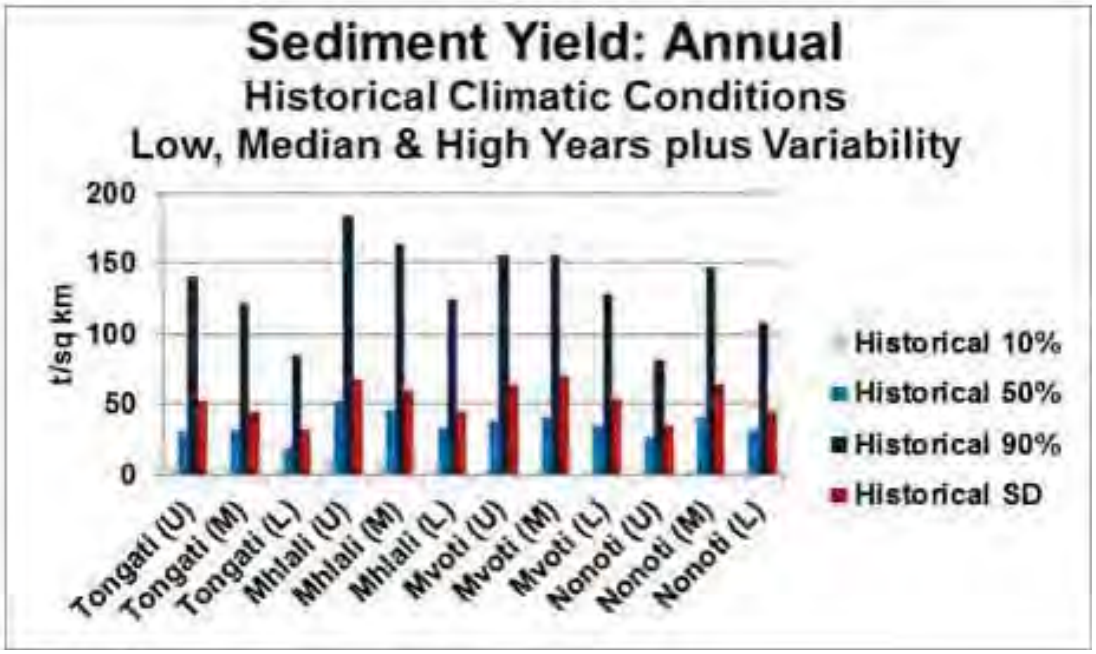
Differences in ratio changes between the intermediate future (2046 – 2065) and the present climate scenarios are shown in Figure 6.5 for runoff, baseflow, accumulated streamflow and sediment yield for 1:10 dry year, median and 1:10 wet year conditions as well as for inter-annual variability for the individual Quinary Catchments which make up the KwaDukuza Municipality. A comparative analysis in which the ratio changes have been averaged across all Quinaries within the Municipality is shown in Figure 6.6 for the four hydrological responses plus rainfall.

Figure L.1.3: Annual hydrological statistics per Quinary Catchment in the KwaDukuza Municipality under historical conditions for dry, median and wet years.



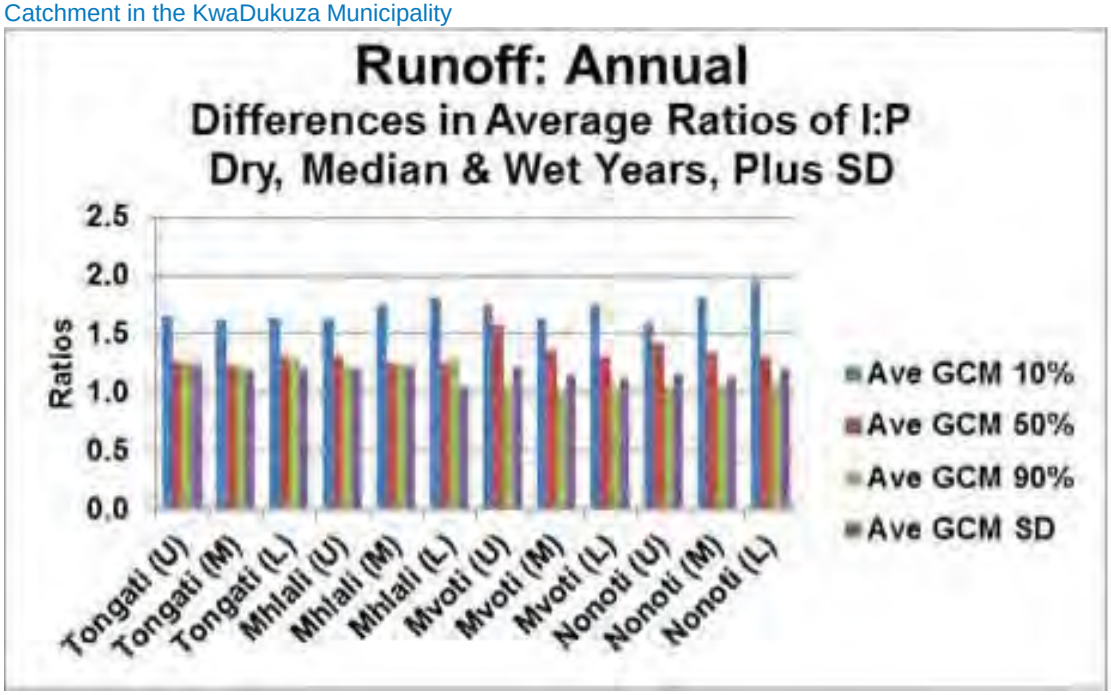

Baseflow: Annual
Historical Climatic Conditions
Dry, Median & Wet Years Plus Variability
mm
400
300
200
100
0
Tongati (U)
Tongati (M)
Tongati (L)
Mhlali (U)
Mhlali (M)
Mhlali (L)
Mvoti (U)
Mvoti (M)
Mvoti (L)
Nonoti (U)
Nonoti (M)
Nonoti (L)
Historical 10%
Historical 50%
Historical 90%
Historical SD

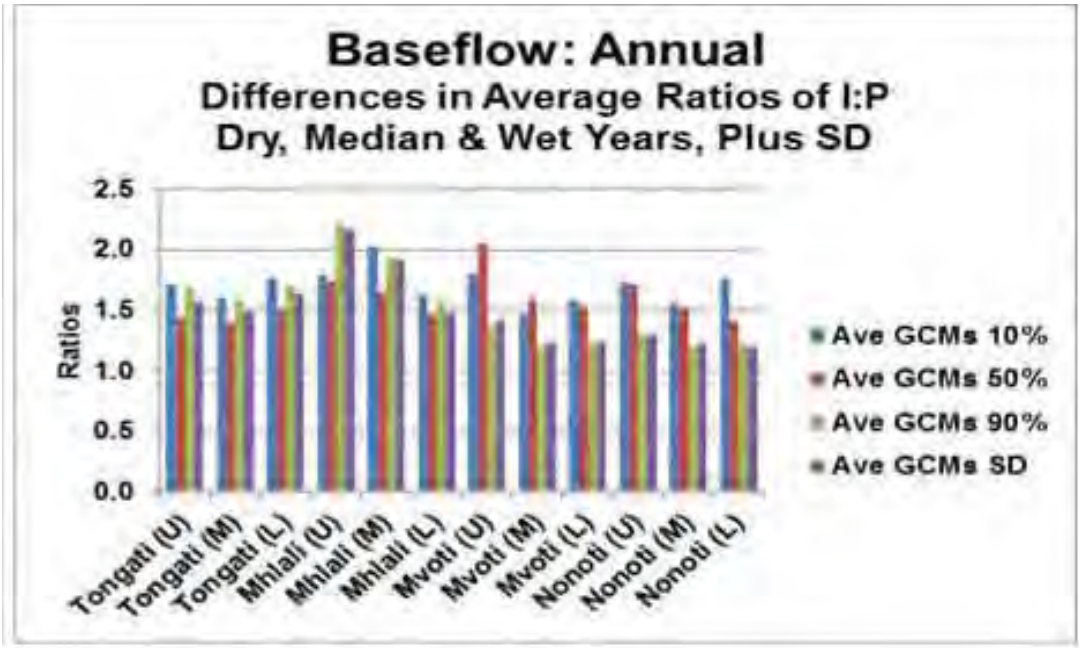

Accum. Streamflow: Annual
Historical Climatic Conditions
Dry, Median & Wet Years Plus Variability
mm equivalent
500
400
300
200
100
0
Tongati (U)
Tongati (M)
Tongati (L)
Mhlali (U)
Mhlali (M)
Mhlali (L)
Mvoti (U)
Mvoti (M)
Mvoti (L)
Nonoti (U)
Nonoti (M)
Nonoti (L)
Historical 10%
Historical 50%
Historical 90%
Historical SD

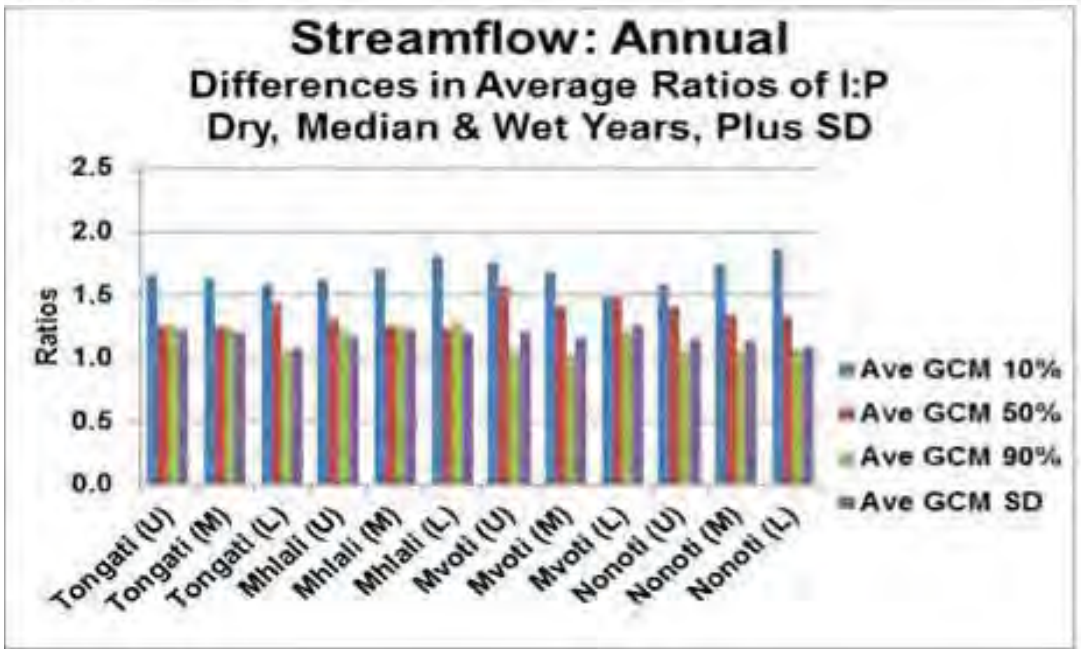


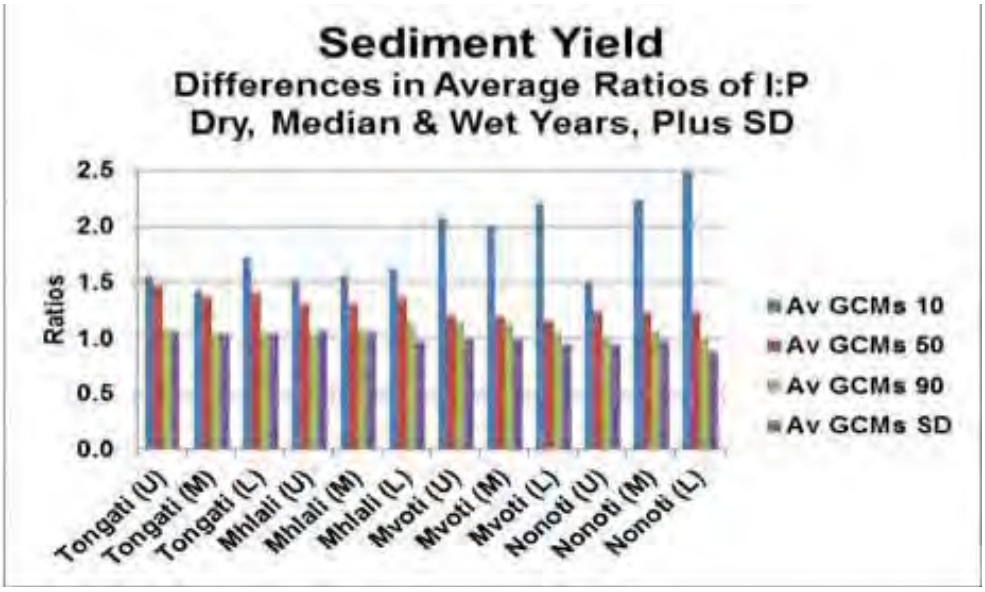
Source: Schulze, 2013

Figure L.1.4: Projected changes into the intermediate future (2046 – 2065) in annual rainfall statistics, derived from multiple GCMs, for dry, median and wet conditions, as well as changes in inter-annual variability, per Quinary Catchment in the KwaDukuza Municipality



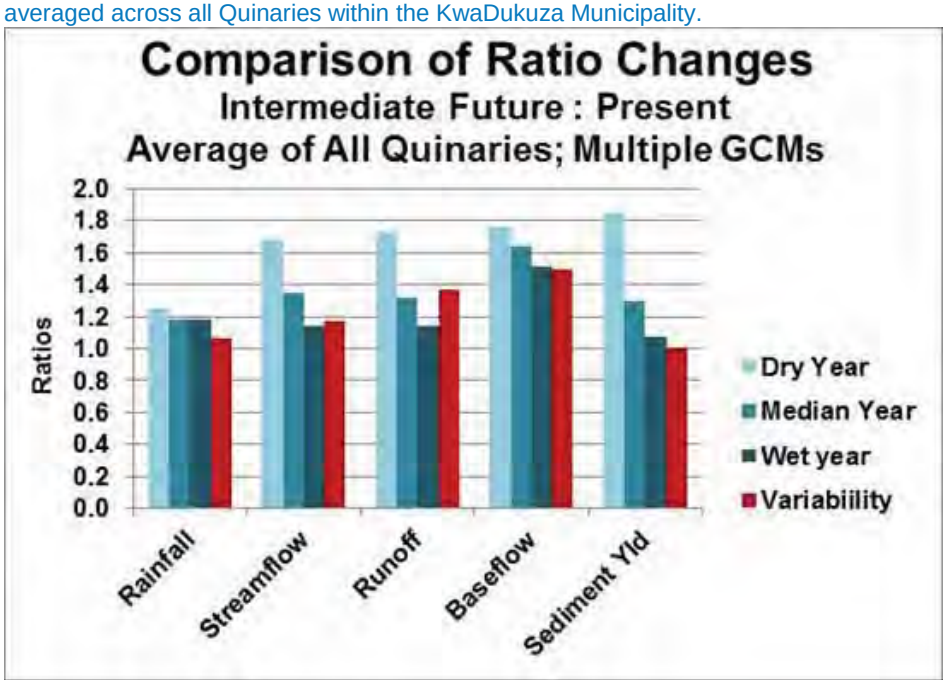

Baseflow: Annual
Differences in Average Ratios of I:P
Dry, Median & Wet Years, Plus SD
Ratios
2.5
2.0
1.5
1.0
0.5
0.0
Tongati (U)
Tongati (M)
Tongati (L)
Mhlali (U)
Mhlali (M)
Mhlali (L)
Mvoti (U)
Mvoti (M)
Mvoti (L)
Nonoti (U)
Nonoti (M)
Nonoti (L)
Ave GCMs 10%
Ave GCMs 50%
Ave GCMs 90%
Ave GCMs SD


Streamflow: Annual
Differences in Average Ratios of I:P
Dry, Median & Wet Years, Plus SD
Ratios
2.5
2.0
1.5
1.0
0.5
0.0
Tongati (U)
Tongati (M)
Tongati (L)
Mhlali (U)
Mhlali (M)
Mhlali (L)
Mvoti (U)
Mvoti (M)
Mvoti (L)
Nonoti (U)
Nonoti (M)
Nonoti (L)
Ave GCM 10%
Ave GCM 50%
Ave GCM 90%
Ave GCM SD



Source: Schulze, 2013

Figure L.1.5: Comparative analysis of ratio changes from multiple GCMs between the intermediate future and present for rainfall, runoff, baseflow, accumulated streamflow and sediment yield statistics for dry, median and wet years, averaged across all Quinaries within the KwaDukuza Municipality.



Source: Schulze, 2013

Key findings from the figures above are as follows:

- Differences in the ratio changes from one Quinary to the next are lowest for accumulated streamflows, highlighting the moderating, buffering and attenuating of change due to upstream effects.
- To a lesser extent ratio changes into the future are also relatively low for runoff, in which case the buffering is due to the moderating effect of baseflows.
- The largest differences in ratios between the Quinaries occurs in baseflows, where values come off a low base and where significant thresholds have to be exceeded for a groundwater recharge event (which feeds the baseflow) to be triggered.
- Overall, the projected positive changes in hydrological responses are greater in dry years than in median years and, in turn, greater in median years than in wet years.
- There is a likelihood of greater hydrological variability from year to year in future, with a small increase in the standard deviation of annual rainfall with becomes progressively larger for streamflow, runoff and baseflow but is surprisingly absent in the projections for sediment yield (Schulze, 2013).

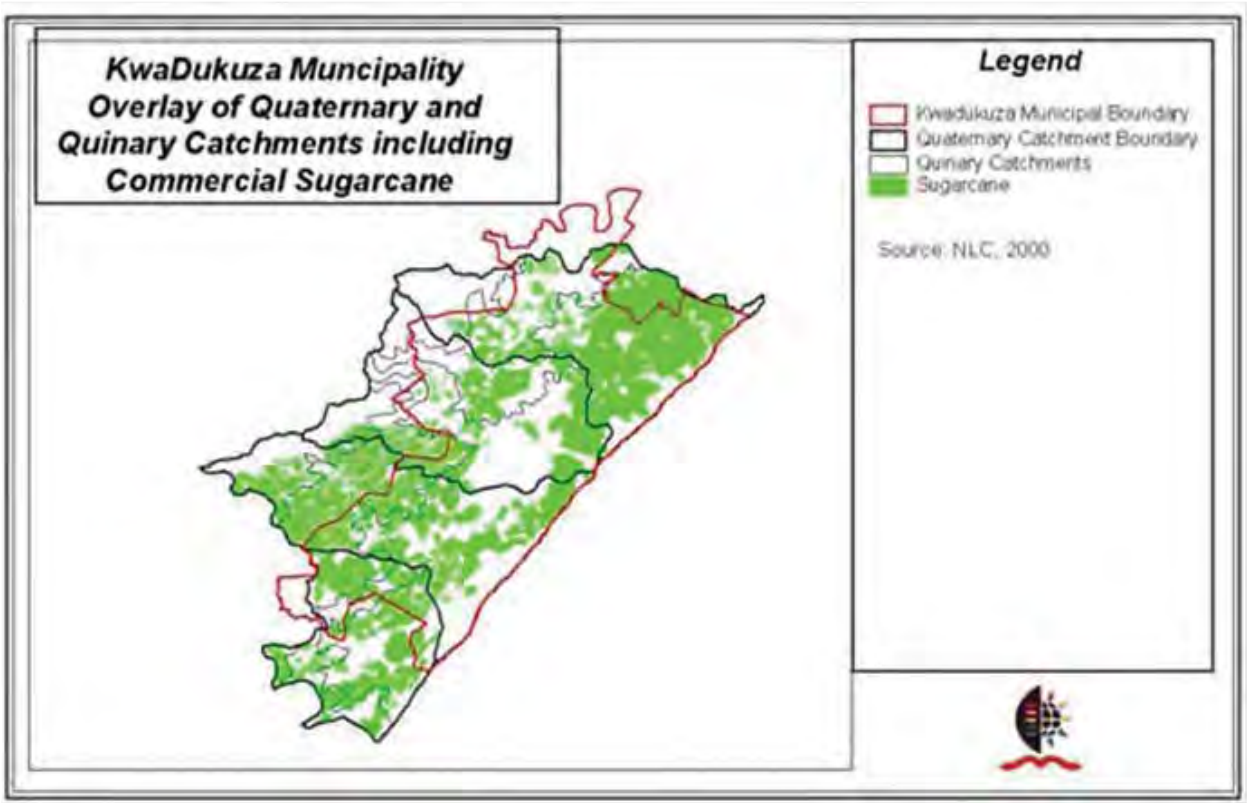
The projected general increases in hydrological responses may be viewed as both positive and negative, with:

- projected increases in base flows being positive,
- as are the higher possible responses in dry years when water is most needed,
- but with an increased risk of flooding, particularly local flooding from individual Quinaries from which local (rather than more regional) water is sourced,
- and with the projected increases in sediment yields having multiple negative effects ranging from increased water purification costs to sediment polluted beaches keeping holiday makers away.

L.4. Agricultural Systems

Figure 6.7 illustrates the amount of land delegated to sugarcane production across KwaDukuza. Sugarcane is a large part of people's lives in South Africa, employing 350,000 residents. The industry contributes approximately R2.0 billion annually to foreign exchange earnings of the country and of the field crops produced in South Africa, sugarcane makes up approximately 15 % of the gross value (Schulze, 2013).

Figure L.1.6: The extent of sugarcane as a land use within KwaDukuza Municipality



Source: Schulze, 2013

The relatively high rainfall which KwaDukuza receives at present means that most of the sugarcane is rain fed, however, many land owners of sugarcane have requested irrigation licenses (table 6.1). The projected yield of sugarcane is to increase and as a result the demand for irrigation is following trend.

Table L.1.1: Areas for which licences to irrigate sugarcane have been granted (Computed from DWA WARMS Database, 2012)

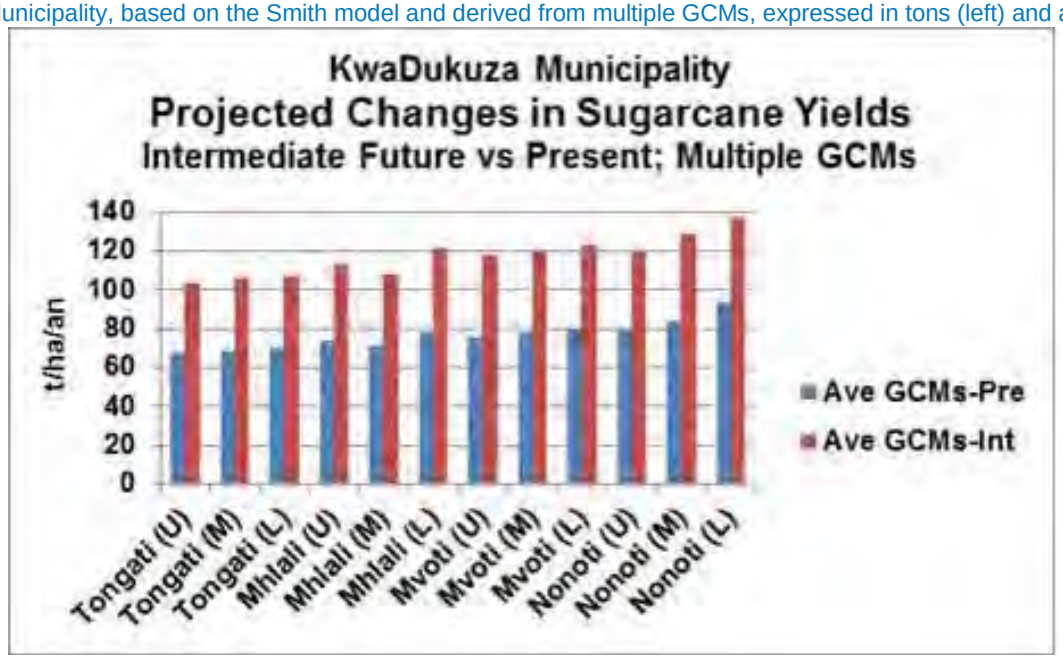
Quaternary	Ha Sugarcane Irrigation Licences
U30D (Proportional)	469
U30E	769
U40J	518
U50A	254
Total	2010

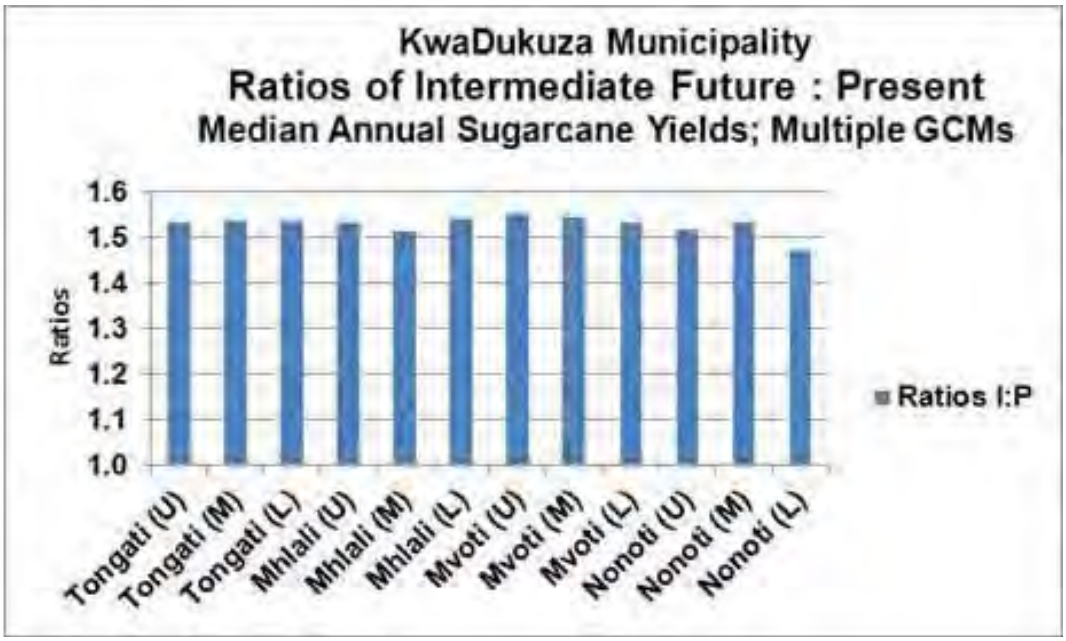
Source: Schulze, 2013

Projected changes in sugarcane yields from the present into the intermediate future some 40 years from now, derived using outputs from multiple GCMs, show increases throughout all Quinaries (Figure 6.8 left) as a result of the combination of projected increases in both temperature (hence heat units) and rainfall. Ratios of change for all Quinaries are shown in Figure 6.8 (right) to be around 1.5 (i.e. a projected 50 % increase in yields).

An increase in temperature also coincides with an increase in reproduction of sugarcane pests, such as *Eldana saccharina* (the African sugarcane borer). A rise in these moths means that yields can potentially be threatened and therefore investment into alternative pest control would have to be considered, environmentally and economically. The projected increase of sugarcane yields of up to 50% annually which will benefit the economy may well be hindered.

Figure L.1.7: Projected changes into the intermediate future in annualised sugarcane yields in the KwaDukuza Municipality, based on the Smith model and derived from multiple GCMs, expressed in tons (left) and as ratios (right).





Source: Schulze, 2013

L.5. Human Settlements

In the KwaDudka area human comfort/discomfort plays an important role in

- the comfort of tourists, especially during the holiday seasons, and in
- the comfort of manual labourers in the sugarcane industry, particularly during the harvest season from April to December.

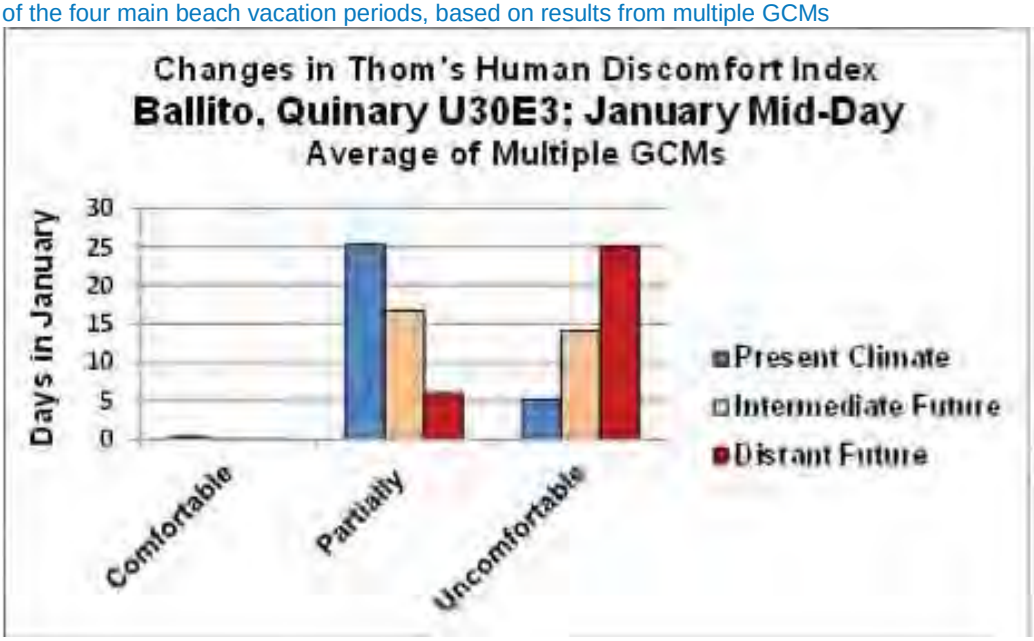
Future projections into climate change upon human impacts were calculated using a Human Discomfort Index (TDI).

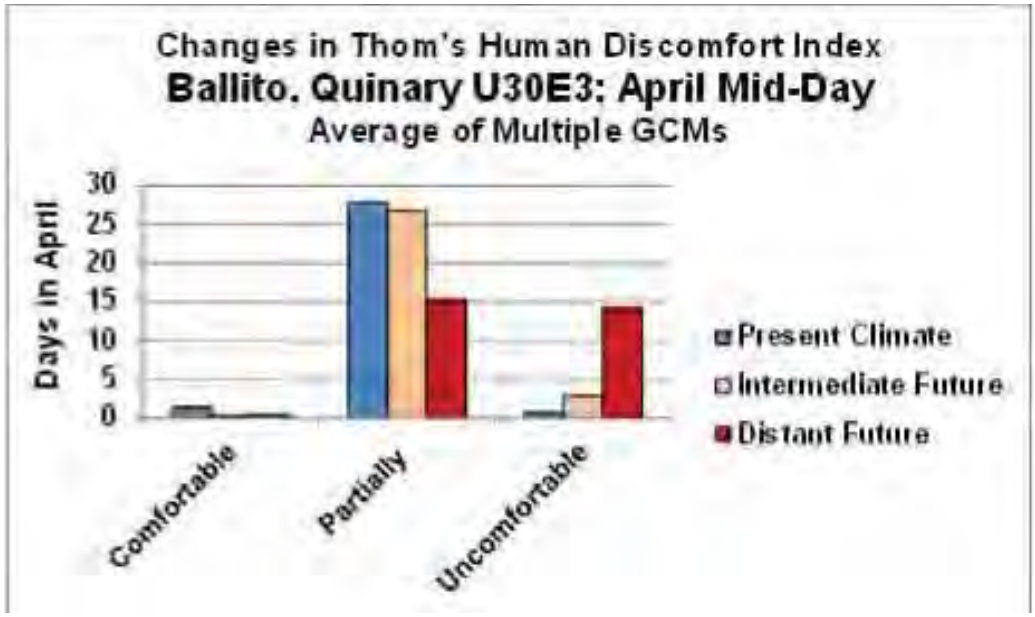
With both agricultural labour and beach activities occurring during daytime hours in KwaDukuza, the TDI was computed for mid-day conditions, i.e. for daily maximum temperature and minimum relative humidity conditions, for both historical as well as for projected future climates. Computations were undertaken for Quinary Catchment U30E3 in which Ballito, the area's prime holiday destination, is located.

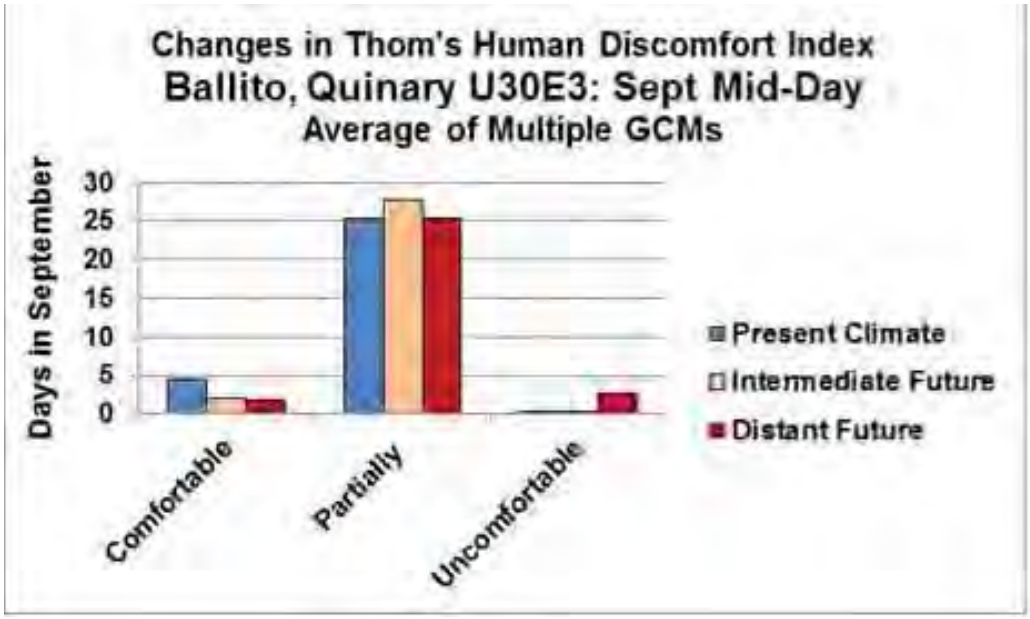
Results based on averages of changes into the future from multiple GCMs are shown in Figure 6.9 for each of the four main beach vacation periods. The main features are:

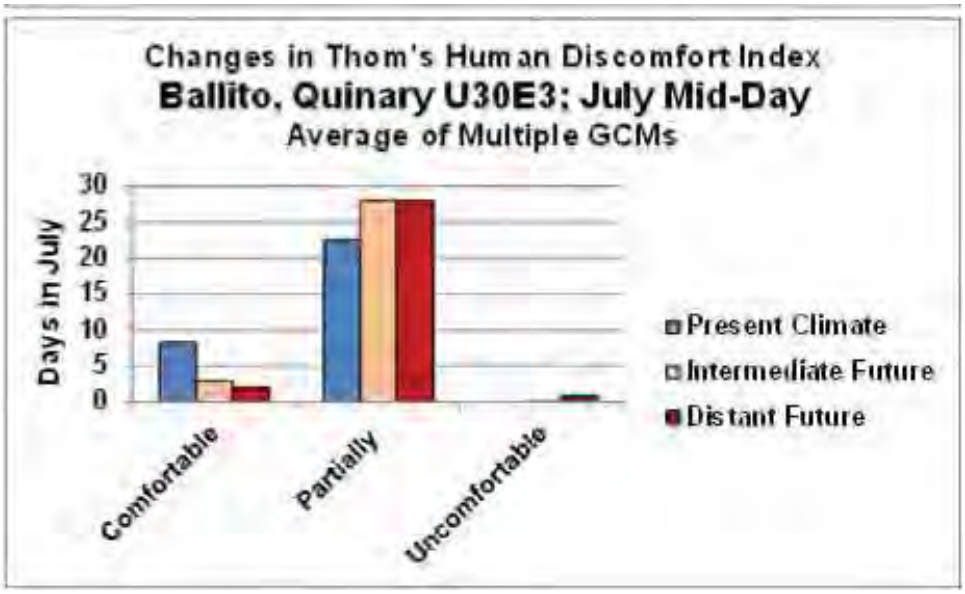
- decreases in partially comfortable days in January (summer vacation) from 25 at present to 16 in the intermediate future some 40 years from now to only 6 in the more distant future (2081 – 2100) and corresponding increases in uncomfortable days from 5 at present to 14 at mid-century to 25 towards the end of the century;
- little change into the intermediate future in April (Easter vacation time), but significant increases in uncomfortable days from virtually none under present conditions to 15 by the end of the century; and
- relatively little change in comfortable / uncomfortable days into the future for July (winter vacation) and September (Michaelmas break).

Figure L.1.8: Averages of changes into the future in comfortable, partially comfortable and uncomfortable days for each of the four main beach vacation periods, based on results from multiple GCMs




Changes in Thom's Human Discomfort Index
Ballito. Quinary U30E3: April Mid-Day
Average of Multiple GCMs
Days in April
30
25
20
15
10
5
0
Comfortable
Partially
Uncomfortable
Present Climate
Intermediate Future
Distant Future


Changes in Thom's Human Discomfort Index
Ballito, Quinary U30E3: Sept Mid-Day
Average of Multiple GCMs
Days in September
30
25
20
15
10
5
0
Comfortable
Partially
Uncomfortable
Present Climate
Intermediate Future
Distant Future



Source: Schulze, 2013