Disaster Risk Assessment Report

Revision 2015

Report Prepared for

Amathole District Municipality

Report Number 481363/1 (Final)

AMATHOLE
DISTRICT MUNICIPALITY

Report Prepared by

ACETE
Development Consultants

In association with

srk consulting

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Disaster Risk Assessment Report Revision 2015

Amathole District Municipality

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Executive Summary

The Amathole District Municipality (ADM) appointed ACETE Development Consultants in association with SRK Consulting (Pty) Ltd (SRK) to conduct a Disaster Risk Assessment (DRA) for the ADM in 2012. The same team was appointed in 2015 to draft a Disaster Management Plan and review the DRA that was compiled in 2012 to 2013. This report presents a description of the DRA process conducted for the ADM, as well as the associated results, conclusions and recommendations of this study.

Outline of work program relevant to this report

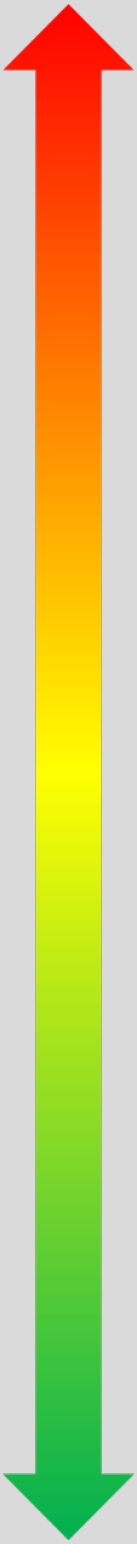
The project consisted of the following main phases:

- Phase 1: Project Initiation and Project Management
- Phase 2: Base Data Collection & Creation of Base Dataset
- Phase 3: Consultation & Disaster Risk Assessment
- Phase 4: Disaster Risk Planning & Reporting

Overview of Results of the Disaster Risk Assessment

The risk profile for the ADM is based on the data received from the workshop consultations, as well as the base data (including reports) collected during the study. The stakeholder consultation data and local resilience data were compared with the desktop hazard assessment results, and the hazard prioritization was reviewed and updated. The major risks identified for the ADM are indicated below

No	Hazard Name	Risk
1	Hydro-meteorological – Drought	Higher Priority
2	Disease / Health - Disease: Human	
3	Transport Hazards - Road Transportation	
4	Civil Unrest – Crime	
5	Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)	
6	Fire Hazards - Formal & Informal Settlements / Urban Area	
7	Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	
8	Fire Hazards - Veld/Forest Fires	
9	Disease / Health - Disease: Animal	
10	Pollution - Water Pollution (Fresh and Sea)	
11	Pollution - Land Pollution	
12	Environmental Degradation – Deforestation	
13	Infestations - Plant Infestations (Intruder Plants)	
14	Pollution - Air Pollution	
15	Infrastructure Failure / Service Delivery Failure – Electrical	
16	Civil Unrest - Demonstrations / Riots	
17	Hydro-meteorological Hazards - Extreme Temperatures	
18	Infrastructure Failure / Service Delivery Failure - Sanitation	
19	Disease / Health - Disease: Plants	
20	Structural Failure - Bridge Failure	
21	Environmental Degradation – Erosion	
22	Transport Hazards - Rail Transportation	
23	Structural Failure - Building Failure	
24	Geological Hazards - Rock-fall	
25	Major Event Hazards – Sport	
26	Environmental Degradation - Land Degradation	
27	Major Event Hazards – Political	
28	Infrastructure Failure / Service Delivery Failure - Water	
29	Transport Hazards - Water Transportation (Incl. Marine Accident)	
30	Major Event Hazards - Cultural / Religious	
31	Major Event Hazards - Recreational / Commercial	
32	Transport Hazards - Air Transportation	
33	Hazardous Material - Spill/Release (Storage & Transportation)	
34	Civil Unrest - Refugees / Displaced People	
35	Civil Unrest - Xenophobic Violence	
36	Infestations - Insect Infestation	
37	Geological Hazards - Earthquake	
38	Geological Hazards - Landslides/Mud flows	
39	Infestations - Animal Infestation / Over Population	
40	Geological Hazards - Subsidence	
41	Structural Failure - Dam failure	
42	Infrastructure Failure / Service Delivery Failure - Transport	
43	Oceanographic - Tsunami	
44	Infestations - Algal Bloom (Red Tide)	
45	Oceanographic - Storm Surge	
46	Hazardous Material - Fire/Explosion (Storage & Transportation)	
47	Environmental Degradation - Loss of Biodiversity	
48	Other - Space Objects	
49	Infrastructure Failure / Service Delivery Failure - Information Technology	
50	Oceanographic - Sea Level Rise (Climate Change)	
51	Hydro-meteorological Hazards - Desertification	
52	Civil Unrest - Armed Conflict (Civil/Political War)	
53	Infrastructure Failure / Service Delivery Failure - Gas	
54	Civil Unrest - Terrorism	Lower Priority



EC121: Mbhashe
Hydro-meteorological - Drought
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Formal & Informal Settlements / Urban Area
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Fire Hazards - Veld/Forest Fires
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)
Environmental Degradation - Deforestation

EC122: Mnquma
Hydro-meteorological - Drought
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Formal & Informal Settlements / Urban Area
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Fire Hazards - Veld/Forest Fires
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)
Environmental Degradation - Deforestation

EC123: Great Kei
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Fire Hazards - Formal & Informal Settlements / Urban Area
Disease / Health - Disease: Animal
Fire Hazards - Veld/Forest Fires
Pollution - Water Pollution (Fresh and Sea)

EC124: Amahlathi
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Formal & Informal Settlements / Urban Area
Fire Hazards - Veld/Forest Fires
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)

Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

EC126: Ngqushwa
Hydro-meteorological - Drought
Disease / Health - Disease: Human
Civil Unrest - Crime
Transport Hazards - Road Transportation
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Fire Hazards - Formal & Informal Settlements / Urban Area
Fire Hazards - Veld/Forest Fires
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

EC127: Nkonkobe
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Veld/Forest Fires
Fire Hazards - Formal & Informal Settlements / Urban Area
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

EC128: Nxuba
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Fire Hazards - Veld/Forest Fires
Fire Hazards - Formal & Informal Settlements / Urban Area
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

Conclusions

The top 10 disaster risks for ADM were identified as:

- Hydro-meteorological - Drought
- Disease / Health - Disease: Human
- Transport Hazards - Road Transportation
- Civil Unrest - Crime

- Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
- Fire Hazards - Formal & Informal Settlements / Urban Area
- Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
- Fire Hazards - Veld/Forest Fires
- Disease / Health - Disease: Animal
- Pollution - Water Pollution (Fresh and Sea)

It was evident from the results of the community survey that there is a strong correlation between the desktop identified hazard, vulnerability and resilience factors and what the perceived causes of potential disasters could be in the community's opinions.

These priority risks should also be reflected in the future budgets and the IDP of ADM. There should be specific focused actions to reduce vulnerability, minimise hazards and to increase resilience in relation to these risks.

It is becoming more and more apparent that we have to consider risk from all angles in South Africa. Strengths such as strong traditional structures should be targeted and utilised in focused community awareness programs aimed at reducing risk. A lot of risks are closely related and directly or indirectly influence each other. Plant Infestation will for example exasperate drought due to the fact that alien plants affect ground water. This means that if plant infestation is addressed, then the risk of drought is consequently also indirectly addressed.

Recommendations

It is recommended that ADM should constructively move towards achieving the requirements for a level 3 Disaster Management Plan, as required by the National Disaster Management Framework by engaging in the following actions:

- A level 2 Disaster Management plan should be drafted, as the next step to following a phased approach to drafting a level 3 plan as contemplated in the National Disaster Management Framework; and
- Detailed risk studies should be conducted into the high priority risks to initiate focused risk reduction strategies and risk monitoring.

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Glossary

AIDS:	Acquired Immune Deficiency/Immunodeficiency Syndrome
C:	Capacity
DEAT:	Department of Environmental Affairs and Tourism
DM:	Disaster Management
DMAF:	Disaster Management Advisory Forum
DMC:	Disaster Management Centre
DMO:	Disaster Management Officer
DMP:	Disaster Management Plan
DRA:	Disaster Risk Assessment
DRM:	Disaster Risk Management
EMS (1):	Emergency Management Services
EMS (2):	Emergency Medical Services
ERM:	Enterprise Risk Management
FET:	Further Education and Training
GDP:	Gross Domestic Product
GGVA:	Geographical Growth Value Add
GIS:	Geographical Information Systems
GPODM:	Green Paper on Disaster Management
H:	Hazard
HAZMAT:	Hazardous Materials
HIV:	Human Immunodeficiency Virus
HVMCR:	Hazard, Vulnerability, Manageability, Capacity & Risk
HVRes:	Hazard, Vulnerability & Resilience
I:	Impact
ICSU:	International Council for Science
ICV:	Incident Command Vehicle
IDP:	Integrated Development Plan
IDPs:	Internally Displaced Persons
IMS:	Internet mapping system
KPAs:	Key Performance Areas
KPIs:	Key Performance Indicators
LM:	Local Municipality
M:	Manageability
MHI:	Major Hazardous Installations
MDMC:	Municipal Disaster Management Centre
MVA(s):	Motor Vehicle Accident(s)
NDMC:	National Disaster Management Centre
NDMF:	National Disaster Management Framework
NGO:	Non-Governmental Organisation
NSoER:	National State of the Environment Report
PDMC:	Provincial Disaster Management Centre
PSC:	Project Steering Committee
R:	Risk
RHVMC:	Risk, Hazard, Vulnerability, Manageability, Capacity
SANDF:	South African National Defence Force
SAPS:	South African Police Service

SAWS:	South African Weather Services
SDF:	Spatial Development Framework
SOP:	Standard Operating Procedures
SRK:	SRK Consulting (Pty) Ltd
TB:	Tuberculosis
UNHCR:	United Nations High Commissioner for Refugees
V:	Vulnerability
WMO:	World Meteorological Organisation
WHO:	World Health Organisation
ADM:	Amathole District Municipality

1 Introduction

The Amathole District Municipality (ADM) appointed ACETE Development Consultants in association with SRK Consulting (Pty) Ltd (SRK) to conduct a Disaster Risk Assessment (DRA) for the ADM in 2012 to 2013. The same team was appointed in 2015 to draft a Disaster Management Plan and review the DRA that was completed in 2012 to 2013. This report presents a description of the DRA process conducted for the ADM, as well as the associated results, conclusions and recommendations of this study.

2 Background and Brief

2.1 Background and objectives

The Disaster Management Act (Act 57 of 2002) as well as the National Disaster Management Framework (2005) (NDMF), requires that Municipalities conduct disaster risk assessments for their area of jurisdiction. The main aim of this project was to conduct a comprehensive disaster risk assessment, for the Amathole District Municipality (ADM).

The main objective of the Disaster Risk Assessment was to provide the ADM with relevant information to enable and support the required disaster risk reduction planning and activities undertaken by the Municipality. The required information includes information related to the levels of disaster risks, hazards, vulnerabilities, manageability, and capacities (RHVMC) within the area of jurisdiction of the ADM. The deliverables also included suitable ratings, mapping and prioritization of the RHVMC levels for the ADM.

2.2 Requirements in terms of Disaster Risk Assessments

Disaster Risk Assessments are a requirement as stipulated in the guiding documents with regards to Disaster Management in South Africa, including the Disaster Management Act and the NDMF (2005). These two documents also outline certain requirements with regards to Disaster Risk Assessments. Below is a summary of the requirements related to Disaster Risk Assessments, as well as how the implemented DRA methodology ensured that these requirements were met by the approach followed in this assessment.

Table 2-1: Requirements related to Disaster Risk Assessments

Requirement	Response
NDMF: 2.3 Monitoring, updating and disseminating disaster risk information	Available statistics were included in the assessment. Where appropriate, recommendations for improvement of risk information are made.
Act: 47. (1) A municipal disaster management centre, to the extent that it has the capacity, must give guidance to organs of state, the private sector, non-governmental organisations, communities and individuals in the municipal area to assess and prevent or reduce the risk of disasters, including- (a) ways and means of- (i) determining levels of risk; (ii) assessing the vulnerability of communities and households to disasters that may occur; (iii) increasing the capacity of communities and households to minimise the risk and impact of disasters that may occur: and (iv) monitoring the likelihood of, and the state of alertness to. disasters that may occur;	These aspects are considered in this report.
Act: Section 52: Preparation of disaster management plans by municipal entities	This document only addresses the methodology and results of the disaster risk assessment. However, the project also covers disaster management planning (see other deliverables of this project)
Integration of Disaster Management Plan with IDP	The main recommendations of the DRA should be included in the IDP.
The Act (Section 53 2) e) A disaster management plan for a municipal area must form an integral part of the municipality's integrated development plan; anticipate the types of disaster that are likely to occur in the municipal area and their possible effects; place emphasis on measures that reduce the vulnerability of disaster-prone areas, communities and households; … identify the areas, communities or households at risk; identification of areas, communities or households at risk: state in this methodology at which scale/level the assessment is done.	Reduction measures are to be included in the recommendations. The methodology allows for the identification of communities and households at risk.
Act: Section 53 2) f) take into account indigenous knowledge relating to disaster management	Indigenous knowledge was collected through the consultation process.
Section 53 4) requires consultation with neighbouring municipalities	Characteristics of neighbouring municipalities are discussed in the Status Quo assessment.
NDMF: Key performance area 2, section 2.1: identification of stakeholders.	List of stakeholders invited to workshops and consultations are in line with requirements of members of the DMAF.
NDMF: Section 2.1.1.1: The framework specifically refers to events of frequency/seasonality, and scale/magnitude, speed of onset, affected area and duration	These characteristics of the hazards were taken into account in the DRA.

Requirement	Response
NDMF: The risk assessment must include: setting priorities for action to be taken	Priorities for action forms part of the recommendations.
NDMF: Section 2.1.2: Identify if the risk is becoming more serious.	This aspect is included in the hazard rating and assessment as part of the disaster risk calculations.
NDMF: Section 2.1.3.5: link the risk assessment with the disaster risk management planning	Reduction measures and risk management planning are included in the recommendations.
NDMF: Section 2.1.4: Community-based disaster risk assessment	Community-based disaster risk assessment was not part of this project's scope. Representatives of communities were invited to stakeholder consultations. Stakeholder consultations and collection of indigenous knowledge was included in this assessment.

3 Work Program

The principal stages of the project were as follows:

Phase 1 - Project Initiation

- Drafting of Project Plan
- Project Initiation Meeting and Approval of Project Plan (The approved project plan was never received back from the ADM)

Phase 2 - Data Collection and Gap Analysis

- ADM Arrange District wide workshop
- Introductory, Gap Analysis, Status Quo Consultation and Data Collection Workshop (1 District Based Workshop with Representatives from each LM)
- Spatial and Non-Spatial Data Collection

Phase 3 - Disaster Risk Assessment and Assessment of Current DRA and Gap Analysis

- ADM and LM Arrange Workshops (1 LM Based Workshop in each Local Municipality)
- Preparation of Data Collection Sheets and Maps
- 7 Local Municipality Workshops
- LM Consultations with Government Departments on DRA, DMP, Hazards, Capacities, etc.
- Mapping of Hazards, Vulnerabilities and Resilience based on GIS Base Data
- Capturing of Collected Information in GIS & Electronic Format
- Combining and Preparing Data Layers to enable Risk Modelling
- Non-Spatial Disaster Risk Modelling
- Spatial (GIS) Disaster Risk Modelling
- Identification of Communities at Risk
- Prioritising of identified hazards and risks
- Identification of Risk Reduction Measures based on Risk Assessment results
- Align Identified Measures with IDP / SDFs
- Creation of Hazard, Vulnerability and Resilience Maps (Electronic & Hard Copy)
- Compilation of Draft Disaster Risk Assessment Report (One Report covering District and each Municipality)
- One Workshop on Draft Report (District Based with Representatives from each LM)
- Circulation of Draft Report for Comments
- Updating and Finalization of Report

- Delivery of Final Report, Maps, GIS Data and Plans

3.1 Main Project team

The key project team consisted of the following persons:

3.1.1 ACETE Development consultants

Ms Nomsa Mkaza: Local Eastern Cape project director and client liaison

Ms Vuyi Mlumbi: Local Eastern Cape data collection and facilitation of Local Municipality Workshops

3.1.2 SRK Consulting

Matt Braune represented the partners of SRK Consulting and acted as the Project Director.

Martin Stols is a Senior Scientist at SRK Consulting and was responsible for the GIS and Disaster Risk Modelling component of the Project. Martin acted as a risk assessment specialist and was also responsible for the creation of data layers, spatial analysis and the risk modelling process.

Andries Fourie is a Senior Technologist at SRK Consulting and acted as the risk assessment specialist. He was involved in abstraction of information from the workshop data sheets, analysing of collected data as well as risk reporting.

4 Disaster Risk Assessment Methodology

In order for the disaster risk assessment to provide valid results, the process needs to be based on scientific principles and accurate information. The methodology followed during the Disaster Risk Assessment process is discussed below:

4.1 Spatial and Non-Spatial Data Collection

The entire disaster risk assessment is based on, and requires specific data and information. This data and information includes both spatial and non-spatial data as well as electronic and hard copy data. Examples of typical spatial and non-spatial data are shown below:

Table 4-1: Typical Spatial and Non-Spatial Data used in Disaster Risk Assessments

Types of Data	Spatial Data	Non-Spatial Data
Description of Data	Spatial data relates to data that can be represented spatially. This includes GIS Data as well as maps and drawings.	Non-Spatial data relates to data which is not represented spatially. This includes reports and statistics in tabular format.
Typical examples of data to be used in Disaster Risk Assessments	• **Infrastructure:** Roads, Rail, Water and Sewerage lines, Water and Sewerage Treatment works, Reservoirs, Power lines and Power sub stations, Gas or Petrol Pipelines, Airports, etc.; • **Land use and Land cover data:** Classification of the environment based on its use or physical characteristics. • **Government Buildings and Critical Facilities:** Key Ministerial and Government Buildings, Government Offices, Police Stations, Fire Stations,	• **Integrated Development Plans** and **Spatial Development Frameworks**; • Census Statistics; • **General statistics**, including Health, Crime, Rainfall, Floods, Fire, etc.; • **Information on disaster management capacity**; and • **Specific reports**, including reports of floods, drought,

Types of Data	Spatial Data	Non-Spatial Data
	Hospitals, Clinics, Schools, Location of all Government or Council properties, Government warehouses and storage areas. • **Other Buildings and Land-use data:** Stadiums, Sport fields, Waste and Landfill Sites, Surveyed Land-parcels with land-use labels, etc. • **Administrative boundaries:** Boundaries for the District, Municipalities and Wards • **Cadastral data:** Erven, Farms, Servitudes • **Topographic data:** Rivers, Streams, Contours, Dolomite and Undermined areas, flood lines, etc. • **Remote Sensing data:** Aerial Photography or Satellite Images. • **Statistical data:** Demography, socio economical and health related.	geological problems, accidents, illegal immigrants and refugees, major hazardous installations and health.

4.2 ADM Disaster Management Centre (DMC) arrange consultation workshops

The ADM DMC arranged the Capacity Building and Community Participation workshops. The aim of these workshops was to collect indigenous knowledge as well as disaster management related information from various stakeholders and representatives in each of the Local Municipalities in the ADM.

Typical key stakeholders that were invited to the workshop included:

- The ADM DMC staff;
- Ward and Portfolio Councillors;
- Ward Committee Members;
- All Departmental Managers / Senior Representatives from each department;
- Organized Business;
- Organized Labour;
- Mining and Large Industry;
- Insurance Industry;
- Representatives from Agricultural Sector;
- Medical, Paramedical and Hospitals;
- Institutions of Education, including Schools and University;
- South African Police Service;
- South African National Defence Force;
- Representatives from the Provincial and National Government and neighbouring Municipalities Disaster Management representatives;
- Representatives from Utilities (Electricity, Water, etc.);
- Fire Protection Authorities and similar entities/organizations such as Working for Water and Roads Agencies;

- Transportation organizations (Spoornet, etc.);
- Non-governmental organizations, Community based development workers and disaster management volunteers;
- Traditional leaders;
- Religious and Welfare organizations; and
- Representatives from all the National Key Points in the Municipal area.

4.3 Creation of Maps and Data Collection Sheets for Workshops

It was necessary to create specific data collection base maps and sheets in order to facilitate the stakeholder consultation process and to be able to collect and capture information in a suitable format. These maps and sheets were used during the consultations to capture collected information.

4.4 Capacity Building and Community Participation workshops

As part of incorporating indigenous knowledge, capacity building and community participation, a consultation workshop was held in each of the ADM local municipalities. Details with regard to these workshops are shown in Table 4-2.

Table 4-2: Information collected during Consultation Workshops

Local Municipality	Date	Total	Attendance						
			DM	LM	Trad Auth	Province	Govt. Dept.	NGO	Councillor
Nkonkobe	12/11/2012	66	3	36	3	1	3	1	19
Nxuba	13/11/2012	11	2	5	0	1	2	0	1
Great Kei	15/11/2012	21	2	12	0	1	2	0	4
Ngqushwa	26/11/2012	25	2	12	4	2		0	5
Mnquma	27/11/2012	126	3	97	2	0	2	0	22
Amahlathi	03/12/2012	36	2	24	2	0	2		6
Mbhashe	06/12/2012	29	2	22	0	0	1	0	4

Attendance registers completed at these workshops are provided in **Appendix D**. The data collection sheets used during these workshop sessions provided for the following hazard and resilience related information to be captured:

Table 4-3: Information collected during Consultation Workshops

Category	Type of Information
General Information	• Municipality name

Hazard Specific Information	• Name of Hazard Event
	• Description of Event
	• Classification of Event: Ordinary, Rare or Extreme.
	• Actual vs. Potential event
	• Location of Hazard Event
	  o Map Grid Code
	  o Suburb, road, etc.
	• History of event (frequency)
	• Perception with regard to increasing occurrence
	• Seasonal occurrence
	• Effects on:
	  o People
	  o Buildings
	  o Infrastructure
	  o Environment
	  o Economic Activities
	• Cause of event
	• Secondary Hazards
	• Responsibility of Department / Line-functions
	• Current Plans, Policies or Programmes to address this hazard
	• Specific reasons people are vulnerable to this hazard
	• Priority to reduce hazard
	• Comments

Resilience Information	• Self-evaluation of Facility's Resources on a scale from 1 – 3.
	  o Staff & Human Resources
	  o Expertise, Experience & Specialist Knowledge
	  o Vehicles
	  o Equipment
	  o Funding/Budget
	  o Prevention, Mitigation & Risk Reduction Plans
	  o Response & Recovery Plans
	• Identification of challenges experienced by role players / departments in terms of safety, security and disaster management
	• Greatest needs in terms of safety, security and disaster management

Other Information	• Additional Comments, remarks or recommendations

The information collected during these consultations and workshops were incorporated into the Risk Profiling process and are discussed in **Section 7**.

4.5 Capturing of Data in GIS and Risk Modelling

After the consultations, all the relevant information was captured into the appropriate electronic formats and prepared for the risk modelling. Base data from various collected documents and reports were also captured and included in the Risk Profiling.

More detail with regard to the Risk Profiling is provided in **Section** 5.

4.6 Creation of HVMCR Maps and Disaster Risk Profiles

The results from the Disaster Risk Model were used to compile the various HVRes and Risk maps, while information collected from workshop consultations as well as information abstracted from base data sources were used to compile disaster risk profiles for the ADM. These results are shown in **Section 10**.

4.7 Compilation of Draft Report and Workshop

The draft DRA report contains the draft findings of the disaster risk assessment. The draft report is being presented to the ADM Project team and stakeholders in order to collect any additional input and comments on this report and results. These comments and inputs will be used to update the report, in order to compile the final disaster risk assessment report.

5 Risk Model and Variables

The Disaster Risk Assessment approach was conducted in terms of an overall theoretical framework. This theoretical framework provides the guiding principles for setting up and running the disaster risk model during the disaster risk assessment.

A model can be defined as a representation of a set of components, a process, a system, or subject area, generally developed for understanding, analysis, improvement, and/or replacement of the subject under investigation. A model therefore provides the opportunity to represent certain aspects of reality in order to illustrate or determine relationships, impacts or influences that normally might be difficult to identify. Due to the fact that disaster risk management takes place in complex and dynamic environments, modelling is ideally suited to determine relative disaster risk levels.

The disaster risk model was used to represent relevant aspects and characteristics of the ADM in order to illustrate the effects of interaction between various HVRes-levels and to calculate relative levels of disaster risk. It was therefore important to ensure that the results achieved from this modelling process are accurate, by making use of accurate and sufficient data as a basis for the risk model.

It should be mentioned that it would be impossible to model an exact and detailed replica of the ADM study area in a spatial model. Therefore, in order to represent the complex and intricate ADM area in a manageable and cost effective spatial model, specific assumptions were made to represent a simplified, but still appropriate model, of the ADM. Furthermore, specific limitations and challenges with regards to the base data, information and modelling approach were identified during the assessment process. Some of these assumptions and limitations are presented in **Section 5.8**.

The guiding theoretical framework as well as technical aspects of the risk modelling and assessment process is discussed below.

5.1 The Disaster Risk Formula

The Disaster Risk Model is based on a mathematical formula taking into account the various factors that constitute the level of risk, based on specific hazards, in a specific area. The mathematical formula can be illustrated as follows:

$$Risk = \frac{Hazard\ x\ Vulnerability}{Manageability + Capacity}$$

Where:

Risk The probability of harmful consequences or expected losses resulting from the interactions of hazards and vulnerable conditions. Conventionally risk is expressed as follows: Risk (R) = Hazard x Vulnerability. However, the concepts of Manageability and Capacity (combined as Resilience) are also included in the formula.

Hazard A potentially damaging physical event, phenomenon and/or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Vulnerability The degree to which an individual, a household, a community, an area or a development may be adversely affected by the impact of a hazard. Conditions of vulnerability and susceptibility to the impact of hazards are determined by political, physical, social, economic and environmental factors or processes. *The political aspect of vulnerability is not included in this assessment since it entails a long process of investigating the political climate and culture of different areas within the study area, which is a complete long-term study on its own.*

Manageability For the purpose of this assessment Manageability will be defined as the combination of all the strengths and resources available within the government departments and line-functions (such as Fire Services, South African Police Service, Department of Health, etc.) that can reduce the level of risk or mitigate the effects of a disaster. Capacity may include physical, institutional, social or economic means as well as skilled personnel or collective attributes such as leadership and management.

Capacity For the purpose of this assessment Capacity will be defined as the combination of all the strengths and resources available within the community or society (including NGOs, CBOs, Faith Based Organizations, etc.) that can reduce the level of risk or the effects of a disaster. Capacity may include physical, institutional, social or economic means as well as skilled personnel or collective attributes such as leadership and management.

Resilience The combined value between the Manageability and Capacity values are referred to as the Resilience value.

5.2 Concepts and Model Variables

In order to accurately interpret the results from the risk assessment, it is important to understand the effects of different HVRes levels on the calculated Risk levels. The underlying principle of the Disaster Risk formula is that an increased Hazard and Vulnerability level, combined with decreased Resilience levels will lead to an increased Risk level. Whereas, a reduced Hazard and Vulnerability level, combined with an increased Resilience level, will lead to a decreased Risk level. A change in any one of the individual HVRes values will have an impact on the resulting Risk level. This relationship is shown below:

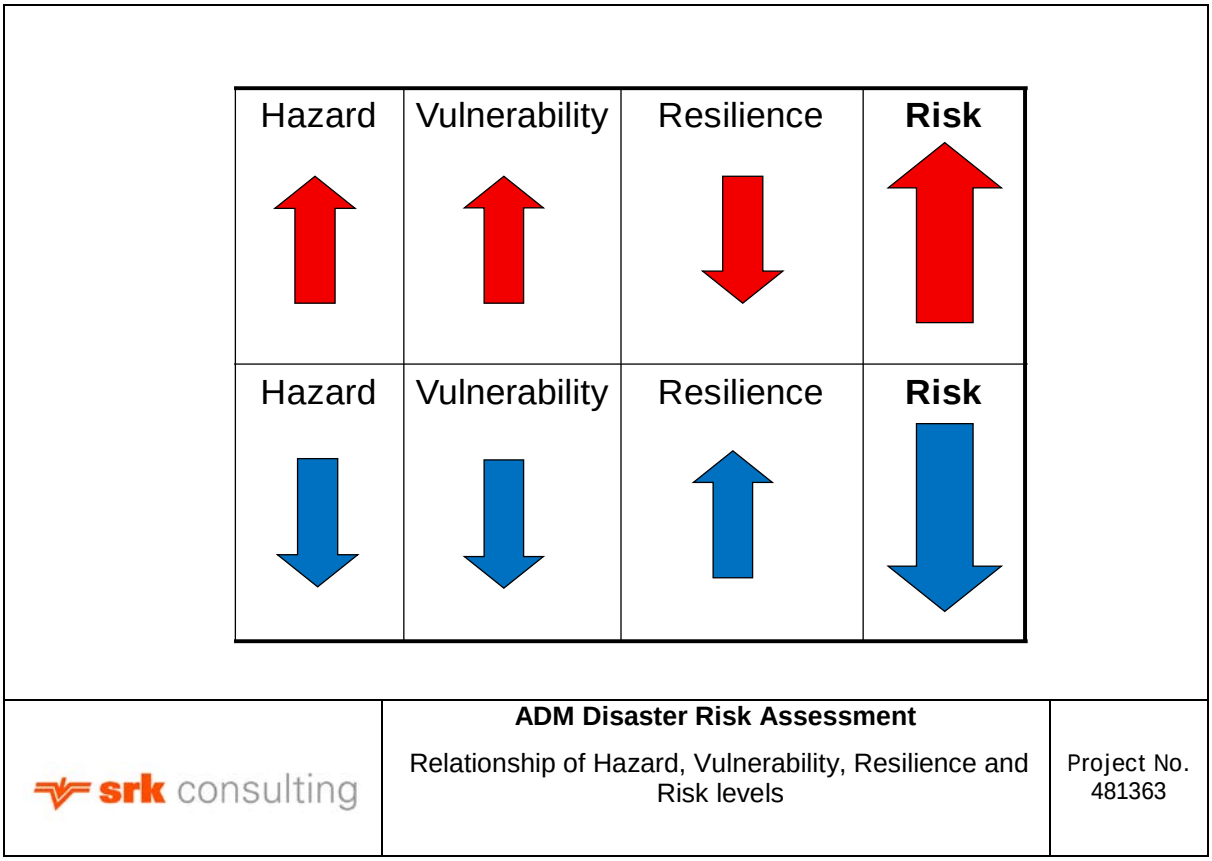


Figure 5-1: Relationship of Hazard, Vulnerability, Resilience and Risk levels

An example of a flood hazard event can be used to illustrate this relationship:

Example 1 – High Disaster Risk

A severe flood event, with high water levels and velocities (high hazard value) occurs in an informal settlement community, where the community has a low income level, low level of general health and informal structures (high vulnerability value). It is also indicated that the local authorities and line functions (fire services, police, health facilities) or the community based NGOs do not have adequate resources (such as vehicles, equipment or human resources) to respond to an event (low resilience value). These circumstances contribute to a high Disaster Risk value.

Example 2 – Low Disaster Risk

A low severity flood event, with low water levels and a low velocity (low hazard value) occurs in a formal and established community. The community has a high income level, high level of general health and the infrastructure in the community is designed and constructed to a suitable standard with required storm water management infrastructure. It is also indicated that both the local authorities and community based NGOs have adequate levels of resources to respond to this type of event. This community will be classified as having a low disaster risk level with regard to this flood event.

It should be remembered that areas with a high vulnerability do not necessary also have a low resilience value, and that any combination of different hazard, vulnerability and resilience values can be identified in an area or community. The interaction between these levels is important to understand and interpret the results (and limitations) of the disaster risk assessment.

5.3 The Use of GIS

Extensive use is made of a Geographical Information System (GIS) during the disaster risk assessment process. This section provides an overview of the GIS approach for the risk assessment for the ADM.

5.3.1 What is a GIS

A Geographical Information Systems (GIS) is an information system that uses a computer to collect, store, manipulate, analyse, and display geographically referenced data. It consists of various components, including data, people, hardware, software and processes. Data related to the hazard, vulnerability, and resilience levels of a specific area or feature is also mostly related to a specific geographical location on the earth's surface, and can therefore be represented in a GIS.

The level of disaster risk in a specific area depends on a range of interrelated factors. Amongst these factors are the spatial extent and distribution of the HVRes related features. A GIS is therefore ideally suited to conduct this type of modelling process.

In order to present the various HVRes-levels spatially, various individual GIS data layers will be created. These data layers are used to calculate and spatially represent the risk levels in this study area. This process is represented below:

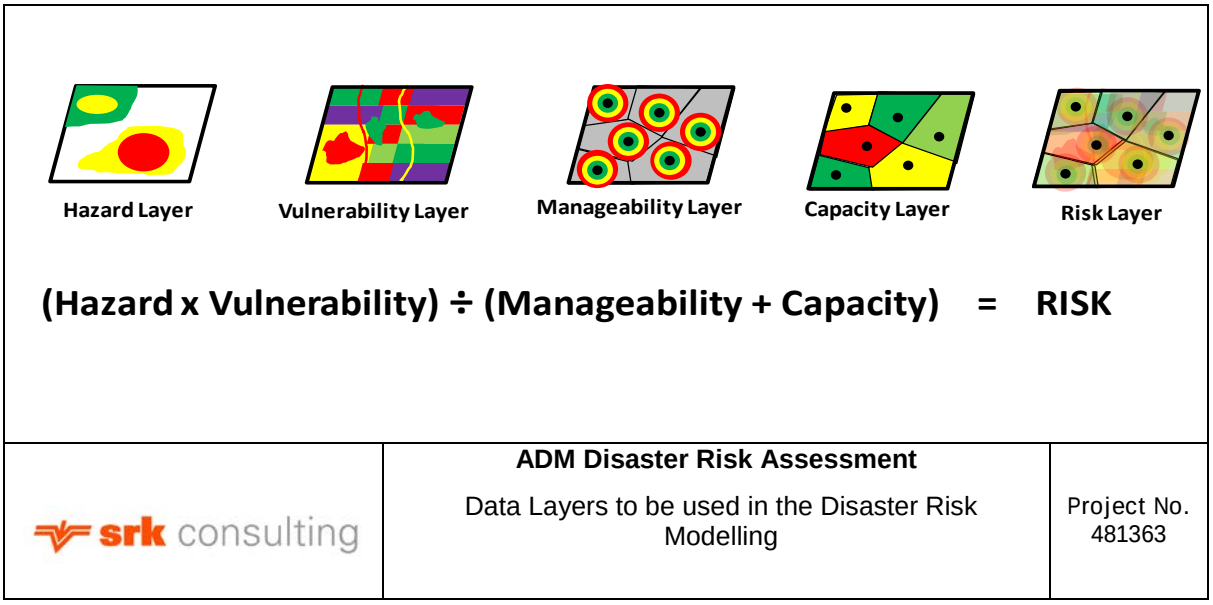


Figure 5-2: Data Layers to be used in the Disaster Risk Modelling

Even though the Spatial Modelling component of the Risk Assessment process involves a complex process of inputs and outputs, the basic process is related to the principle described in the previous section. In the simplest form, the Risk Assessment Process involves the following steps:

- Input;
- Processing; and
- Output.

Input used in the Risk Assessment process relates to the collected spatial and non-spatial data, and information. These are further supplemented and refined by using inputs received from participants and stakeholders through the workshops and consultation sessions.

Processing involves the capturing, transforming/projecting, format changing, quality control/checking and calculation in both the spatial (GIS) and non-spatial environments. It also includes re-visiting aspects that may have been collected during the input stage which may need clarification, i.e. data based on certain stakeholder perceptions or spatial data that may need to be adjusted or edited.

Output is mostly in the form of descriptions, values or ratings and is presented in the report in the form of qualitative descriptions, quantitative tables and figures. Maps will be presented as an integral part of the output since it will clearly identify areas and communities at risk.

5.3.2 Software

The risk assessment includes a spatial disaster risk modelling process. This modelling process was conducted by making use of ESRI's ArcGIS10.1™ software and it's Spatial Analyst Extension.

5.3.3 Coordinate System

The following coordinate system was used for the Amathole District Municipality. All data was transformed to this system to enable the quantification of hazard exposure per municipality.

Projection: Transverse_Mercator

False_Easting: 0.0

False_Northing: 0.0

Central_Meridian: 27.0

Scale_Factor: 1.0

Latitude_Of_Origin: 0.0

Linear Unit: Meter (1.0)

Geographic Coordinate System: GCS_Hartebeesthoek_1994

Angular Unit: Degree (0.0174532925199433)

Prime Meridian: Greenwich (0.0)

Datum: D_Hartebeesthoek_1994

- Spheroid: WGS_1984
- Semimajor Axis: 6378137.0
- Semiminor Axis: 6356752.314245179
- Inverse Flattening: 298.257223563

5.3.4 Data distribution

All hazard, vulnerability and resilience data generated during the execution of this project will be made available to the District as an ArcGIS 10.1 map package. The map package will enable the District to view edit and redistribute all spatial data generated for this project.

5.4 Hazard Severity Indices and Mapping

This section describes the technical aspects and approach used to conduct the hazard assessment and profiling for the ADM.

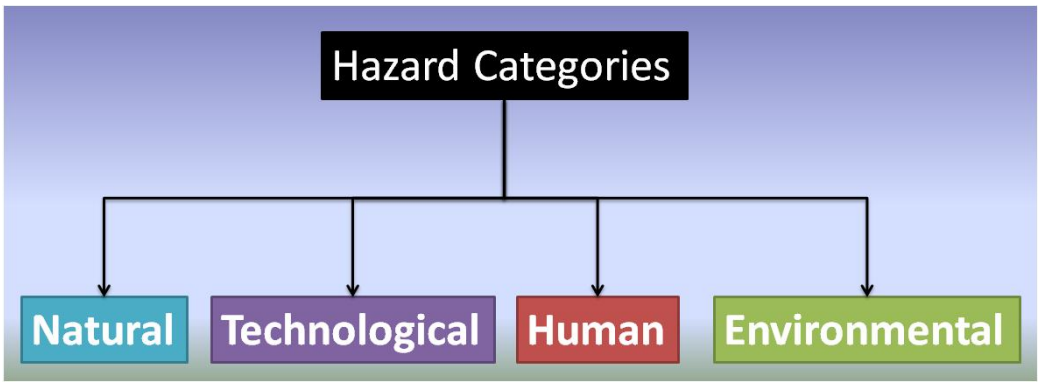
5.4.1 Hazards Description and Categories

The National Disaster Management Framework provides a list of hazards to be considered during a disaster risk assessment. The hazard categorization is shown in Table 5-1:

Table 5-1: Classification of Hazards according to the National Disaster Management Framework

Natural hazards	Examples
Geological	Landslides, rockslides, liquefaction, subsidence
Biological	Epidemic diseases affecting people or livestock, veld fires, plant infestations
Hydrometeorological	Floods, debris flows, tropical cyclones, storm surges, severe storms, drought, desertification
Technological hazards	**Examples**
	Industrial pollution, nuclear activities, toxic waste, dam failure, transport accidents
Environmental hazards	**Examples**
Environmental degradation	Land degradation, deforestation, loss of biodiversity

For the purpose of the Disaster Risk Assessment for the ADM, Table 5-1 was further refined and expanded, and the following hazard categorization was used:



srk consulting	**ADM Disaster Risk Assessment** Hazard Categories	Project No. 481363

Figure 5-3: Hazard Categories

Each of these main hazard categories contained a number of individual hazards. In order to facilitate reporting as well as the creation of maps, these individual hazards were grouped into 'Combined Hazard Categories'. These categories are shown in Table 5-2:

Table 5-2: Hazards considered during the Disaster Risk Assessment

No	Hazard category
1	Civil Unrest - Armed Conflict (Civil/Political War)
2	Civil Unrest - Crime
3	Civil Unrest - Demonstrations / Riots
4	Civil Unrest - Refugees / Displaced People
5	Civil Unrest - Terrorism
6	Civil Unrest - Xenophobic Violence
7	Disease / Health - Disease: Animal
8	Disease / Health - Disease: Human
9	Disease / Health - Disease: Plants
10	Environmental Degradation - Deforestation
11	Environmental Degradation - Erosion
12	Environmental Degradation - Land Degradation
13	Environmental Degradation - Loss of Biodiversity
14	Fire Hazards - Formal & Informal Settlements / Urban Area
15	Fire Hazards - Veld/Forest Fires
16	Geological Hazards - Earthquake
17	Geological Hazards - Landslides/Mud flows
18	Geological Hazards - Rock-fall
19	Geological Hazards - Subsidence
20	Hazardous Material - Fire/Explosion (Storage & Transportation)
21	Hazardous Material - Spill/Release (Storage & Transportation)
22	Hydro-meteorological - Drought
23	Hydro-meteorological Hazards - Desertification
24	Hydro-meteorological Hazards - Extreme Temperatures
25	Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
26	Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
27	Infestations - Algal Bloom (Red Tide)
28	Infestations - Animal Infestation / Over Population
29	Infestations - Insect Infestation
30	Infestations - Plant Infestations (Intruder Plants)
31	Infrastructure Failure / Service Delivery Failure - Electrical
32	Infrastructure Failure / Service Delivery Failure - Gas
33	Infrastructure Failure / Service Delivery Failure - Information Technology
34	Infrastructure Failure / Service Delivery Failure - Sanitation
35	Infrastructure Failure / Service Delivery Failure - Transport
36	Infrastructure Failure / Service Delivery Failure - Water
37	Major Event Hazards - Cultural / Religious
38	Major Event Hazards - Political
39	Major Event Hazards - Recreational / Commercial

No	Hazard category
40	Major Event Hazards - Sport
41	Oceanographic - Sea Level Rise (Climate Change)
42	Oceanographic - Storm Surge
43	Oceanographic - Tsunami
44	Other - Space Objects
45	Pollution - Air Pollution
46	Pollution - Land Pollution
47	Pollution - Water Pollution (Fresh and Sea)
48	Structural Failure - Bridge Failure
49	Structural Failure - Building Failure
50	Structural Failure - Dam failure
51	Transport Hazards - Air Transportation
52	Transport Hazards - Rail Transportation
53	Transport Hazards - Road Transportation
54	Transport Hazards - Water Transportation (Incl. Marine Accident)

5.4.2 Approach to Hazard Profiling

The South African National Disaster Management Act as well as the NDMF stipulates that indigenous knowledge relating to disaster management should be included in Disaster Management planning, as well as in disaster risk assessments. However, indigenous knowledge, especially when related to the occurrences of hazard events and disasters, might sometimes be based on a particular individual's perception and memory, and might therefore not always be entirely accurate. It is therefore often valuable to verify indigenous knowledge in a group set-up, where information can be discussed and verified by more than one member of a specific community. Alternative sources of information such as incident reports and statistics can provide a formal record of events. However, formal records might not always be available, or statistics might be captured incorrectly or inconsistently and not always illustrate or take into account all factors related to specific events (Adams 2001).

For this assessment and related hazard profiling, three approaches were used to compile the hazard profile of the ADM. These approaches were:

- Hazard profiling through individual and workshop consultations and group discussions to collect specialist and indigenous knowledge with regards to hazards in the ADM;
- Desk-top hazard profiling through the use of statistics, reports and base data (where available); and
- GIS Based hazard profiling through the use of GIS base data to identify hazards based on local conditions in the ADM (where available).

The results of these three approaches were compared and are presented in the relevant sections of this report.

A ward level indigenous knowledge survey was conducted to be used to verify the findings of the hazard profiling.

5.4.3 Hazard Profiling through Individual and Workshop Consultation Sessions

As outlined in Section 4, hazard data was collected during individual and workshop consultations sessions. The information collected during these workshops and consultations was captured in an electronic format, and used to calculate indicative hazard ratings for the various identified hazards. This was done by assigning specific ratings and weights to the various hazard characteristics. The hazard characteristics used in the calculation of the indicative hazard ratings, based on stakeholder perceptions, were:

- Probability Factor:
    - Frequency
    - Perception of Increase in Hazard Events
    - Seasonal / Monthly Occurrence of Hazard

- Severity Factor
    - Perceived impact of Hazard on
        - People
        - Buildings
        - Infrastructure
        - Environment
        - Economy

The results from this assessment are discussed in the relevant section of this report.

5.4.4 Desk-Top Hazard Profiling

The desktop risk assessment was conducted based on information abstracted from various data sources and statistics. The desktop risk assessment calculated the relative risk levels associated with each of the identified hazards, for each of the local municipalities. In order to calculate relative risk levels, the risk assessment model made use of the following components:

- **Vulnerability**: Vulnerability levels for each of the local municipalities were based on:
    - Level of access to water;
    - Level of access to sanitation;
    - Level and access to refuse removal services;
    - Dwelling types;
    - Sources of energy;
    - Age profile of the community; and
    - Income levels of the community.

- **Impact:** The impact of each typical hazard event was estimated, based on:
    - Impact on people;
    - Impact on buildings;
    - Impact on infrastructure;
    - Impact on the environment;

- Size of area generally affected by hazard event; and
- The general time period over which the impact is caused.

- **Frequency:** The estimated frequency of the hazard event and if incidents are occurring more frequently;
- **Possibility:** The possibility of the event occurring; and
- **Exposure:** The level to which the municipality is exposed to the specific hazard.

The results received from the desktop assessment were compared with the results from the GIS modelling, previous assessments and stakeholder perception value, and all of this information was used to compile the final risk ratings for the ADM.

5.4.5 GIS Based Hazard Profiling

Hazard profiles were also represented spatially by making use of a GIS. This was done by considering the land-use/land-cover data of the ADM, and then mapping specific hazards applicable to the different land-use/land-cover categories as well as particular features in the ADM. The hazard mapping and buffering guidelines are attached in Appendix B – GIS RHVMC Modelling & Buffer Guidelines. Information received from stakeholders, as well as information from base data was also included in the GIS hazard mapping.

5.4.6 Finalizing the Hazard Profile

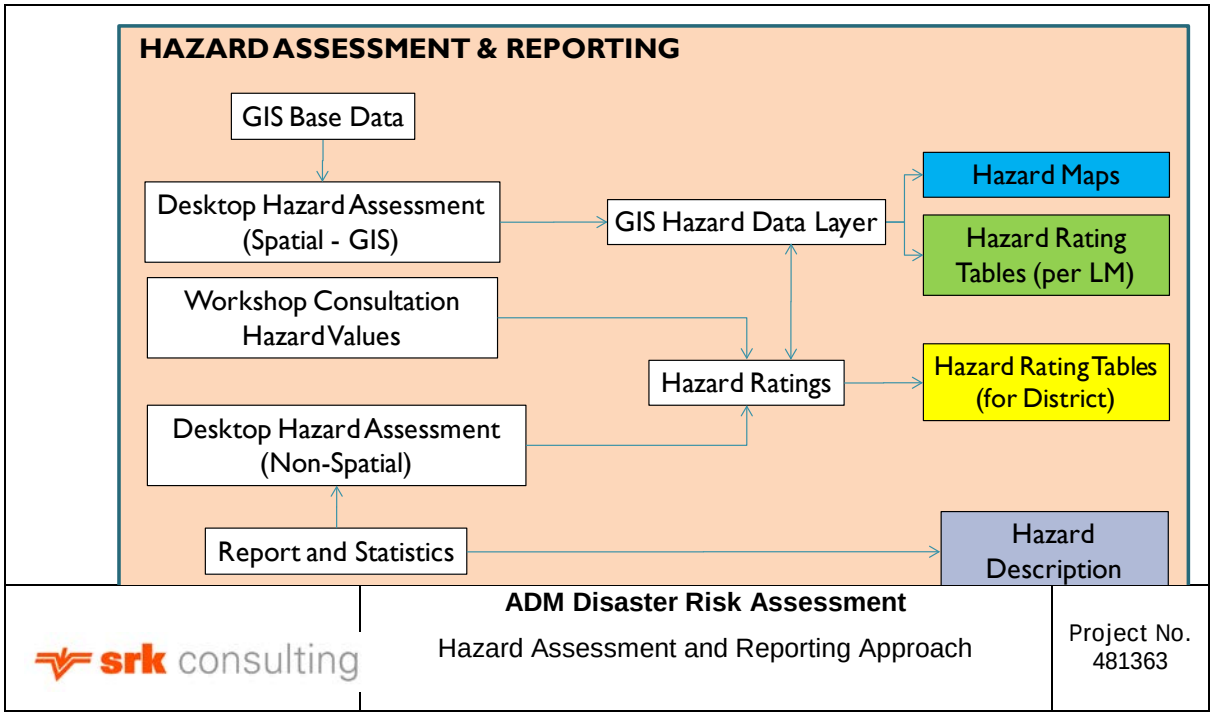


Figure 5-4 is a summary of the process followed during the hazards assessment as part of disaster risk assessments.

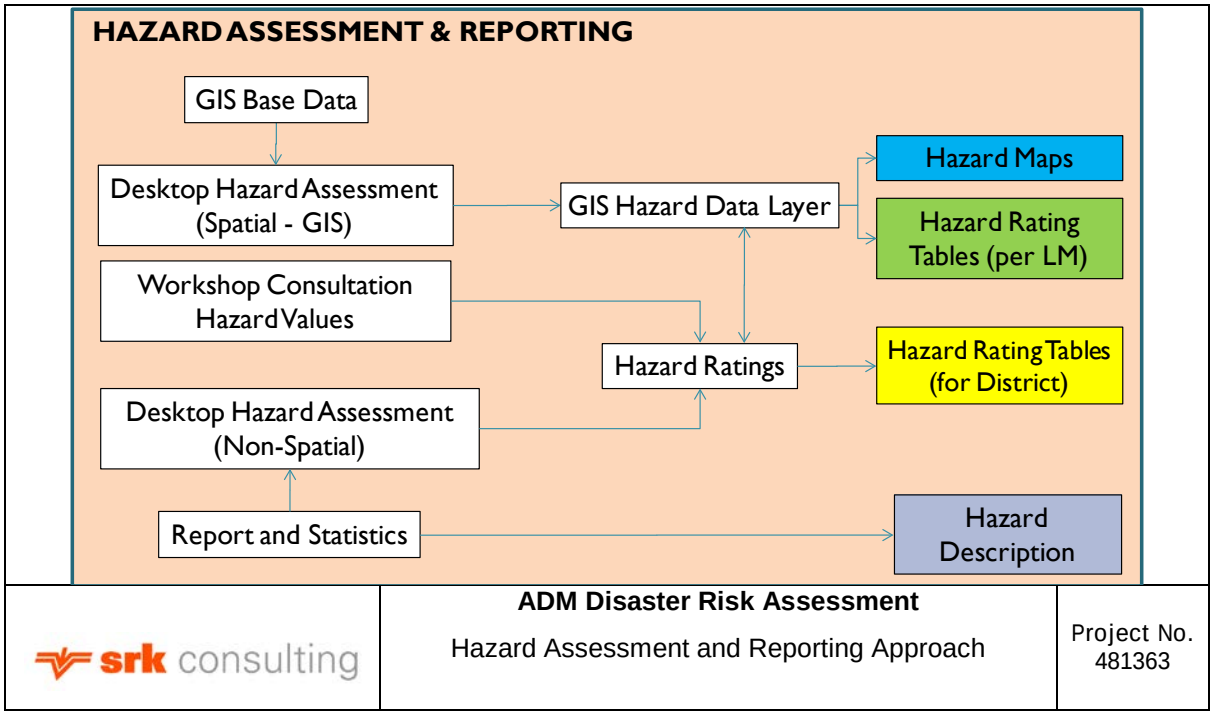


Figure 5-4: Hazard Assessment and Reporting Approach

5.5 Vulnerability Indices and Mapping

Vulnerability assessments and reporting also form part of the DRA process. This vulnerability profiling for the ADM consists of three processes. These processes are discussed in the following sections:

5.5.1 General Vulnerability Description

During the first process, the vulnerability of the ADM is described in terms of general vulnerability indicators. This mainly includes census 2011 information. During this assessment, the vulnerability of the ADM is described and compared with key indicators of neighbouring municipalities and areas.

5.5.2 Vulnerability Rating

The second approach to vulnerability mapping in the ADM involves the classification of land-use/land-cover data, environmental status and social statistics to create a single vulnerability rating. Land-use data was used to classify the vulnerability of various land-uses within the study area to the effects of different types of hazards. The vulnerability of the various areas in the ADM was classified in terms of social, structural, environmental and economic vulnerability. The results of this vulnerability profiling are discussed in Section 8.2.

5.5.3 Finalizing the Vulnerability Profile

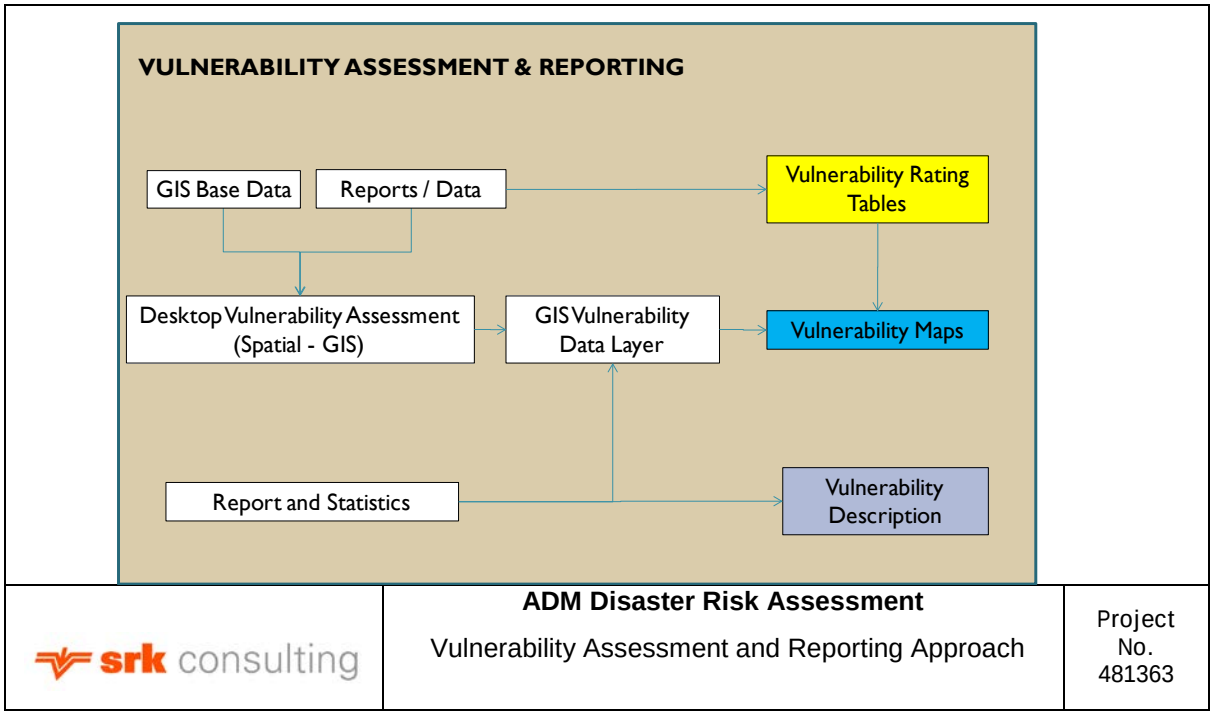


Figure 5-5 represents an overview of the process generally followed to conduct the vulnerability assessment as part of a disaster risk assessment.

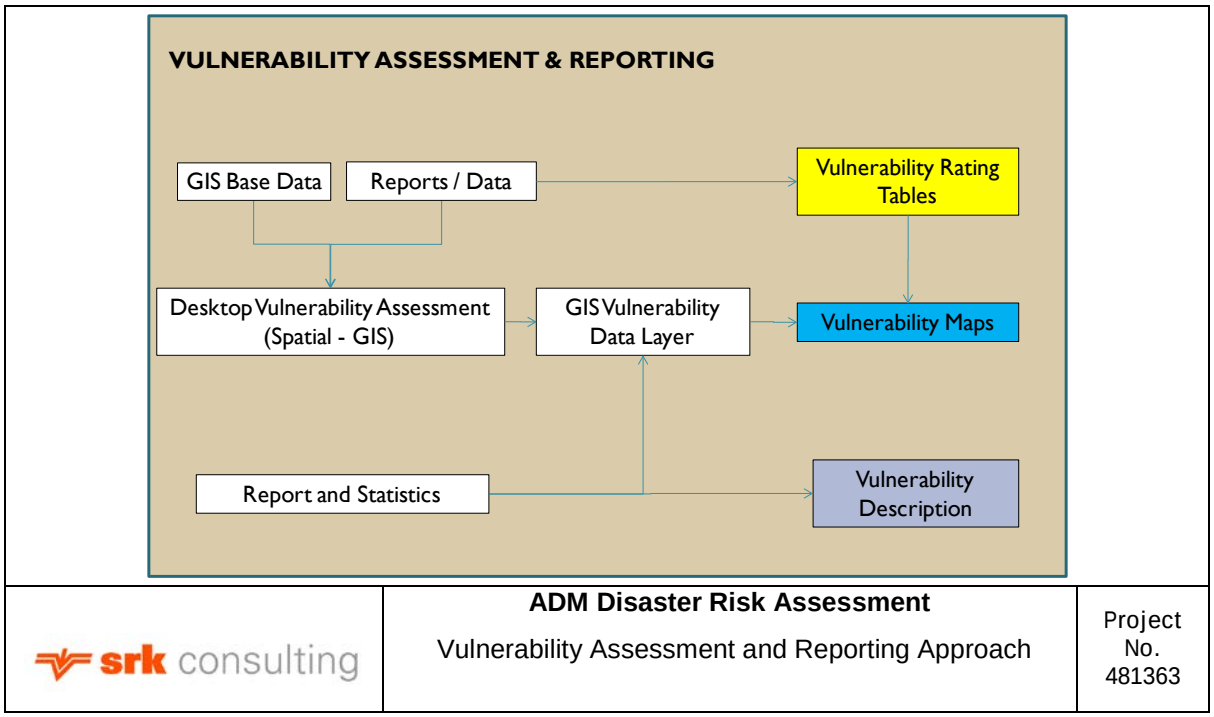


Figure 5-5: Vulnerability Assessment and Reporting Approach

The results from this vulnerability assessment are discussed in Section 0.

5.6 Resilience Indices and Mapping

Resilience mapping was required as part of this assessment. Resilience mapping refers to the mapping of a combination of the Manageability and Capacity levels within the study area. The resilience assessment consisted of two main activities. The first activity relates to the resilience

profiling based on input received from stakeholders. The second activity was GIS based resilience mapping, based on the location of resilience-related facilities in the ADM.

5.6.1 Resilience Profiling through Stakeholder Consultation

During the stakeholder consultation workshops and interviews, representatives from various departments and line functions were provided with the opportunity to undertake a self-assessment with regard to their own organization's capacity to fulfil their responsibility in terms of disaster management activities. The representatives were provided with a questionnaire, instructing them to rate the capacity of their own line function/department in terms of the capacity to conduct the required day-to-day, disaster risk reduction as well as disaster response activities. Representatives were also instructed that the result of the assessment should not act as a 'wish list' but should reflect the current and actual resources required to adequately perform disaster management related activities.

Representatives were asked to rate their capacity in terms of the following aspects:

- Staff/Human Resources;
- Expertise, Experience & Specialist Knowledge;
- Vehicles;
- Equipment;
- Funding/Budget;
- Facilities/Buildings;
- Risk Reduction Plans, Policies & Programmes; and
- Response Plans, Policies & Programmes.

Representatives were instructed to rate the above mentioned categories in terms of one of the following ratings:

"1" Representing an **insufficient** level of resources, equipment, or plans to fulfil the disaster management related responsibilities;

"2" Representing a **sufficient** level of resources, equipment, or plans to fulfil the disaster management related responsibilities; and

"3" Representing a **more than sufficient** level of resources, equipment, or plans to fulfil the disaster management related responsibilities.

Representatives also had the opportunity to identify and describe specific needs their organization has in order to reduce disaster risk or ensure a more effective response to disasters. It should, however, be noted that the results achieved during the capacity self-evaluation is based only on the feedback received from the representatives, and was not subjected to additional confirmation and verification.

The result of this assessment was used to calculate average resilience values for each of the role players and the results are discussed in Section 9.1.

5.6.2 GIS Based Resilience Profiling

In order to model the disaster risk in the ADM spatially, it was required to represent the resilience values spatially. This was done by making use of the location of key line-functions, and to represent approximate service areas spatially. The basis of this approach relates to the assumption that communities that are located in proximity of facilities such as hospitals, police stations and fire

stations, might have relatively more access to services than communities located far away from facilities. Based on this, it was therefore assumed that communities closer to facilities will have a comparatively higher resilience value, than communities that were located further away from facilities. An example of resilience mapping based on the location of key facilities (fire brigade services) is shown in Figure 5-6.

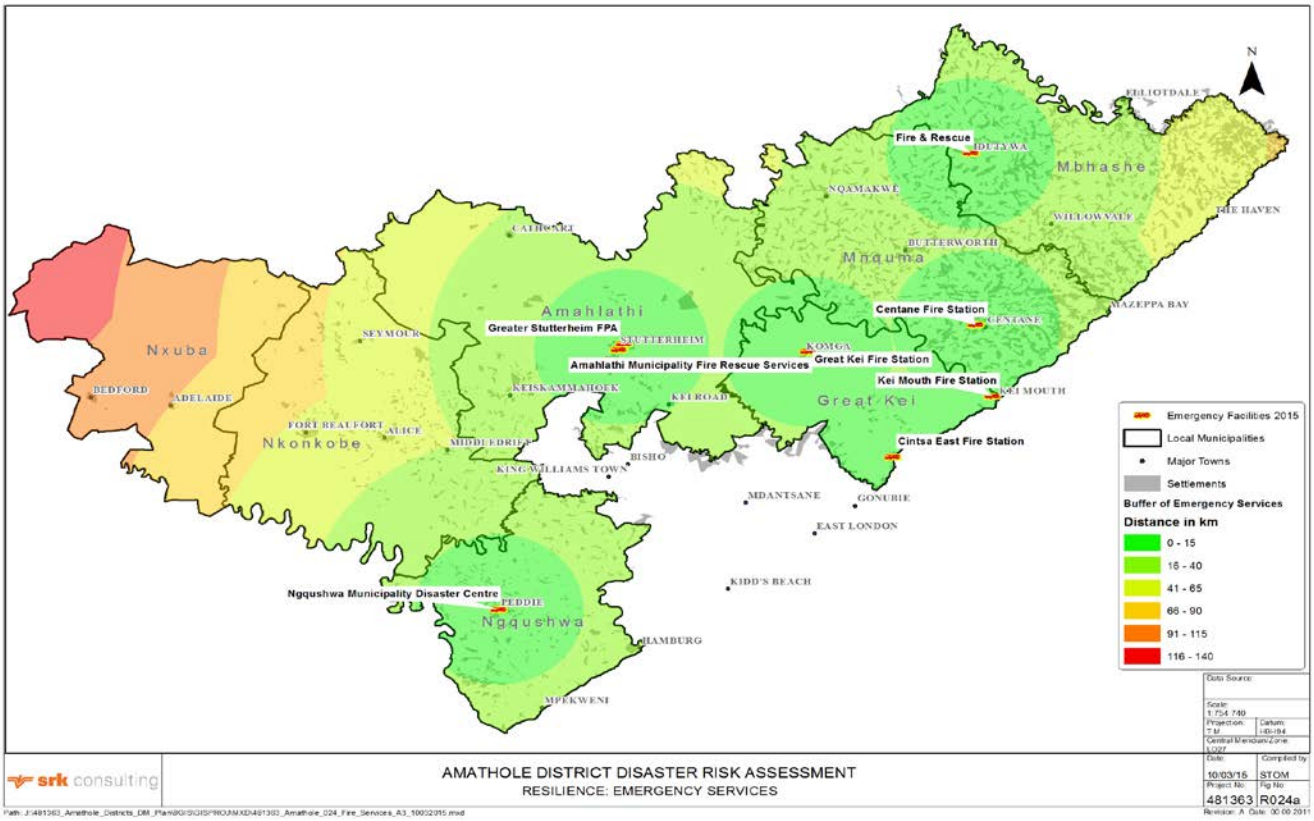


Figure 5-6: Example of resilience mapping based on location of Fire Brigade Services in the ADM

5.6.3 Finalizing the Resilience Profile

The resilience profile (consisting of Capacity & Manageability data) for the ADM consisted of two deliverables:

- The first deliverable is the description of the various resilience role players as contained in Sections; and
- The second deliverable is the Resilience map as shown in Section 9.2.

These components should not be considered as stand-alone resilience profiles of the ADM, but should be considered together in order to analyse and understand the resilience profile of the ADM. An overview of the process followed to compile the resilience profile is shown in

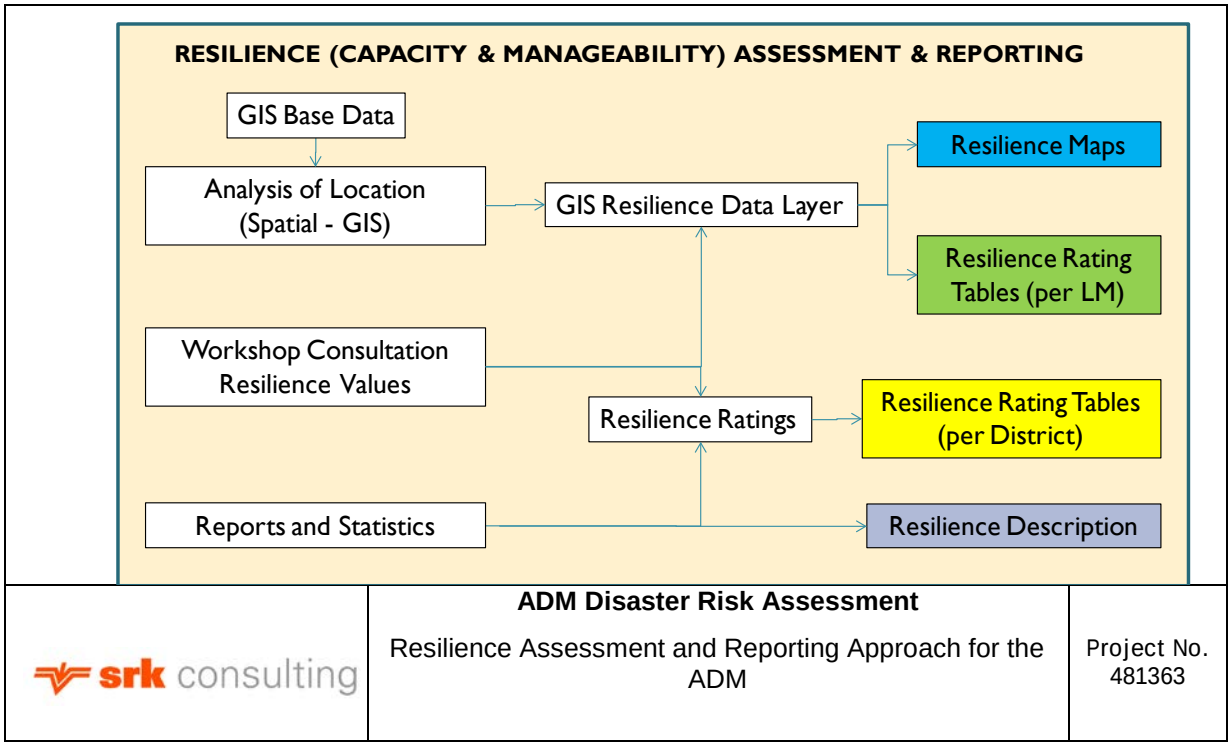


Figure 5-7.

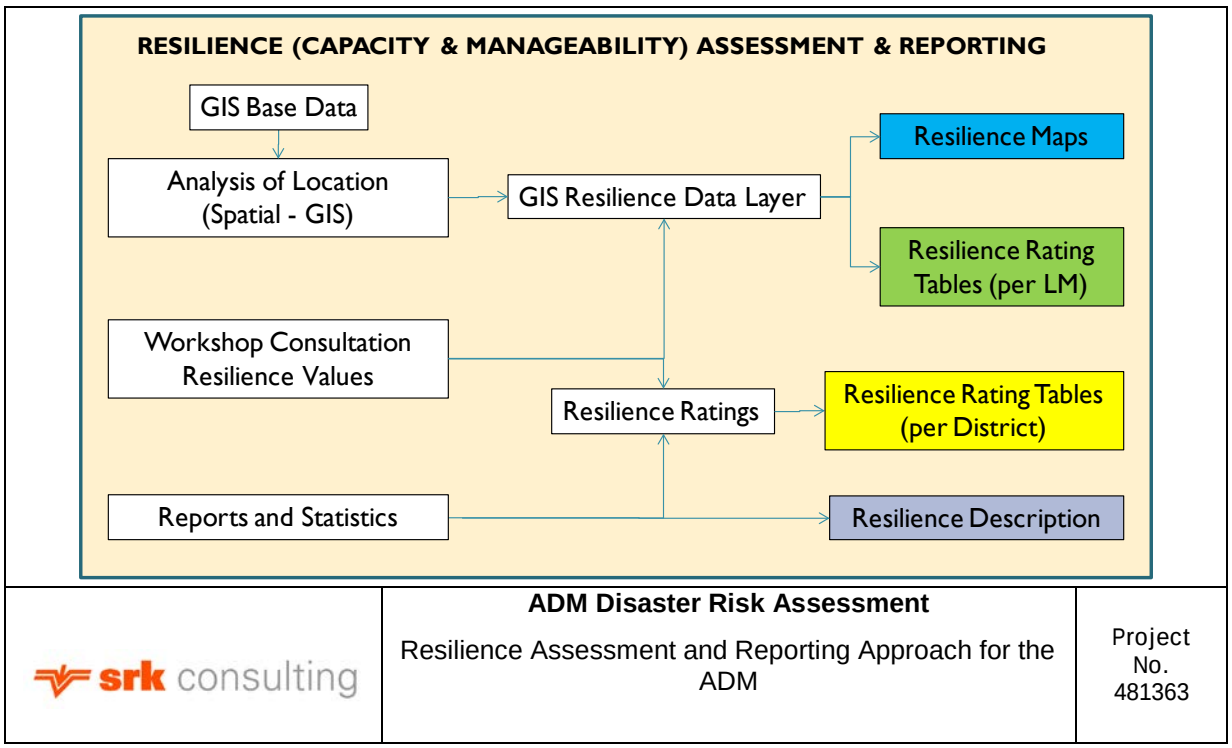


Figure 5-7: Resilience Assessment and Reporting Approach for the ADM

The results from this resilience assessment are discussed in Section 9.

5.7 Risk Profiling and Rating

The final risk values were calculated by making use of the defined risk formula, and combining the appropriate HVRes values and data layers. The result of this process included maps, descriptions and rating tables.

5.7.1 Interpreting the Results

The deliverables from the Risk Assessment include, amongst other items, various maps and tables. In addition to ratings, colour coding is also used to represent various hazard, vulnerability, resilience or risk levels.

In interpreting the maps and tables, it is important to consider the following:

Tables – The tables represent the quantitative results of the various calculations, and provide a tool for comparing different levels of the hazard, vulnerability or resilience values. In most cases, the tables are also colour coded, with Red indicating a negative value (High Hazard, Vulnerability or Risk), with Green indication a positive value (Low Hazard, Vulnerability or Risk).

Maps – The results contained in the maps provides a spatial representation of the various Hazard, Vulnerability, Resilience and Risk levels. For example, Road Transport Hazards may be high on major routes. It should however be stated that maps represent only a spatial representation of the component under investigation, and different maps should generally not be compared with one another. For example, a Red Hazard Rating on a Fire Hazard map should not be compared with a Red Hazard Rating for Transportation Hazards. The rating only relates to the relative intensity and spatial occurrence of the hazard. All comparison should be done on the basis of the provided prioritization table which was compiled for the ADM.

Table 5-3: Rating Classifications in Reporting Tables and Maps

Colour	Hazard	Vulnerability	Resilience	Risk	Priority
Red	A high hazard rating, causing an increased risk	A high vulnerability rating, causing an increased risk rating	A low resilience rating, causing an increased risk	A high risk rating	Higher Priority, mitigation or treatment options should be implemented over a shorter term
Yellow	A medium hazard rating	A medium vulnerability rating	A medium resilience rating	A medium risk rating	Medium Priority, mitigation or treatment measures should be implemented over the medium term
Green	A low hazard rating, causing a decreased risk	A low vulnerability rating, causing a decreased risk rating	A high resilience rating, causing a decreased risk rating	A low risk rating	Lower Priority, mitigation or treatment measures should be implemented over a longer term

It is important to consider that the highest risk rating will be achieved in an area where the Hazard and Vulnerability levels are high, while the Resilience levels are low. This interaction between the three components should be considered to determine the risk level within any area under investigation.

5.8 Assumptions and Limitations

5.8.1 Data Limitations and Challenges

It should be noted that SRK are not custodians of any of the project data and therefore cannot guarantee the accuracy of data received from the data custodians consulted during this project or any of the stakeholders involved. Where multiple sets of the same data were gathered the data was evaluated and an attempt was made to use the most accurate or most recently updated data.

It should also be considered that most spatial entities are dynamic and changes occur over time. Changes in land use for instance can have major implications on the modelling results as both a large amount of hazard information and vulnerability information is based on land cover and land use data.

It must therefore also be considered that the modelling of disaster risk is a dynamic process that needs to be updated regularly to reflect any changes in the physical environment and human settlement and activities.

5.8.2 Limitations and Challenges to the Methodology

Specific other limitations and challenges identified during the assessment include:

- The manageability and Capacity assessment is dependent on information received from role players.
- The project scope did not allow for independent and in depth assessment of the resilience levels of departments, line-functions or community role-players. The results from the self-evaluation were used as a basic indication of the resilience levels (capacity and manageability) and needs within the ADM. It is proposed that a more detailed and in depth assessment of resilience be conducted.
- Resilience values are not hazard specific, but average multi-hazard resilience values for role players in the ADM were used. It is proposed that, should additional funds be available, a more detailed hazard-specific resilience assessment be conducted in the ADM.

6 Status Quo Assessment of the ADM

The current characteristics of the ADM need to be taken into account during the Risk Assessment process. This section focuses on the characteristics of the ADM, and investigates how the current situation impacts on disaster risks in the ADM.

6.1 Geographical Setting

Amathole District Municipality is located in the Eastern Cape Province. It consists of 7 local municipalities; Amahlathi, Great Kei, Mbhashe, Mnquma, Ngqushwa, Nkonkobe and Nxuba. Amathole District Municipality has approximately 225 km of coast line along the local municipalities of Mbhashe, Mnquma, Great Kei and Ngqushwa. A Locality Map of ADM is provided in Figure 6-1 below. The ADM includes large parts of the former Ciskei and Transkei homeland areas. It is bordered by the Buffalo City Metro, Cacadu, Chris Hani, and OR Tambo District municipalities. The District covers a land area of roughly 21598 km².

6.1.1 Changes in demarcation

The most important change in demarcation was when Buffalo City became a Metropolitan Municipality on 18 May 2011. The change in resources and economy will have an impact on Amathole District Municipality. The change in demarcation will affect the resilience and vulnerability of Amathole District Municipality which in turn could have a notable impact on the risk profile for Amathole District Municipality.

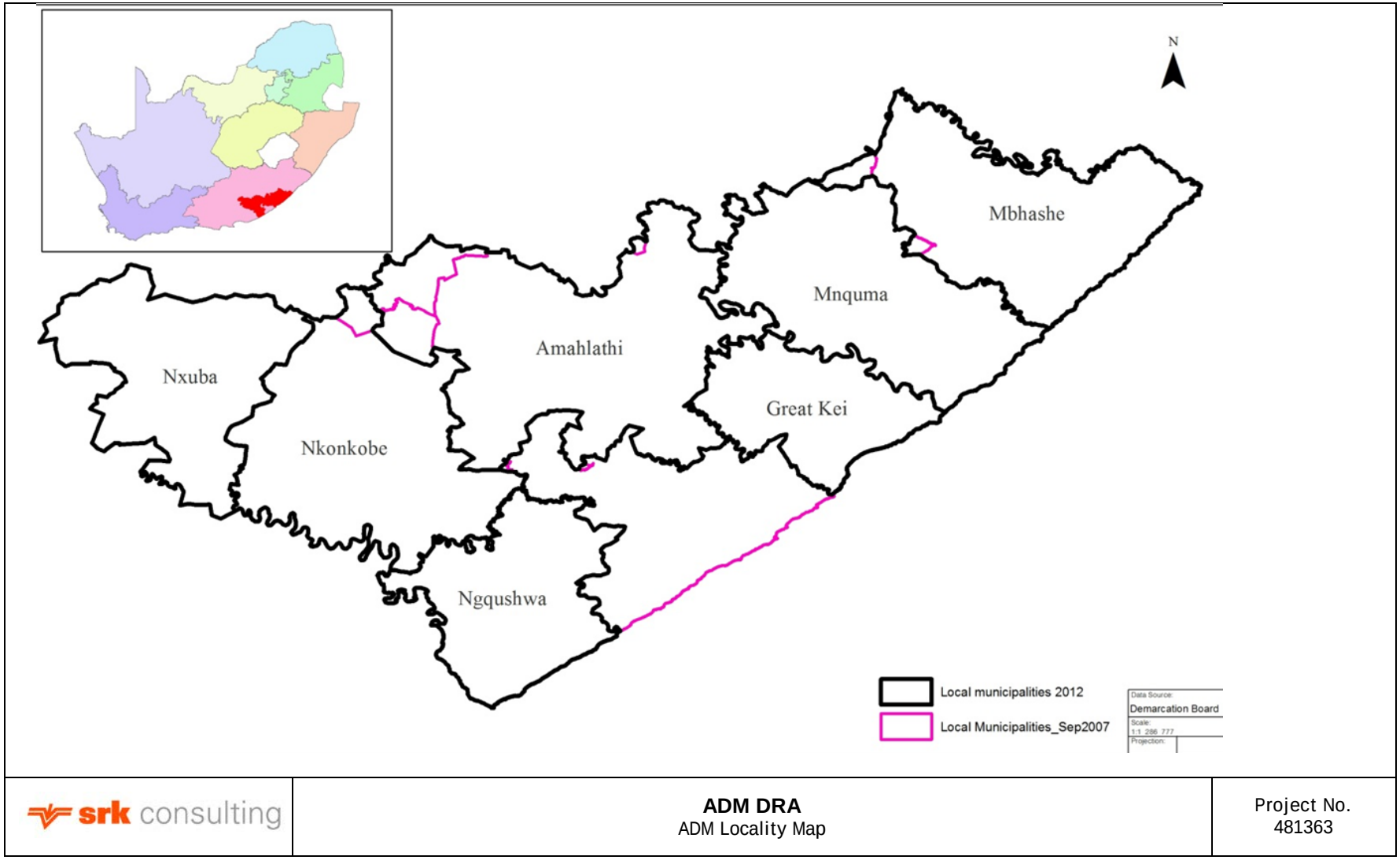


Figure 6-1: ADM Locality Map

Below is a list of the larger towns and populated places in ADM:

Amahlathi Municipality:

- Stutterheim;
- Cathcart;
- Keiskammahoek; and
- Kei Road.

Nxuba Municipality:

- Bedford; and
- Adelaide.
- Nkonkobe Municipality:
- Alice;
- Fort Beaufort;
- Middledrift;
- Hogsback; and
- Seymour.

Ngqushwa Municipality:

- Peddie; and
- Hamburg.
- Great Kei Municipality:
- Komga;
- Kei Mouth;
- Haga Haga;
- Morgan Bay; and
- Cintsa.

Mnquma Municipality:

- Butterworth;
- Ngqamakwe; and
- Centani.

Mbhashe Municipality:

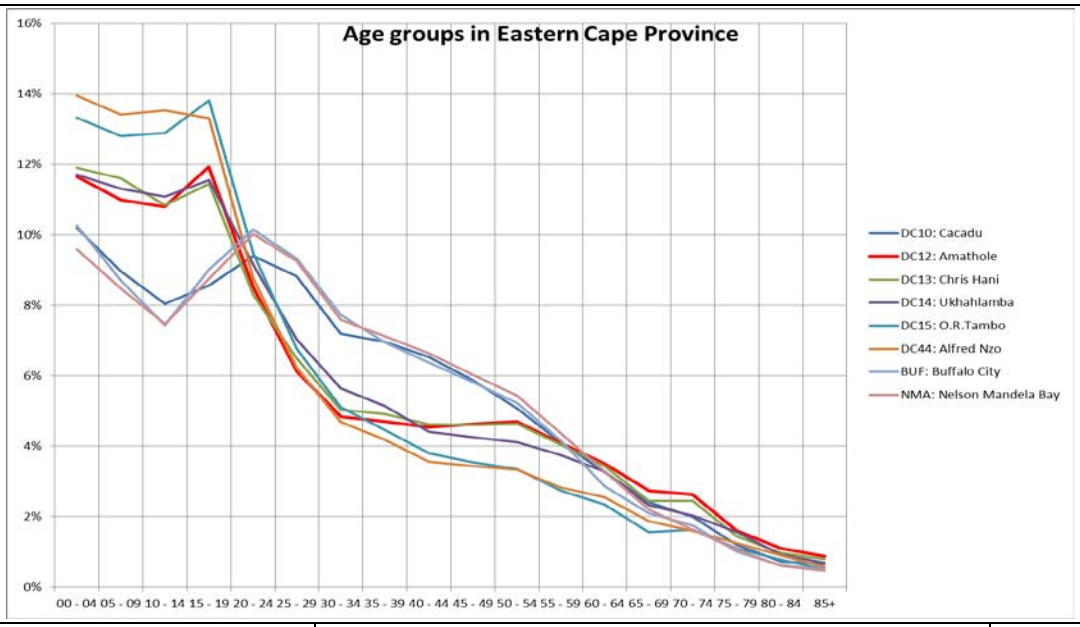
- Idutywa;
- Elliotdale; and
- Willowvale.

6.2 Population and Socio-Economic Characteristics

The population and socio-economic characteristics of the ADM provides insight into the vulnerability of communities within the district. Information related to the ADM is provided in this section.

6.2.1 Demographic Characteristics

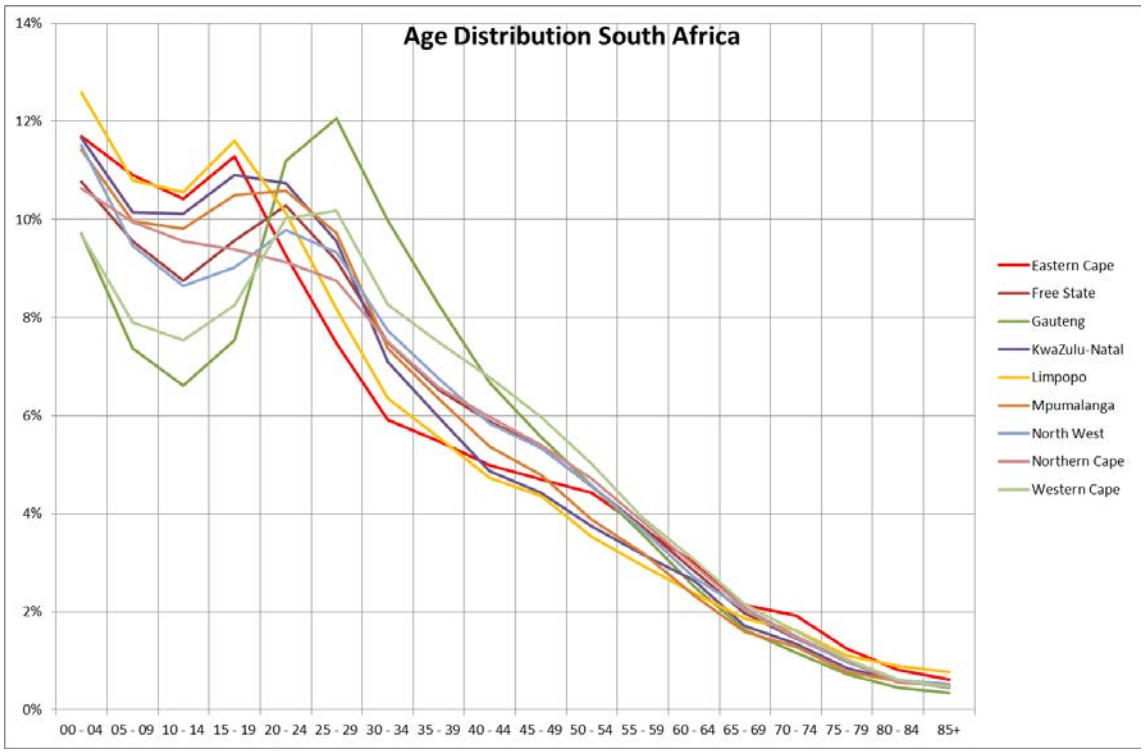
The population age groups for the various districts in the Eastern Cape Province, based on the StatsSA Census 2011 results, are shown below.



srk consulting	**ADM Disaster Risk Assessment** Age Groups – Eastern Cape Districts	Project No. 481363

Figure 6-2: Age Groups – Eastern Cape Districts

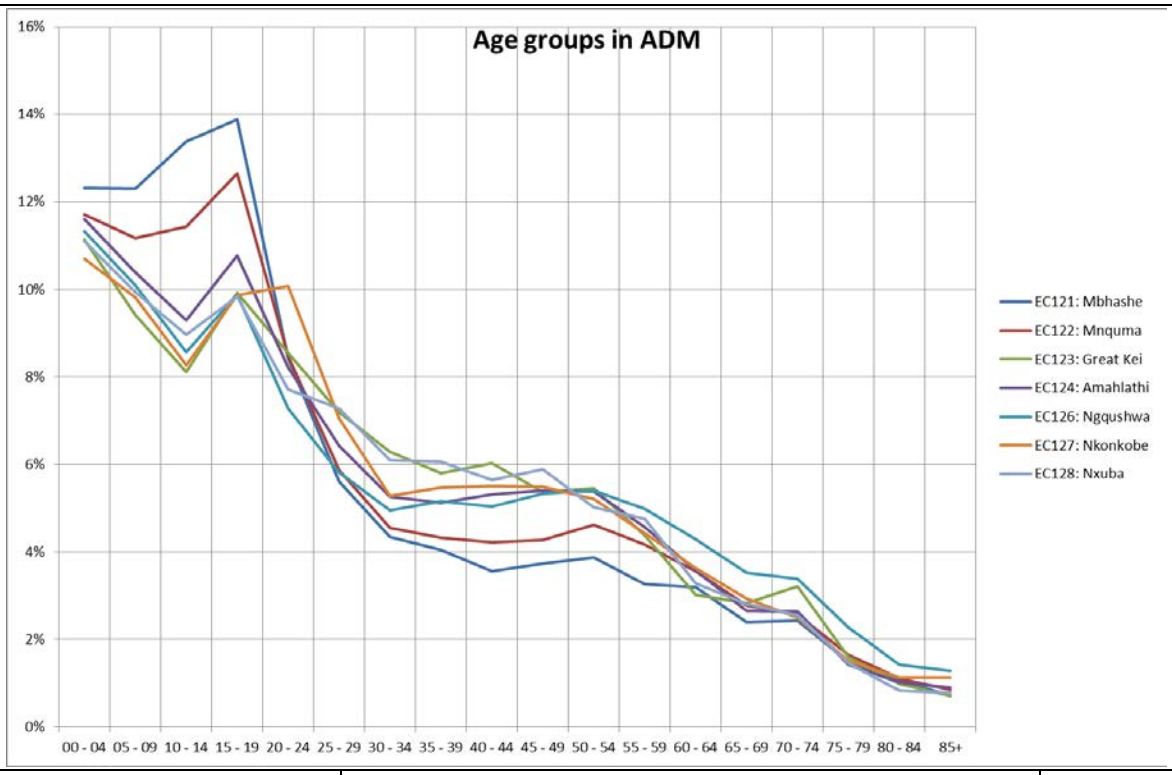
ADM has the second smallest population profile in the Easter Cape and shares a common significant drop with the other Municipalities in population between 19 and 35.



srk consulting	**ADM Disaster Risk Assessment** Age distribution South Africa	Project No. 481363

Figure 6-3: Age distribution South Africa

A clear disparity is visible between the profile of Gauteng, Western Cape and that of the Eastern Cape, which can be attributed to a number of dynamics.



srk consulting	**ADM Disaster Risk Assessment** Age Groups – ADM Local Municipalities	Project No. 481363

Figure 6-4: Age Groups – ADM Local Municipalities

The above figure represents an overview of the age group distribution between the various local municipalities in the ADM.

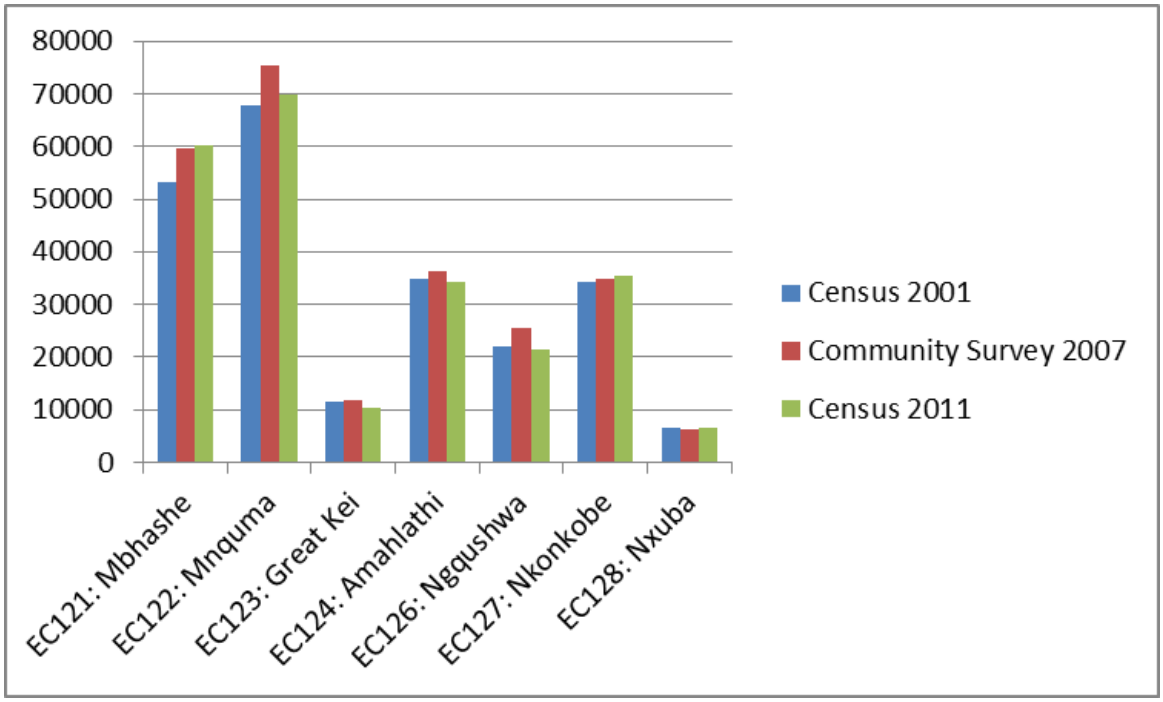
6.2.2 Households and Population Growth

The following table shows a comparison in household counts between Census 2001, Community Survey 2007 and Census 2011.

Table 6-1: Household count comparison

Municipality	Census 2001	Community Survey 2007	Census 2011	Difference Census 2001 and Census 2011
EC121: Mbhashe	53173	59705	60124	6951
EC122: Mnquma	67847	75410	69732	1885
EC123: Great Kei	11496	11957	10310	-1186
EC124: Amahlathi	34872	36389	34159	-713
EC126: Ngqushwa	21895	25564	21384	-511
EC127: Nkonkobe	34370	34890	35355	985
EC128: Nxuba	6625	6280	6711	86
	230278	250195	237775	7497

Figure 6-5 shows this information graphically.



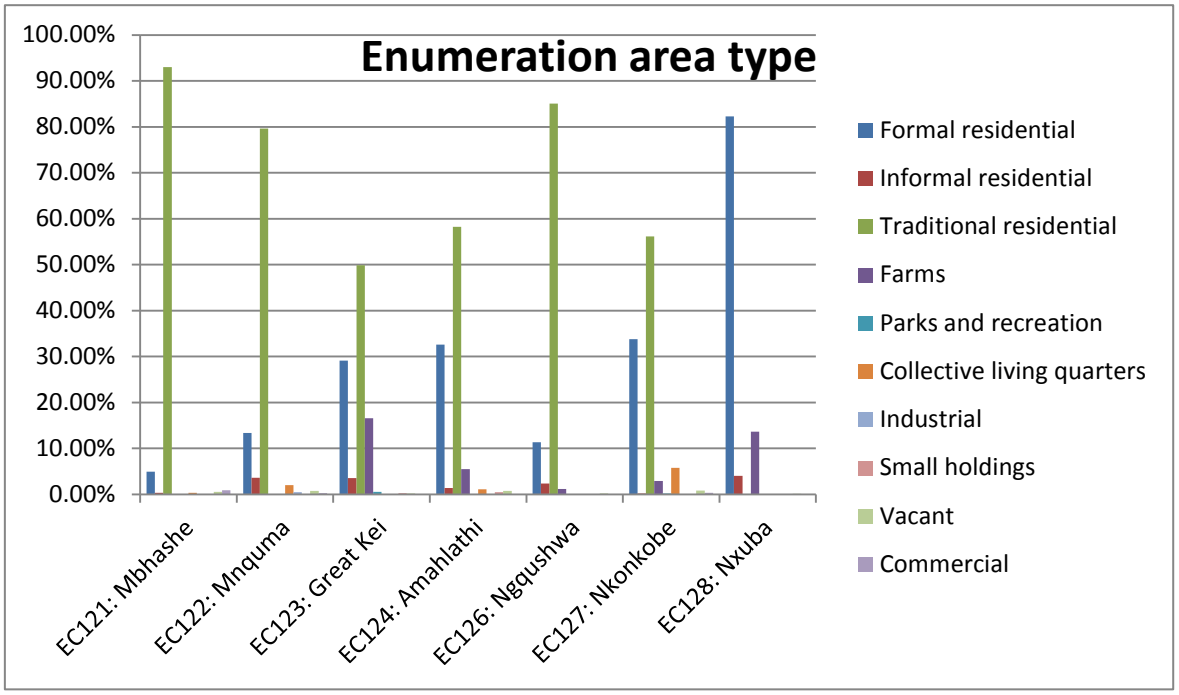
srk consulting	**ADM Disaster Risk Assessment** Household count comparison	Project No. 481363

Figure 6-5: Household count comparison

From the above the following is noted:

- Great Kei, Amahlathi and Ngqushwa household count declined.
- A total increase of 3.15% was observed for the ADM
- 3.02% of this growth in Mbhashe

The following table shows the enumeration area type



srk consulting	ADM Disaster Risk Assessment Enumeration Area Type	Project No. 481363

Figure 6-6: Enumeration area type

The following should be noted:

- Traditional residential enumeration is the most prevalent in the local municipalities except in Nxuba where formal residential is more common.

The following table shows a comparison between Census 2001, Community Survey 2007 and Census 2011 for the total population for ADM

Table 6-2: Total population comparison ADM

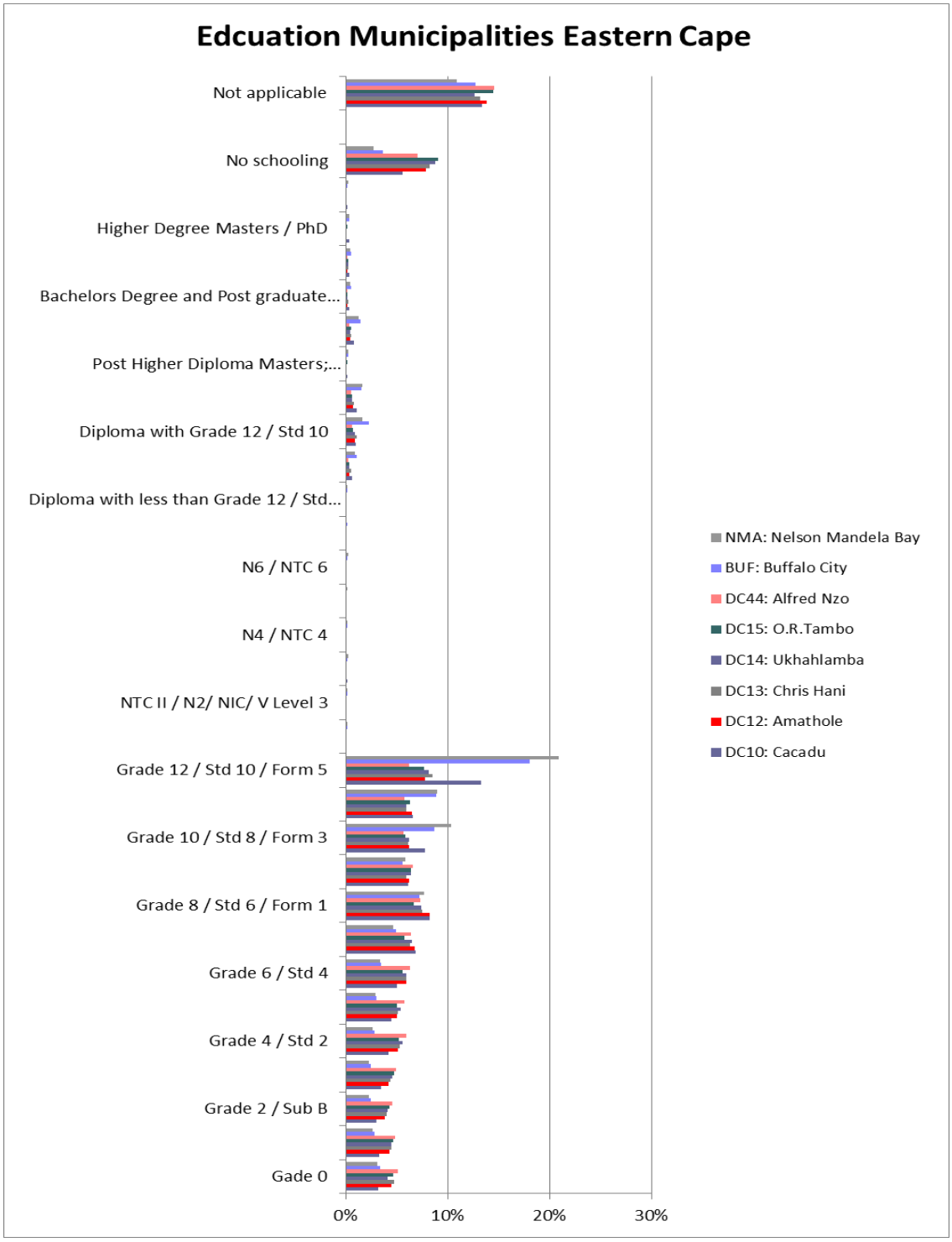
Municipality	Census 2001	Community Survey 2007	Census 2011	Difference Census 2011 and Census 2001	% Difference
EC121: Mbhashe	253386	262004	254909	1523	0.60%
EC122: Mnquma	287768	297663	252390	-35378	-12.29%
EC123: Great Kei	44456	33383	38991	-5465	-12.29%
EC124: Amahlathi	139039	112735	122778	-16261	-11.70%
EC126: Ngqushwa	84228	83087	72190	-12038	-14.29%
EC127: Nkonkobe	128660	130101	127115	-1545	-1.20%
EC128: Nxuba	24824	21469	24264	-560	-2.26%
Total	962361	940442	892637	-69724	-7.25%

A total population reduction of 7.25% for ADM can be seen. The only local municipality that showed growth was Mbhashe, which showed an increase of 0.6%

6.2.3 Education

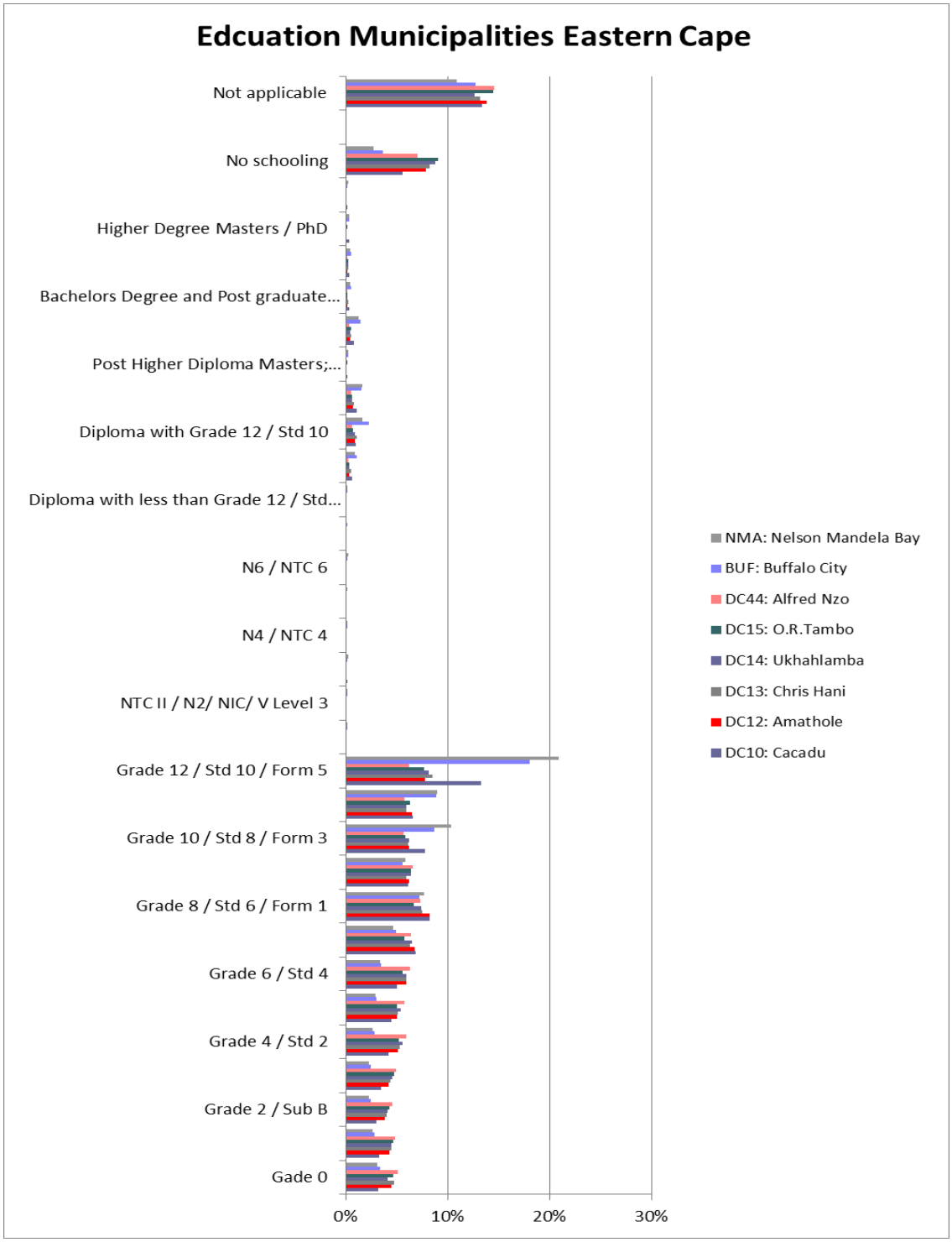
There is a very strong correlation between level of education and standard of living. The poverty rate among people in South Africa with no education is sixty nine percent (69%), compared with fifty four percent (54%) among people with primary education, twenty four percent (24%) among those with secondary education, and three percent (3%) among those with tertiary education (The Poverty and Inequality Report, 1998). Poor households are characterized by a lack of wage income; either as a result of unemployment or of low-paying employment due to lack of education, and typically rely on multiple sources of income, which help reduce risk of suffering income poverty. The provision of educational services and proper schooling is therefore a very effective method of reducing poverty and thereby reducing vulnerability and disaster risk.

The educational profile of the various municipalities in the Eastern Cape District, based on the StatsSA Census 2011 is shown in



srk consulting	**ADM Disaster Risk Assessment** Eastern Cape education profile	Project No. 481363

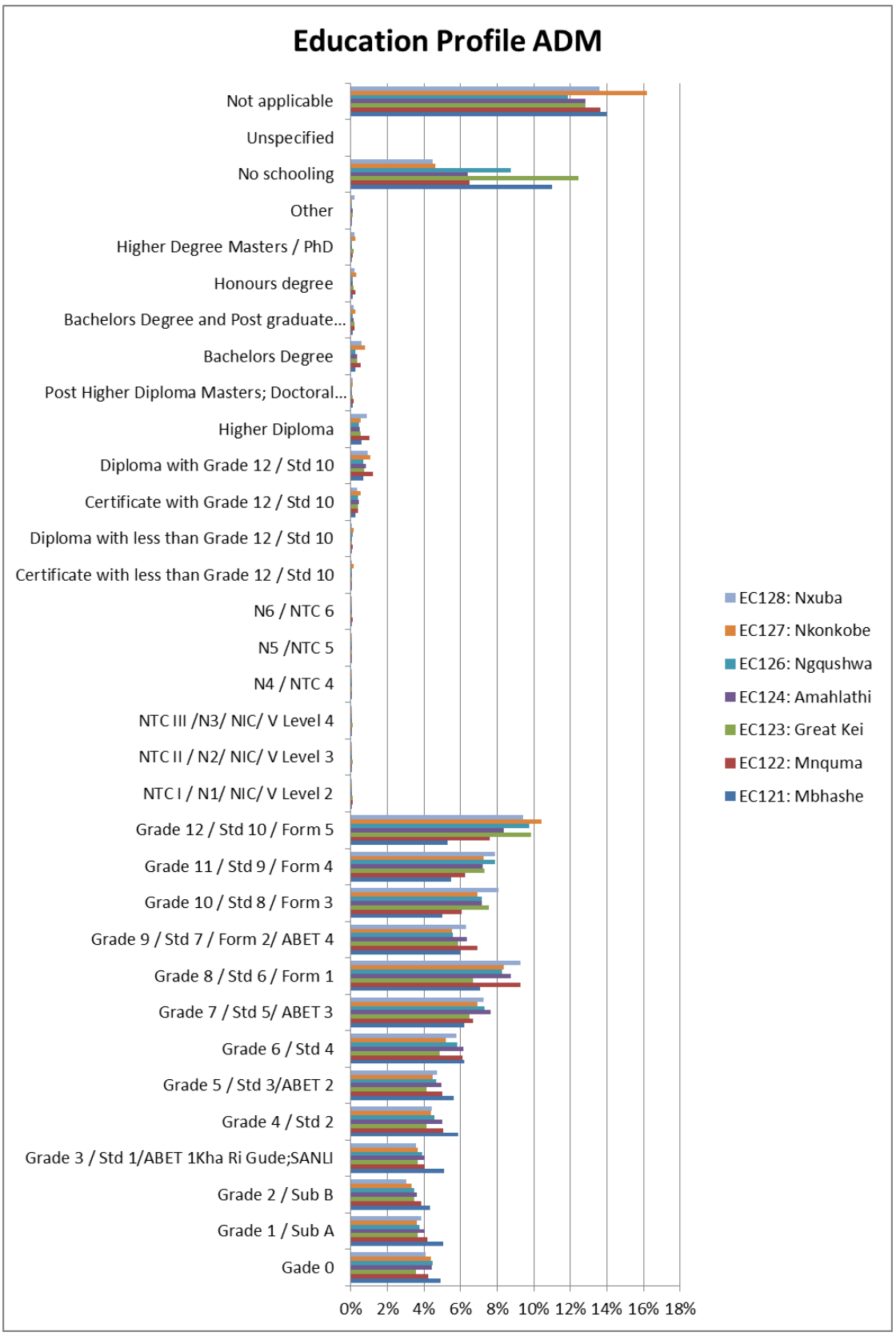
Figure 6-7 below.



srk consulting	**ADM Disaster Risk Assessment** Eastern Cape education profile	Project No. 481363

Figure 6-7: Eastern Cape education profile

The educational profile of the various Local Municipalities in the ADM, based on the StatsSA Census 2011 is shown below.

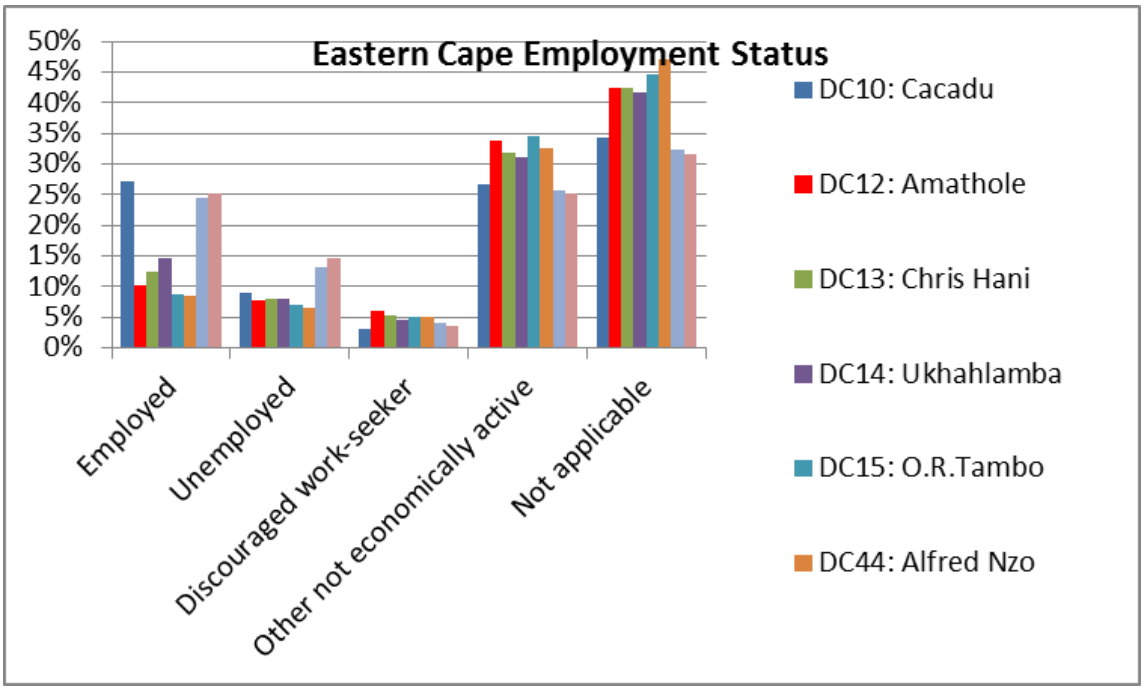


srk consulting	**ADM Disaster Risk Assessment** ADM Educational Profile	Project No. 481363

Figure 6-8: ADM Educational Profile

6.2.4 Employment

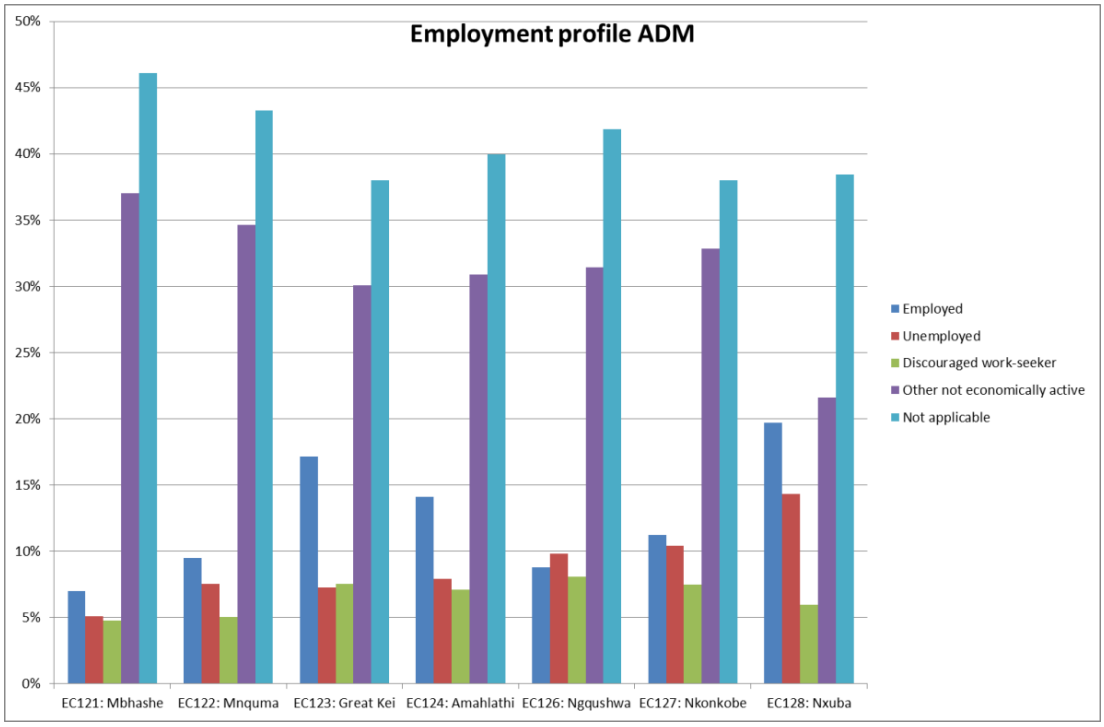
The employment level within the district can play an important role with regard to the vulnerability of communities. Below is an overview of the employment levels within the Municipalities in Eastern Cape.



srk consulting	**ADM Disaster Risk Assessment** Employment Profile of the Eastern Cape Province	Project No. 481363

Figure 6-9: Employment Profile of the Eastern Cape Province

The employment profile of the various Local Municipalities in the ADM, based on the StatsSA Census 2011 is shown in



srk consulting	**ADM Disaster Risk Assessment** Employment Profile of the ADM	Project No. 481363

Figure 6-10 below. The StatsSA data perceives people from 15-64 as people of working age. The people who are younger than 15 or older than 64 are classified as "Not applicable" in figure 6-9. People within the age group of 15-64 that choose not to work are seen as not economically active (Naidoo, 2015)

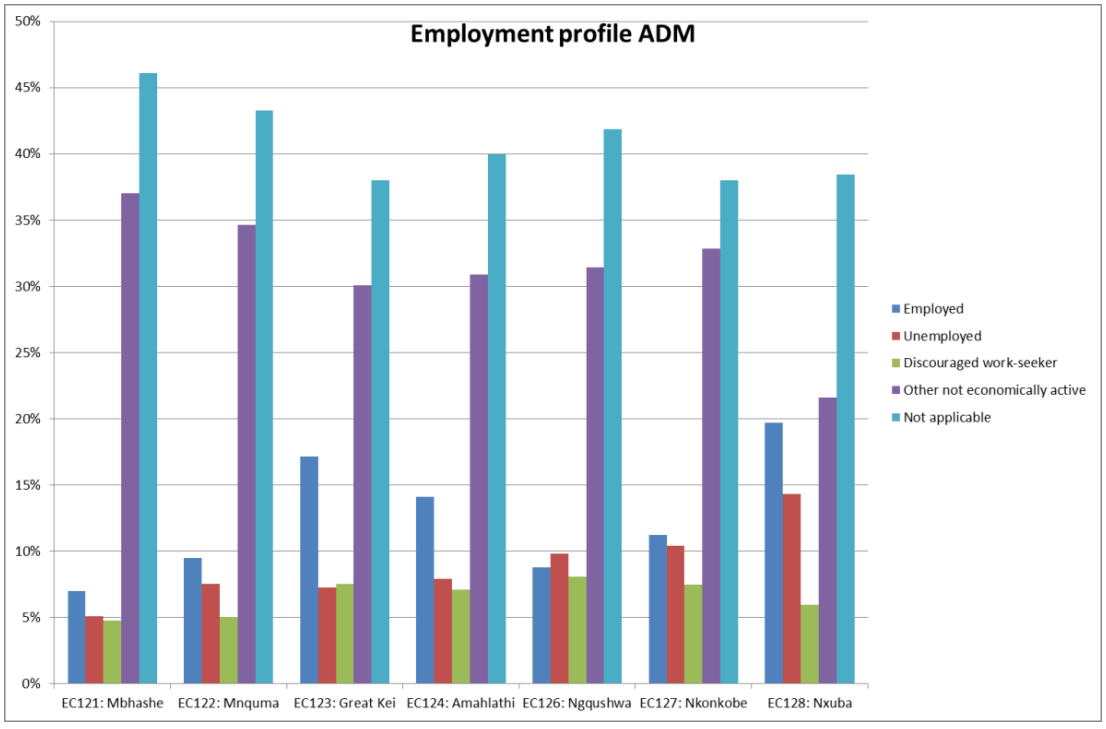


Figure 6-10: Employment Profile of the ADM

The employment profile suggests a strong variance between employment levels in the various local municipalities. The highest percentage employment and unemployment is observed in Nxuba. There is consistent high numbers of "Other economically not active" throughout the municipalities. According to StatsSA, the term 'not economically active' is used for *'a person who is not working and not seeking work or not available for work... This group includes full time students, housewives, retired people, the disabled and others who cannot work. …the term is only officially applied to those of working age, 15 to 65."*

6.2.5 Income Levels

Income levels can have a substantial influence on the vulnerability and resilience of individuals in a community. The income level profile of the various Local Municipalities in the ADM, based on the StatsSA Census 2011, is shown in

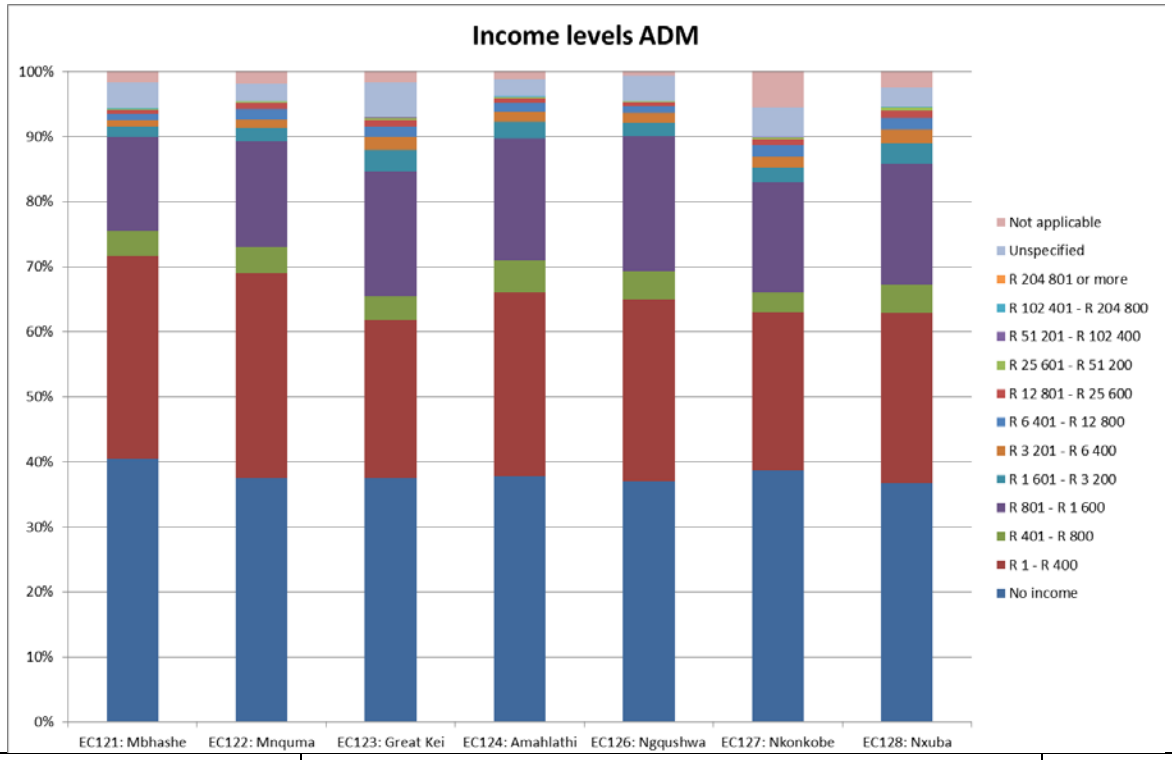
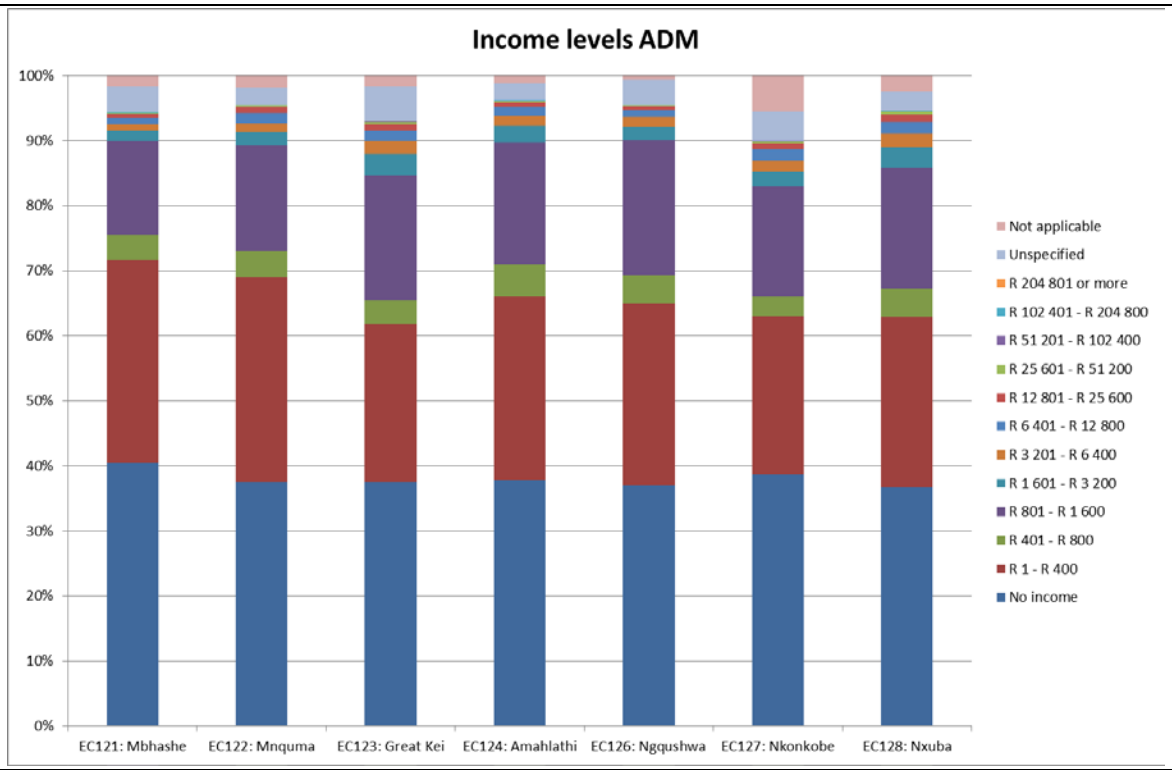


Figure 6-11 below.



srk consulting	**ADM Disaster Risk Assessment** ADM Income Profile	Project No. 481363

Figure 6-11: ADM Income Profile

6.3 Economic Activities

According to the Easter Cape Socio Economic Database (ecsecc, 2012) the ADM economy is largely driven by government, both in terms of employment and economic growth.

Buffalo City became a Metropolitan Municipality on 18 May 2011. Buffalo City is an economic pivotal point in the area and the exclusion from ADM will have an effect the economy of ADM.

The ADM recognises the importance of the economy and have focus areas which include tourism, sport, agriculture and local economic development, (Amathole District Municipality, 2013).

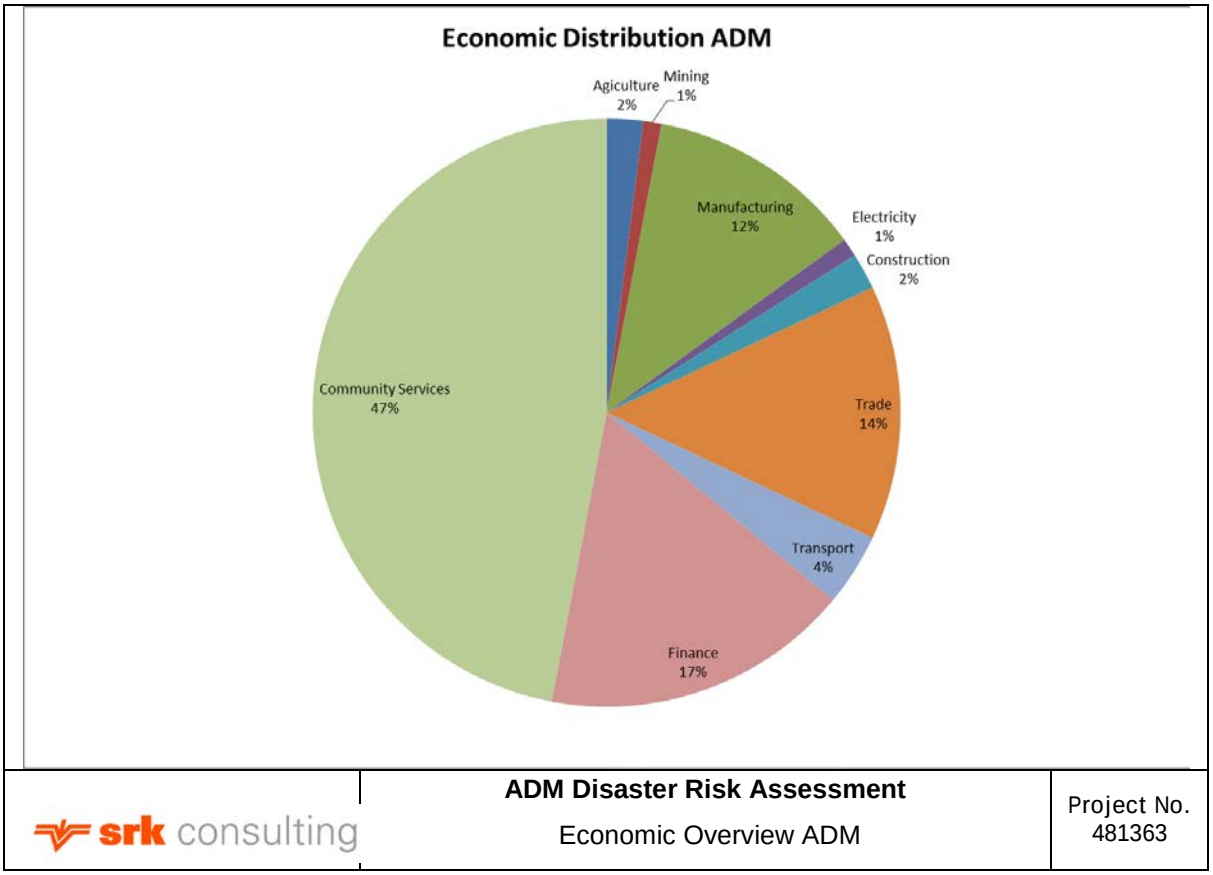


Figure 6-12: Economic Overview ADM

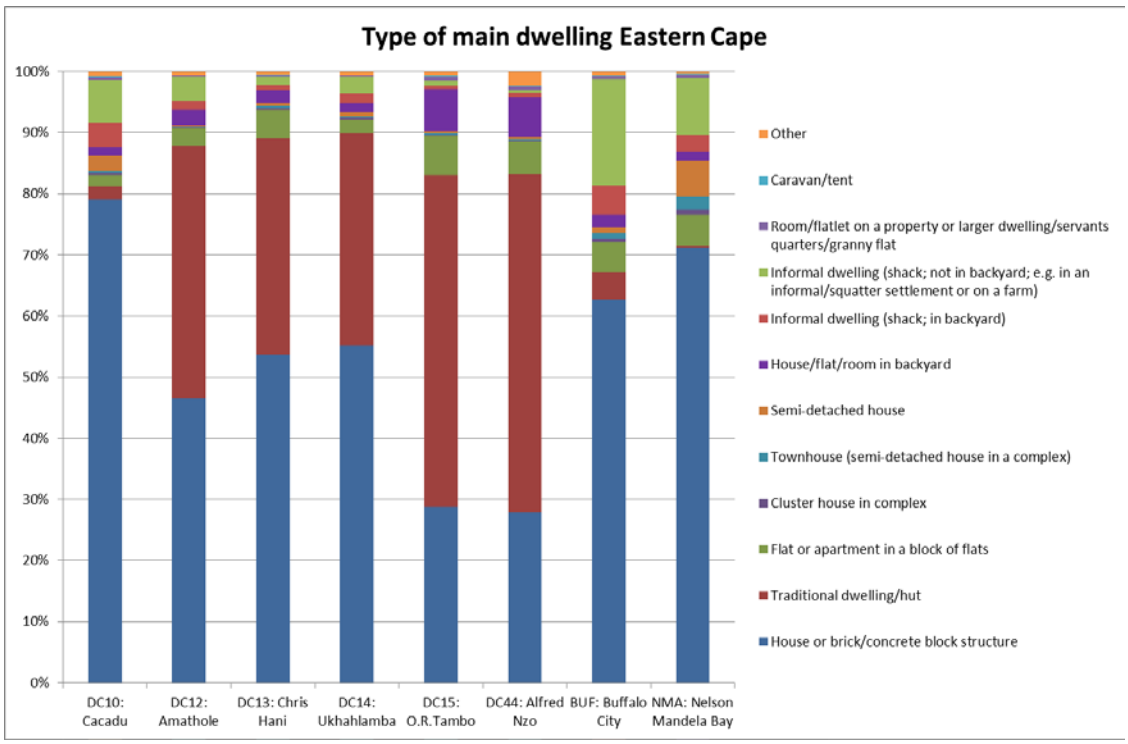
Subsistence farming is prevalent in Amathole. This provides a means for self-sustaining but does not contribute much to the local economy. It can however be seen as an opportunity for enhancing the role that agriculture plays in the local economy.

6.4 Housing, Service Delivery and Infrastructure

6.4.1 Housing

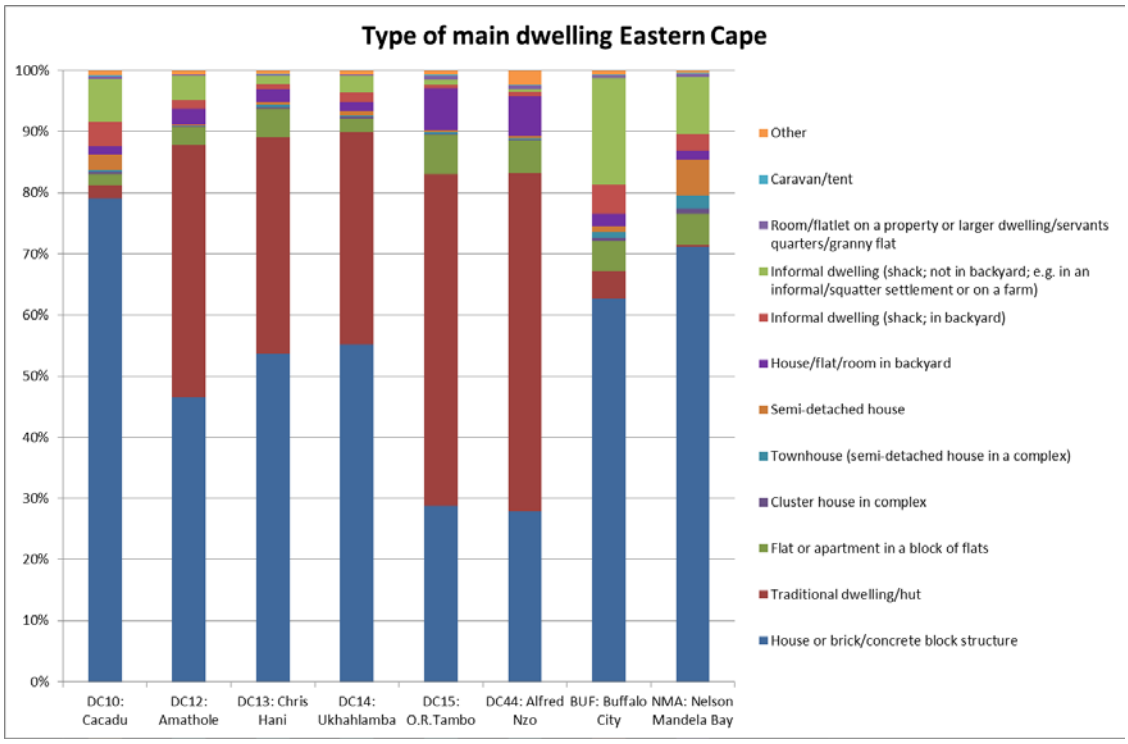
The availability of safe and well-constructed houses with sufficient levels of infrastructure services not only add to living quality but also reduces vulnerability levels in communities. The type and supply of housing could therefore have a big influence on vulnerability levels in a municipality.

The Provincial Department of Housing has been engaged in a number of housing projects throughout the Amathole District. It should be noted that in the past, the focus has solely been in providing housing in urban areas as shown by the completed and current housing projects in the District. However, a shift has been made recently to provide housing in rural areas in light of poverty prevalence that exists in these rural areas. The housing profile of the various Districts in the Eastern Cape Province, based on the StatsSA Census 2011, is shown in



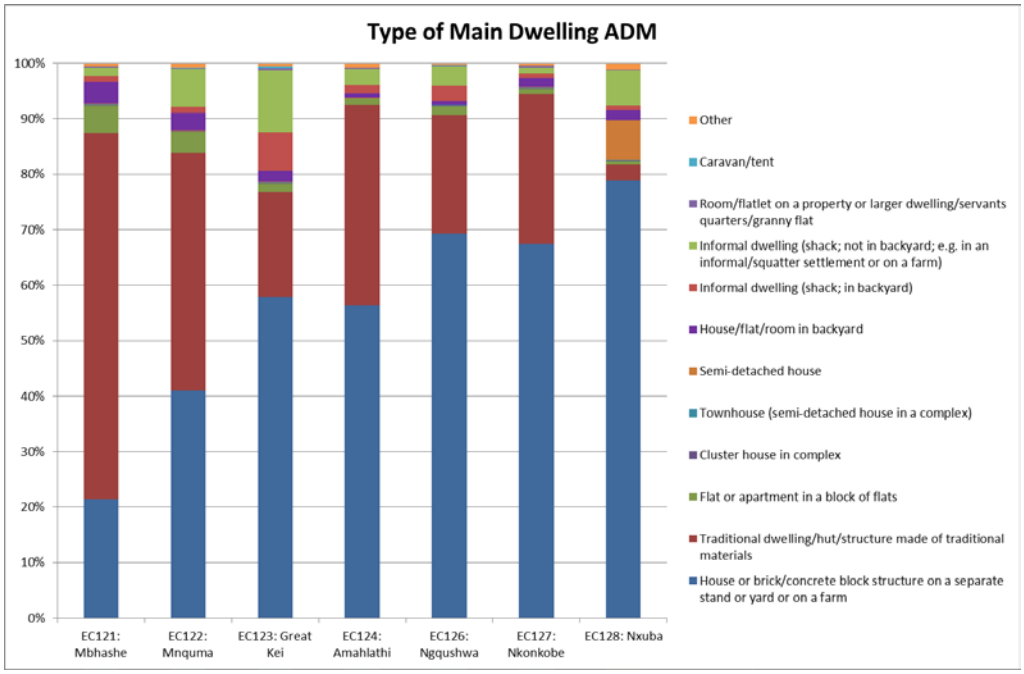
srk consulting	**ADM Disaster Risk Assessment** Comparison of Dwellings Types in the Eastern Cape Province	Project No. 481363

Figure 6-13 below.



srk consulting	**ADM Disaster Risk Assessment** Comparison of Dwellings Types in the Eastern Cape Province	Project No. 481363

Figure 6-13: Comparison of Dwellings Types in the Eastern Cape Province



srk consulting	**ADM Disaster Risk Assessment** Comparison of Dwellings Types in the ADM	Project No. 481363

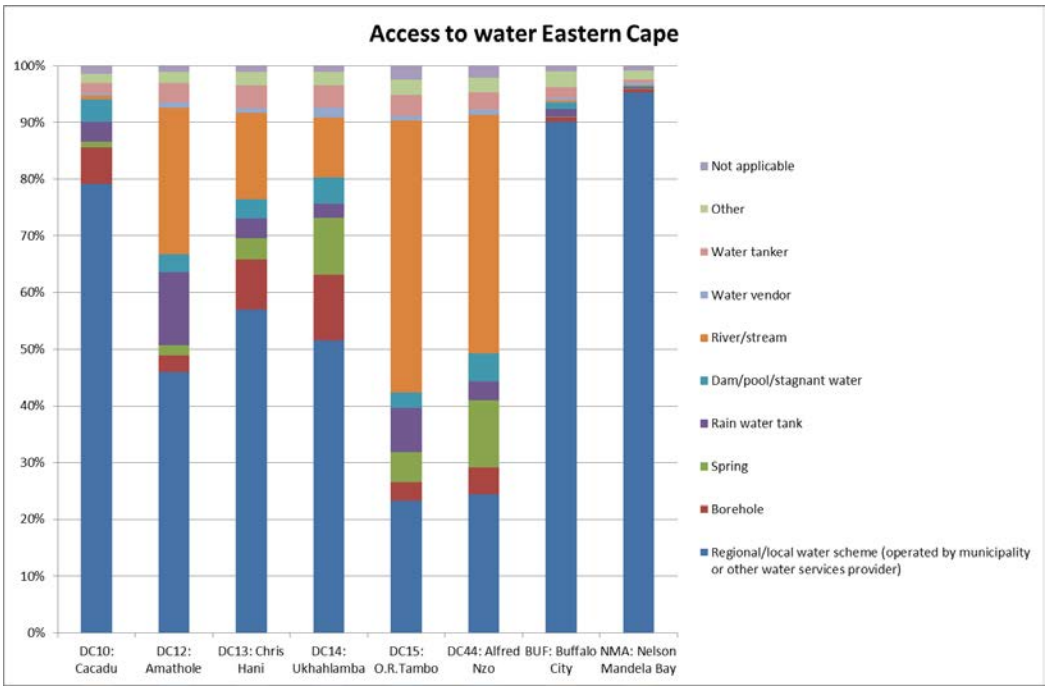
Figure 6-14: Comparison of Dwellings Types in the ADM

Based on the above, it appears as if the Mbhashe has the highest percentage of traditional dwellings, with Nxuba has highest percentage of brick or concrete houses.

6.4.2 Water

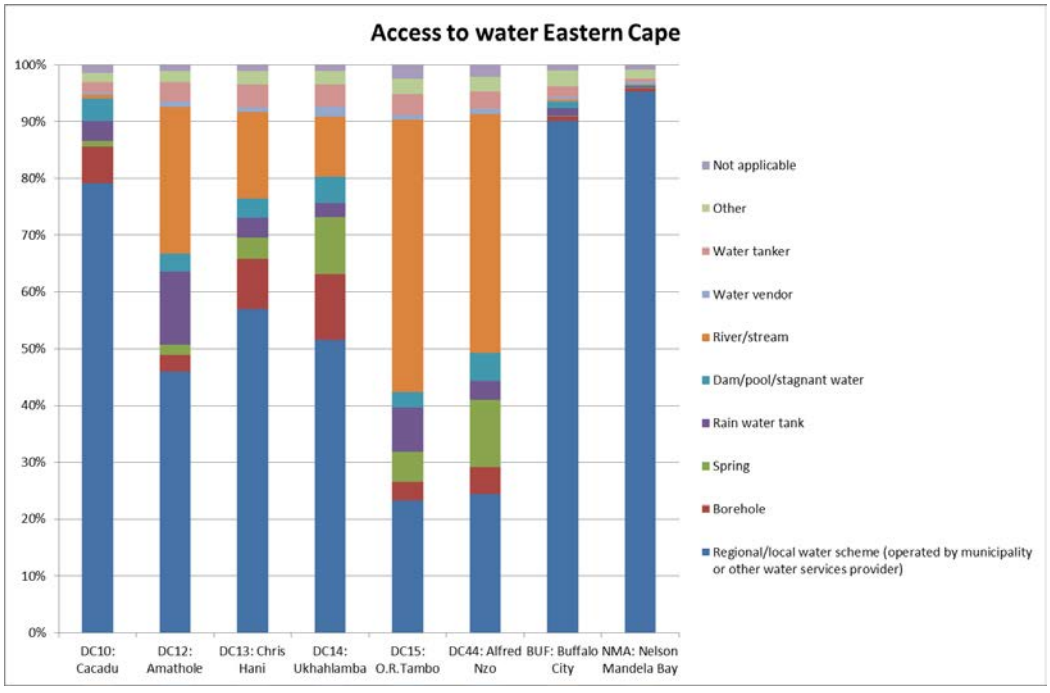
The access of communities to water can also influence the vulnerability profile of communities. In areas where communities need to make use of rivers or streams, they are more vulnerable to the effects of water pollution, waterborne diseases or low water quality levels.

The profile associated with communities' access to water in the various municipalities in the Eastern Cape Province, based on the StatsSA Census 2011, is shown in



srk consulting	**ADM Disaster Risk Assessment** Comparison of Access to Water in the Eastern Cape Province	Project No. 481363

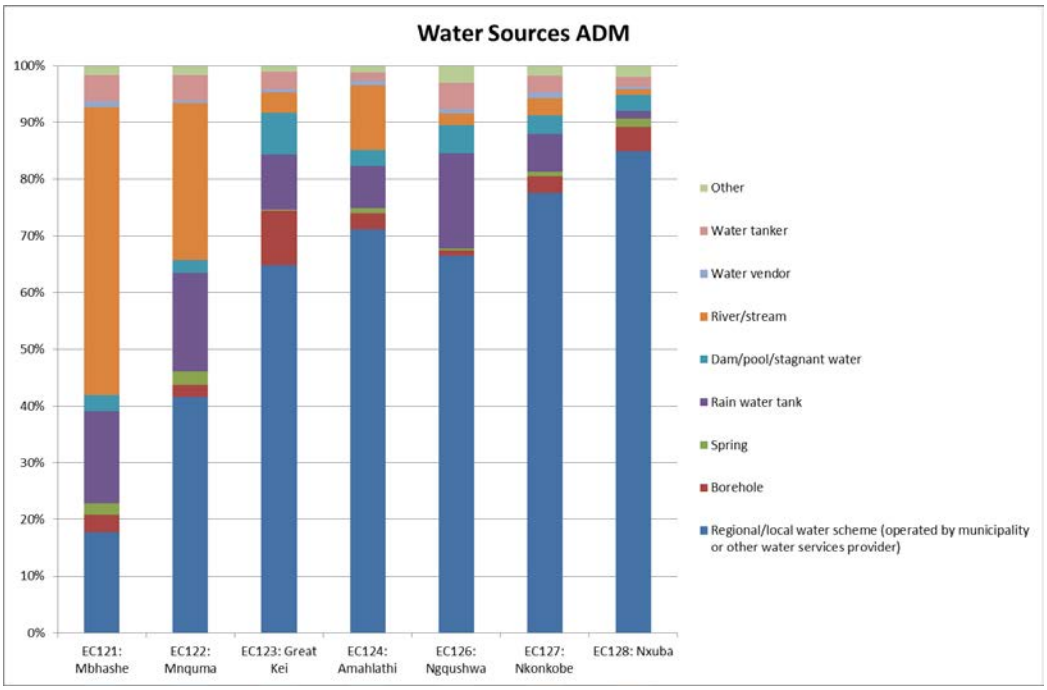
Figure 6-15 below.



srk consulting	**ADM Disaster Risk Assessment** Comparison of Access to Water in the Eastern Cape Province	Project No. 481363

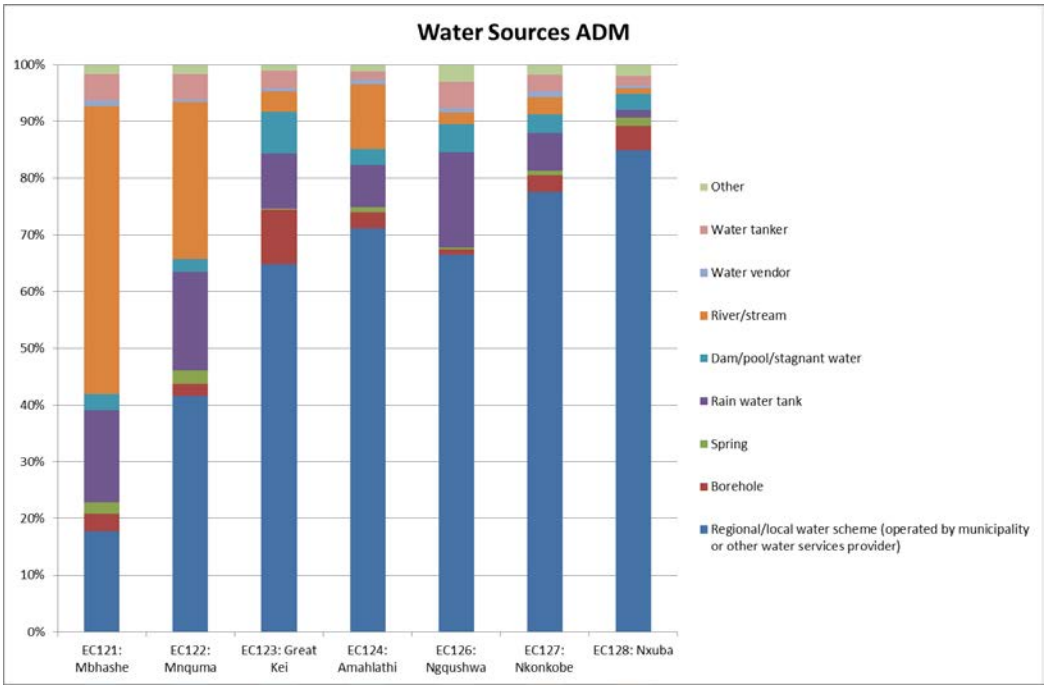
Figure 6-15: Comparison of Access to Water in the Eastern Cape Province

Information related to the access to water of communities in the local municipalities, based on the StatsSA Census 2011, is shown in



srk consulting	**ADM Disaster Risk Assessment** Comparison of Access to Water in ADM	Project No. 481363

Figure 6-16 below.



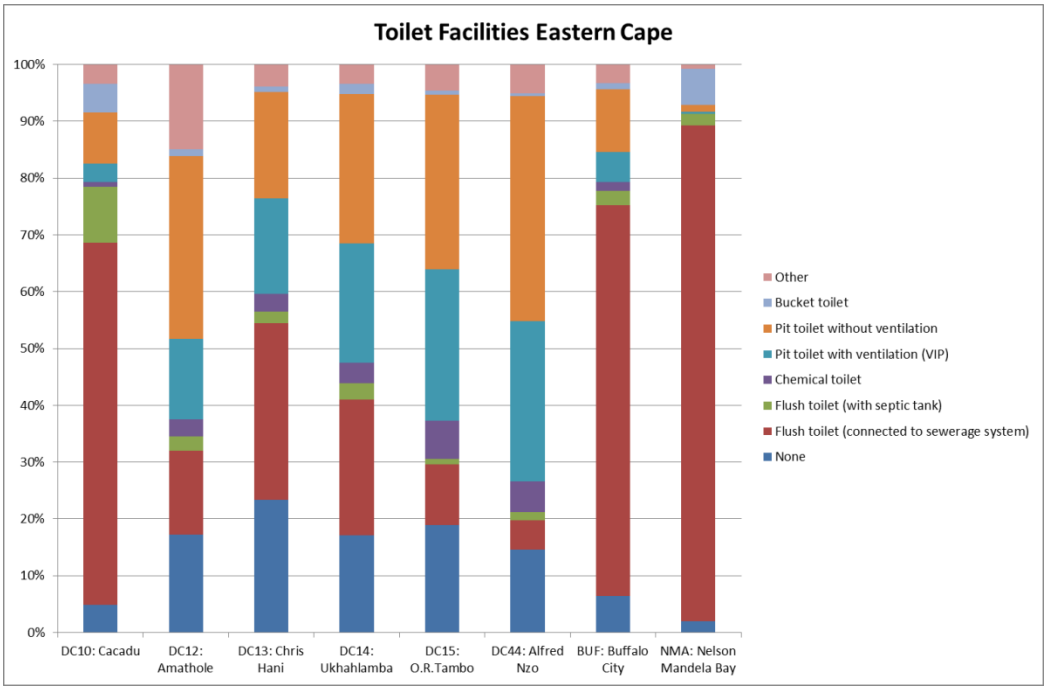
srk consulting	**ADM Disaster Risk Assessment** Comparison of Access to Water in ADM	Project No. 481363

Figure 6-16: Comparison of Access to Water in ADM

The above figure clearly illustrates the difference in the percentage of persons with access to water between the various local municipalities. There is a large percentage reliance on water from "river/stream" from Mbhashe and Mnquma.

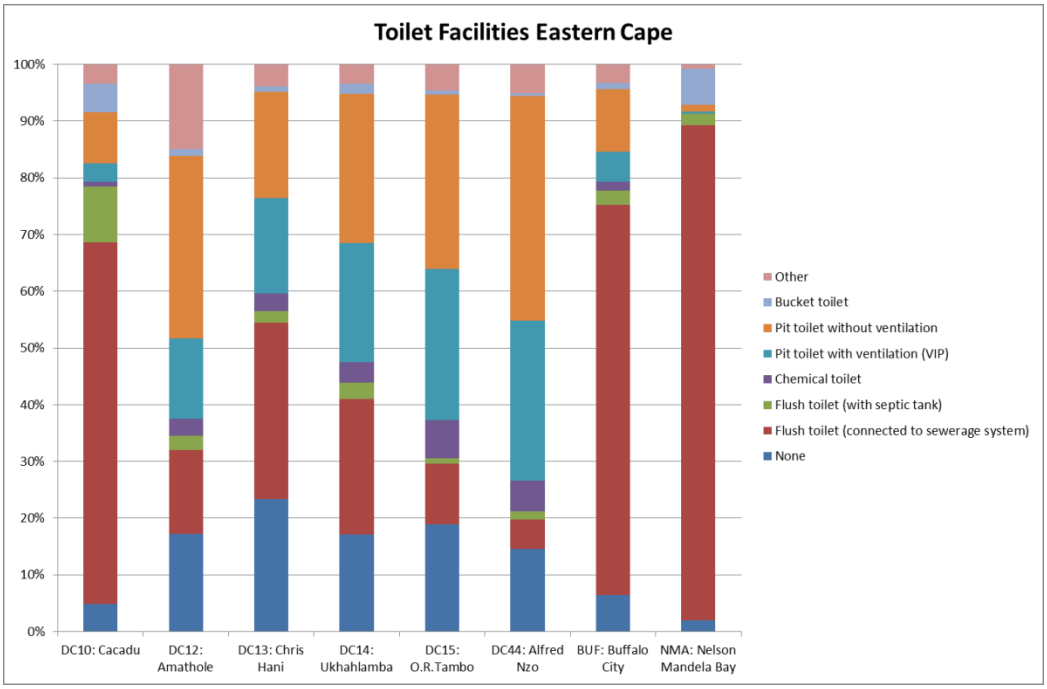
6.4.3 Sanitation

Sanitation is also a key consideration as part of the disaster risk assessment, influencing both the vulnerability and hazard profile of communities. Sanitation in the rural areas of the ADM is being provided in the form of dry-pit VIP toilets and the strategy is to implement these simultaneously with the roll-out of water services. This ensures a more effective impact with health and hygiene awareness training. The sanitation profile of the various Local Municipalities in the ADM, based on the StatsSA Census 2011, is shown in



srk consulting	**ADM Disaster Risk Assessment** Comparison of Type of Sanitation System in Eastern Cape Province	Project No. 481363

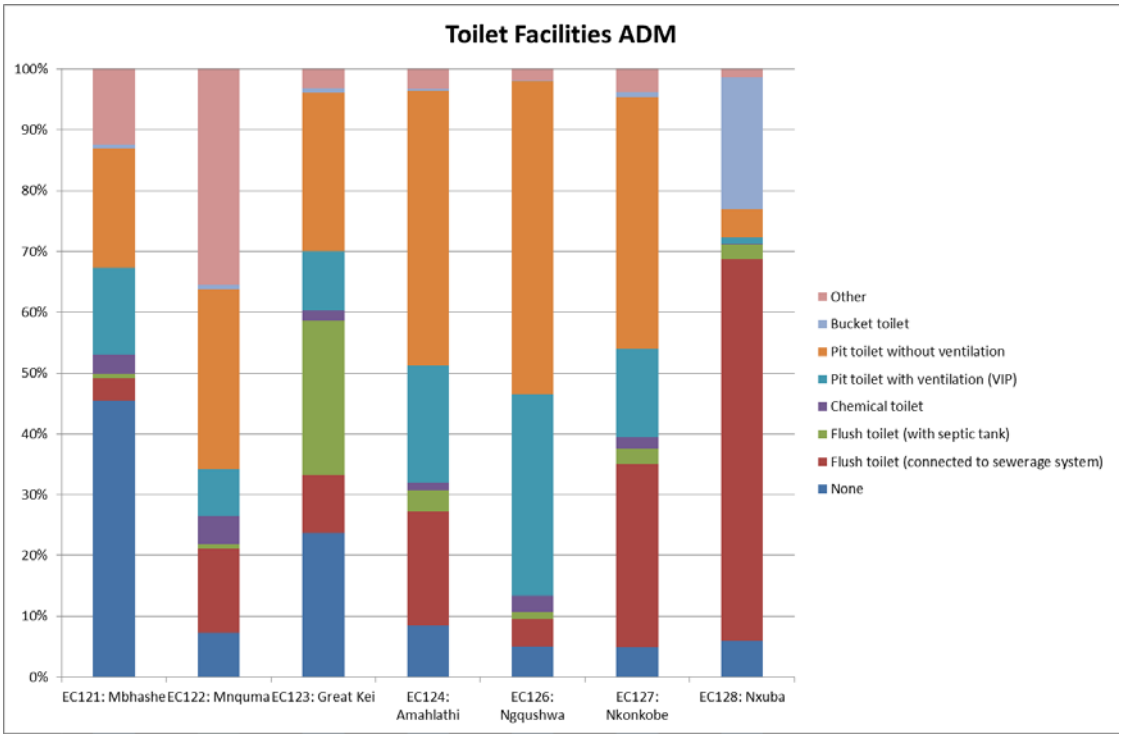
Figure 6-17 below.



srk consulting	**ADM Disaster Risk Assessment** Comparison of Type of Sanitation System in Eastern Cape Province	Project No. 481363

Figure 6-17: Comparison of Type of Sanitation System in Eastern Cape Province

There is a large contrast between the facilities available in the different municipalities. Nelson Mandela Bay and Cacadu have a large percentage "flush toilets (connected to the sewage system)"



srk consulting	**ADM Disaster Risk Assessment** Comparison of Type of Sanitation System in ADM	Project No. 481363

Figure 6-18: Comparison of Type of Sanitation System in ADM

According to the above figure, the municipality with the highest percentage of households serviced by flush toilets is Nxuba Local Municipality, with Mbhashe and Ngqushwa Municipalities with the lowest percentage. The service level of water and sanitation infrastructure in the ADM is shown in Table 6-3 below.

Table 6-3: Water and Sanitation service levels in ADM (Department of water & sanitation, 2015)

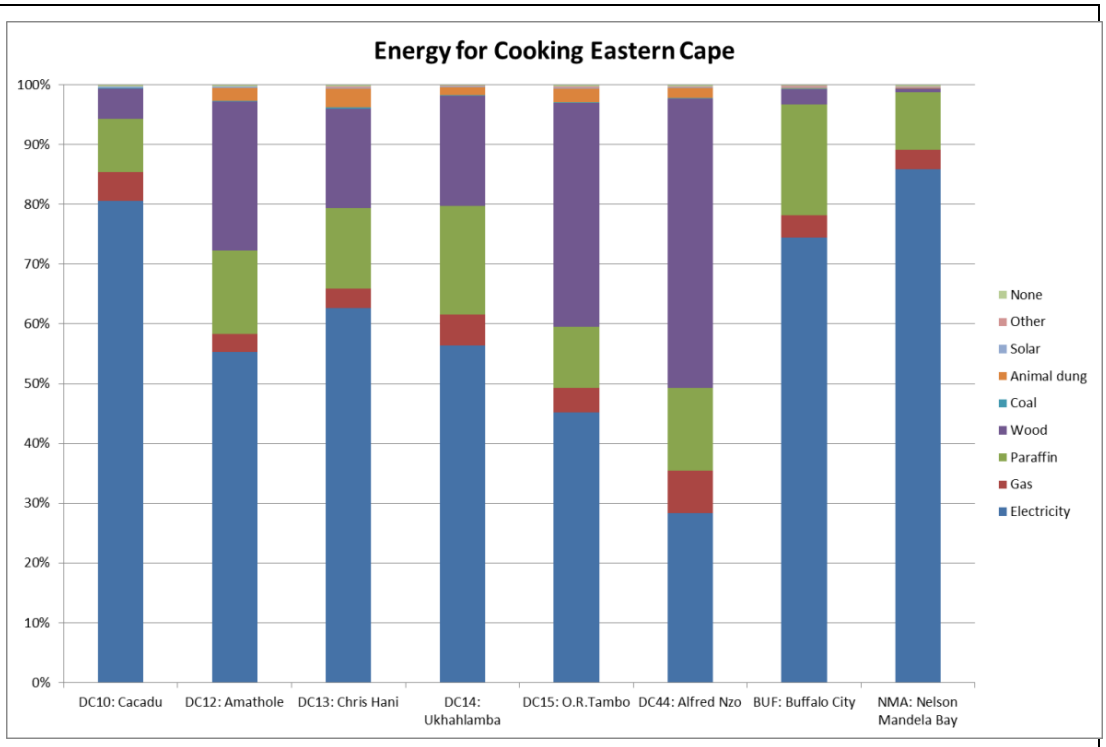
Water Service Level	Number of Settlements	Population	Households
No Water Services	0	120,704	27,654
Inadequate DWAF Infrastructure Need: Extension	0	20,529	4,736
Inadequate DWAF Infrastructure Need: Upgrade	0	0	0
Inadequate DWAF Resource Need	0	0	0
Inadequate DWAF Management Need: O&M	0	0	0
Inadequate DWAF Management Need: Refurbishment	0	44,426	10,181
Inadequate Housing Interim	0	0	0
Inadequate Housing Permanent	0	20,005	4,649
Standpipe	3	186,967	42,924
Yard Connection	0	30,817	8,068
House Connection	300	3,037,978	731,586
Total	303	3,461,426	829,798
Sanitation Service Level	Number of Settlements	Population	Households
No Sanitation	0	85,049	19,555
Inadequate Infrastructure Need: Upgrade to RDP level;	0	135,861	31,230
Bucket Programme	0	31,687	4,961
Inadequate: Infrastructure Need: Upgrade	0	0	0
Inadequate: Resource Need	0	0	0
Inadequate Management Need: O&M	0	0	0
Inadequate RDP Management Need: Refurbishment	0	0	0
Inadequate Housing Interim Solutions	0	0	0
Inadequate Housing Permanent Solutions	0	21,812	5,074
Non-Waterborne	3	668,148	144,493
Waterborne Low Flush	0	0	0
Septic Tanks	0	0	0
Waterborne Waste Water Treatment Works	237	1,544,315	349,382
Total	240	2,486,872	554,695

Goal 7 of the Millennium development goals is to “ensure environmental sustainability”. Target 7.C is to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation (United Nations, 2015).

6.4.4 Energy

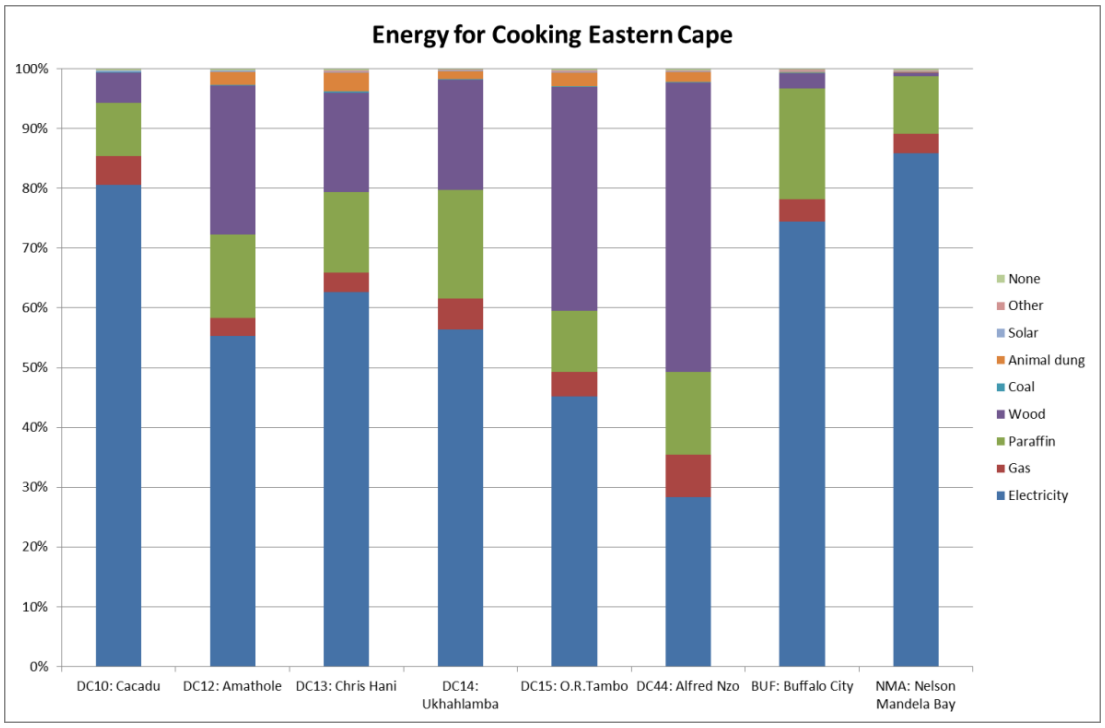
Access and sources of energy not only influence the hazard profile of an area, but also have an impact on the health and vulnerability of communities. In ADM six of the seven local municipalities are supplied directly by Eskom (Amahlathi, Great Kei, Mbhashe, Mnquma, Ngqushwa and Nkonkobe) and Nxuba local municipality supplies directly to its residents (Amathole District Municipality, 2015).

The provincial profile associated with usage of energy for cooking is shown in



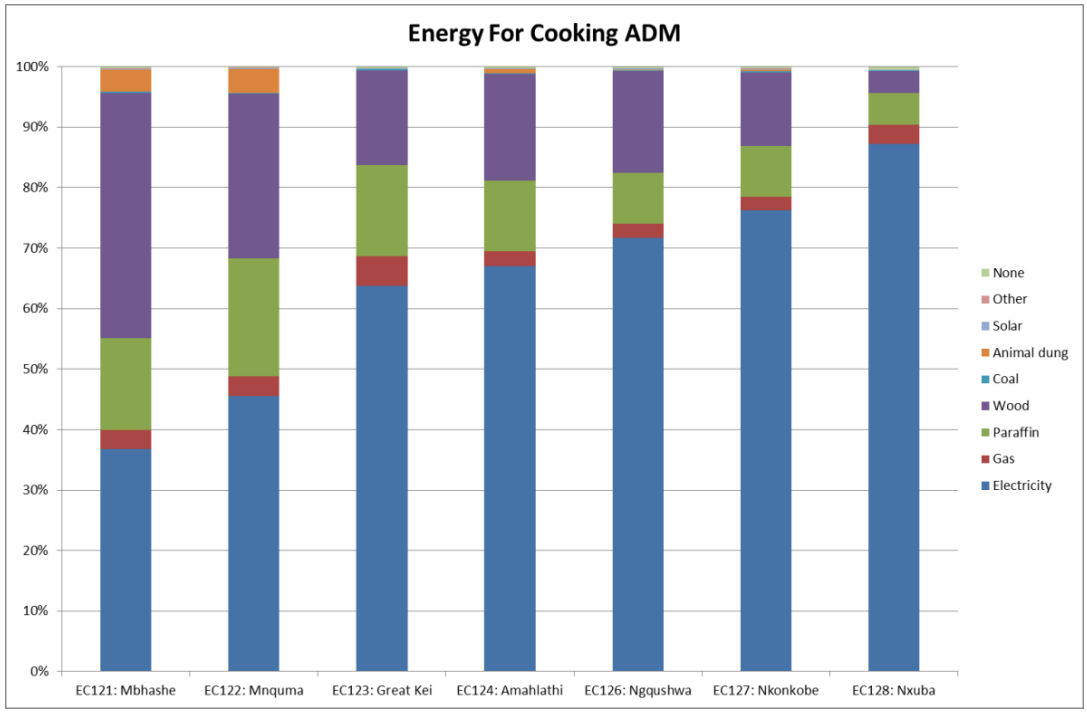
srk consulting	**ADM Disaster Risk Assessment** Comparison of Energy Sources in the Eastern Cape Province	Project No. 481363

Figure 6-19 below.



srk consulting	**ADM Disaster Risk Assessment** Comparison of Energy Sources in the Eastern Cape Province	Project No. 481363

Figure 6-19: Comparison of Energy Sources in the Eastern Cape Province



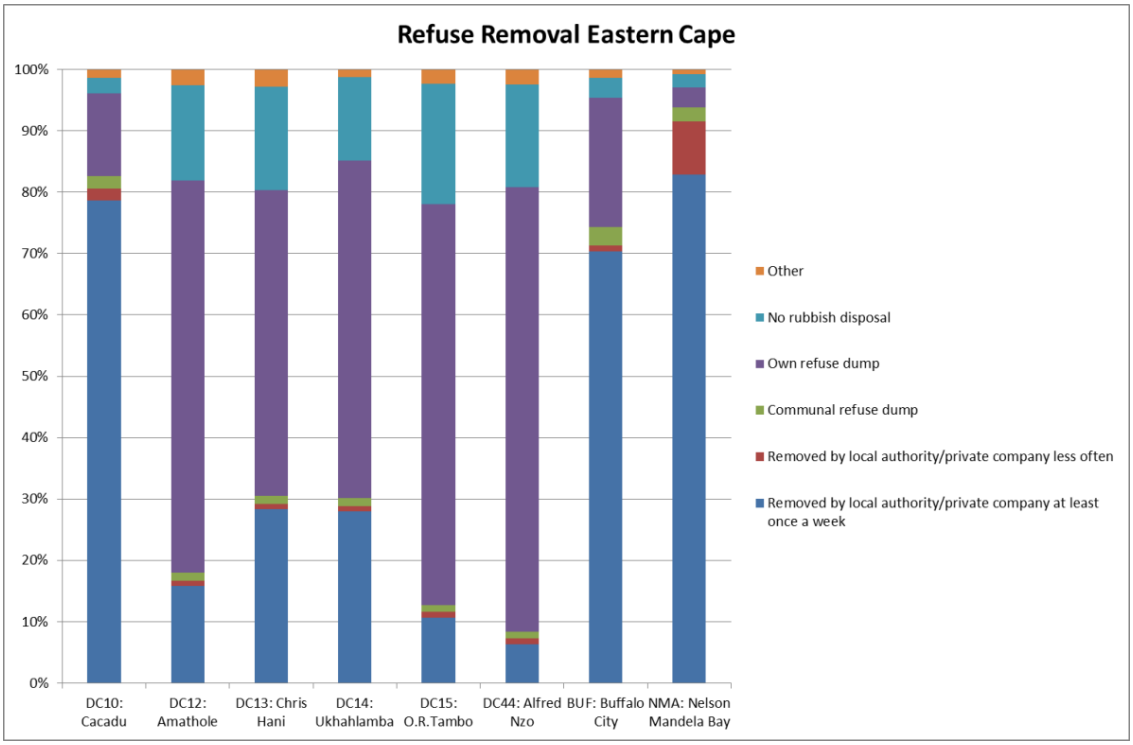
srk consulting	**ADM Disaster Risk Assessment** Comparison Energy used for Cooking in ADM	Project No. 481363

Figure 6-20: Comparison Energy used for Cooking in ADM

Based on the above figure it is shown that the relative electricity usage is the highest in the Nxuba while a high percentage in Mbhashe and Mnquma uses wood.

6.4.5 Waste Management

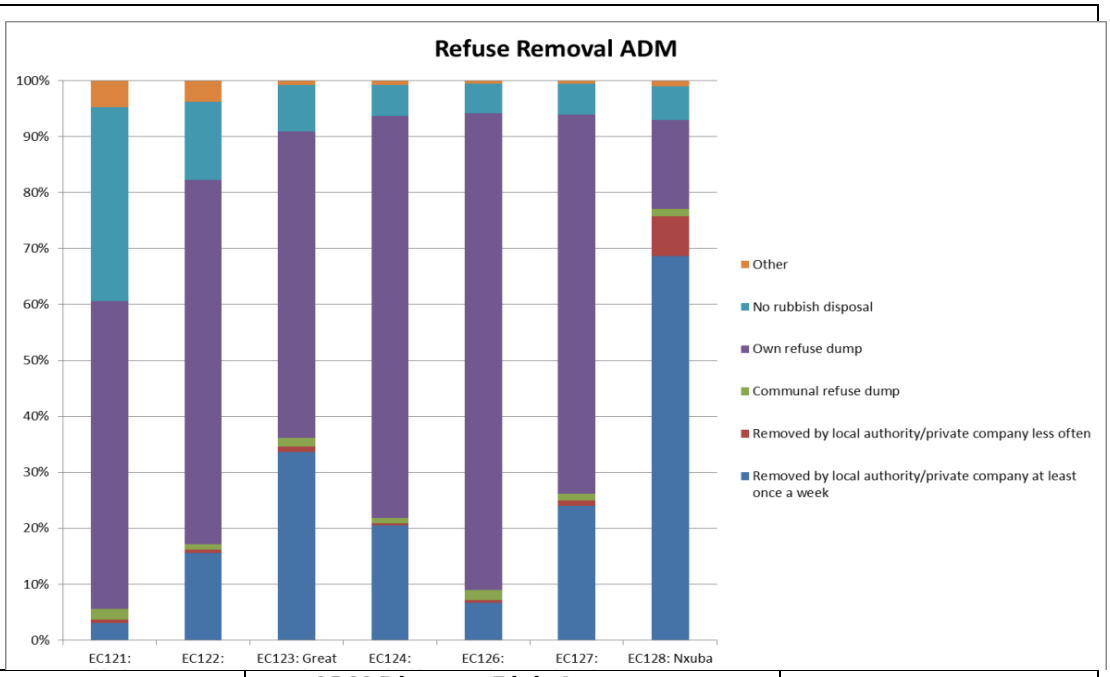
Waste management not only influences the vulnerability and hazard profile of human populations, but can also have a severe impact on environmental quality in the ADM.



srk consulting	**ADM Disaster Risk Assessment** Comparison of refuse removal in the Eastern Cape Province	Project No. 481363

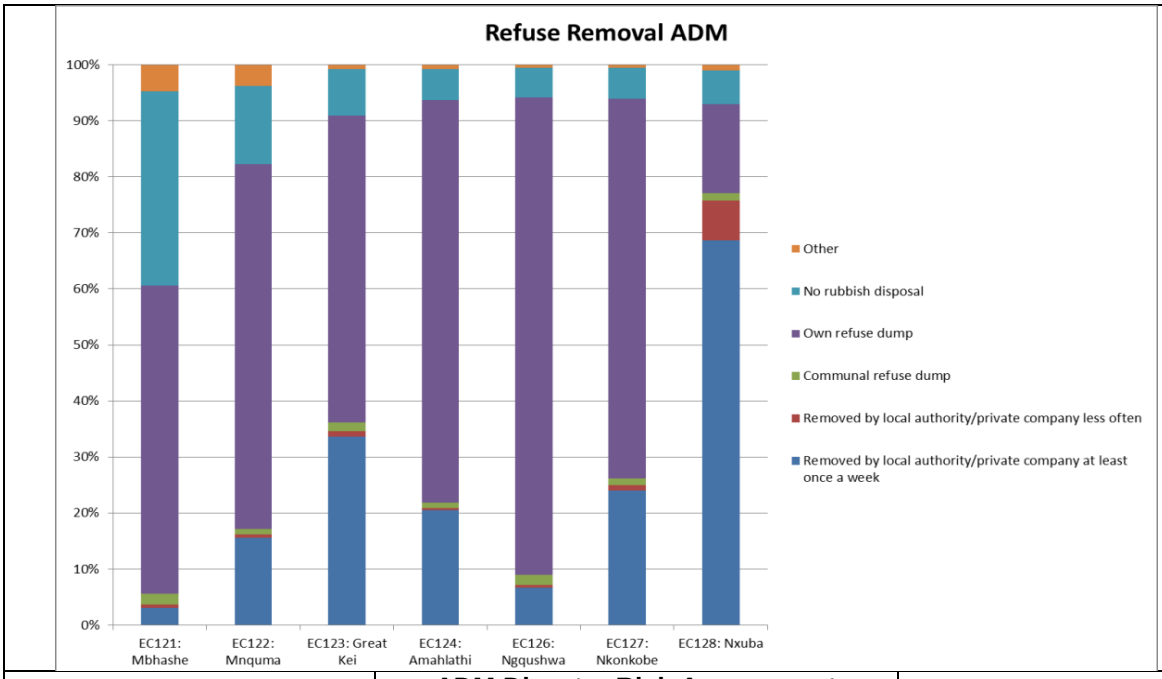
Figure 6-21: Comparison of refuse removal in the Eastern Cape Province

The percentage of households having access to weekly refuse removal in the ADM is rated as the third lowest in the Eastern Cape Province.



srk consulting	**ADM Disaster Risk Assessment** Comparison of Refuge Disposal System in ADM	Project No. 481363

Figure 6-22 represents an overview of the refuse disposal services in each of the local municipalities.



srk consulting	**ADM Disaster Risk Assessment** Comparison of Refuge Disposal System in ADM	Project No. 481363

Figure 6-22: Comparison of Refuge Disposal System in ADM

The above results indicate that the municipality with the highest percentage of weekly refuse removal services is the Nxuba Local Municipality, while the Mbhashe Local Municipality is shown to have the lowest percentage of weekly refuse removal services.

6.5 Transport Infrastructure

ADM has an Integrated Transport Plan (ITP) that has been adopted in June 2003 (Amathole District Municipality, 2015). The main aim of this plan is to rectify the fragmented approach in which transport is provided in urban and in rural areas.

It is recognised in the ITP that more than 60% of residents in the district do not have access to public transport services and or facilities within a 2km walking distance from their households. It is mainly the rural poor that are highly affected by the need for a better and more regular public transport service (Amathole District Municipality, 2015).

6.5.1 Road Transportation

The ITP focuses on the road-based public transport infrastructure challenges and also includes a Public Transport Plan, comprising the Operating License Strategy and Rationalization Plan, as key components, in addressing the service-based challenges, through support from the Department of Transport (Amathole District Municipality, 2015).

6.5.2 Rail Transportation

The rail lines in ADM are mainly used for freight transport and the infrastructure for passengers is limited.

6.6 Facilities

Facilities in the ADM not only serve the normal functions of providing services, education or recreation, but can also support disaster risk reduction or disaster response activities in the ADM.

6.6.1 Education Facilities

Figure 6-23 below indicates all schools within ADM.

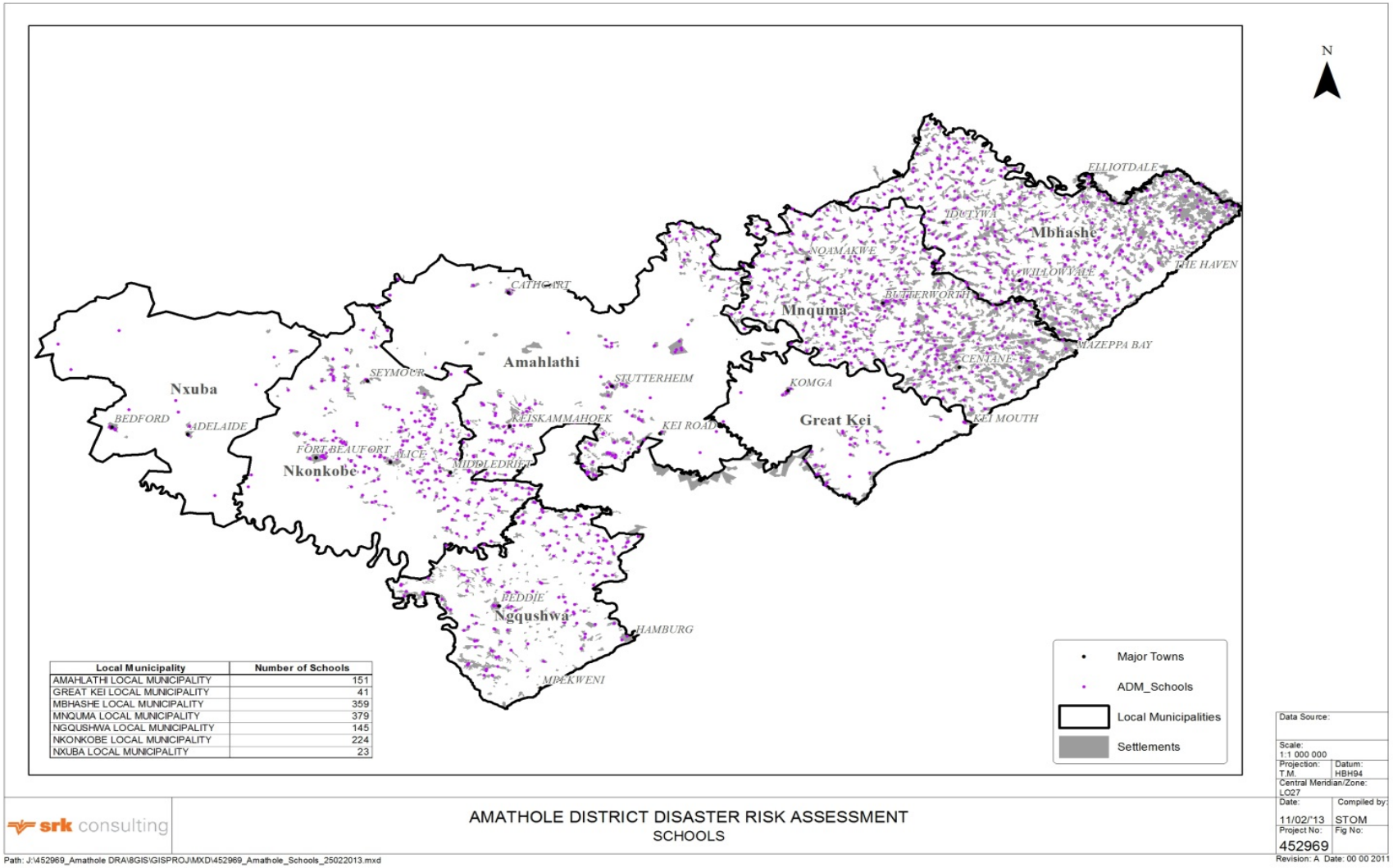


Figure 6-23: Schools in ADM

According to the IDP numerous Disaster Management and Fire Safety awareness campaigns have been conducted at schools throughout ADM (Amathole District Municipality, 2015).

6.6.2 Healthcare Facilities

The Eastern Cape Health Department aims to improve the access to primary health services and according to their 2012/13 annual report have initiatives to provide more and improved health care facilities to achieve this (Eastern Cape Department of Health, 2015).

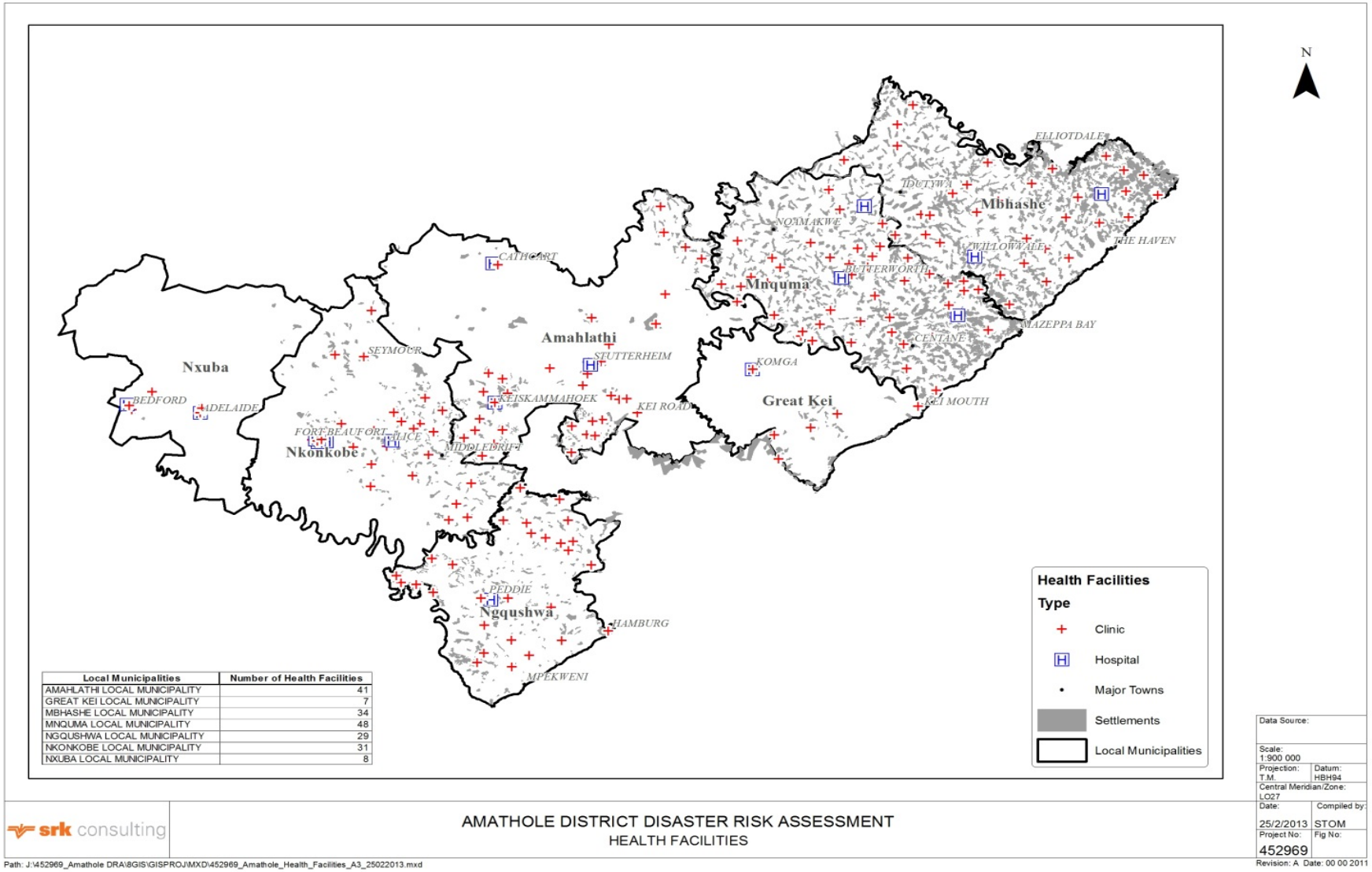


Figure 6-24: Health Care Facilities in ADM

6.6.3 Police Stations

The ADM supports an integrated approach to crime prevention which is supported by their annually updated Community Safety Plan that adapts strategies to achieve this on a regular basis (Amathole District Municipality, 2015).

In Figure 6-25 the police stations in ADM are shown graphically.

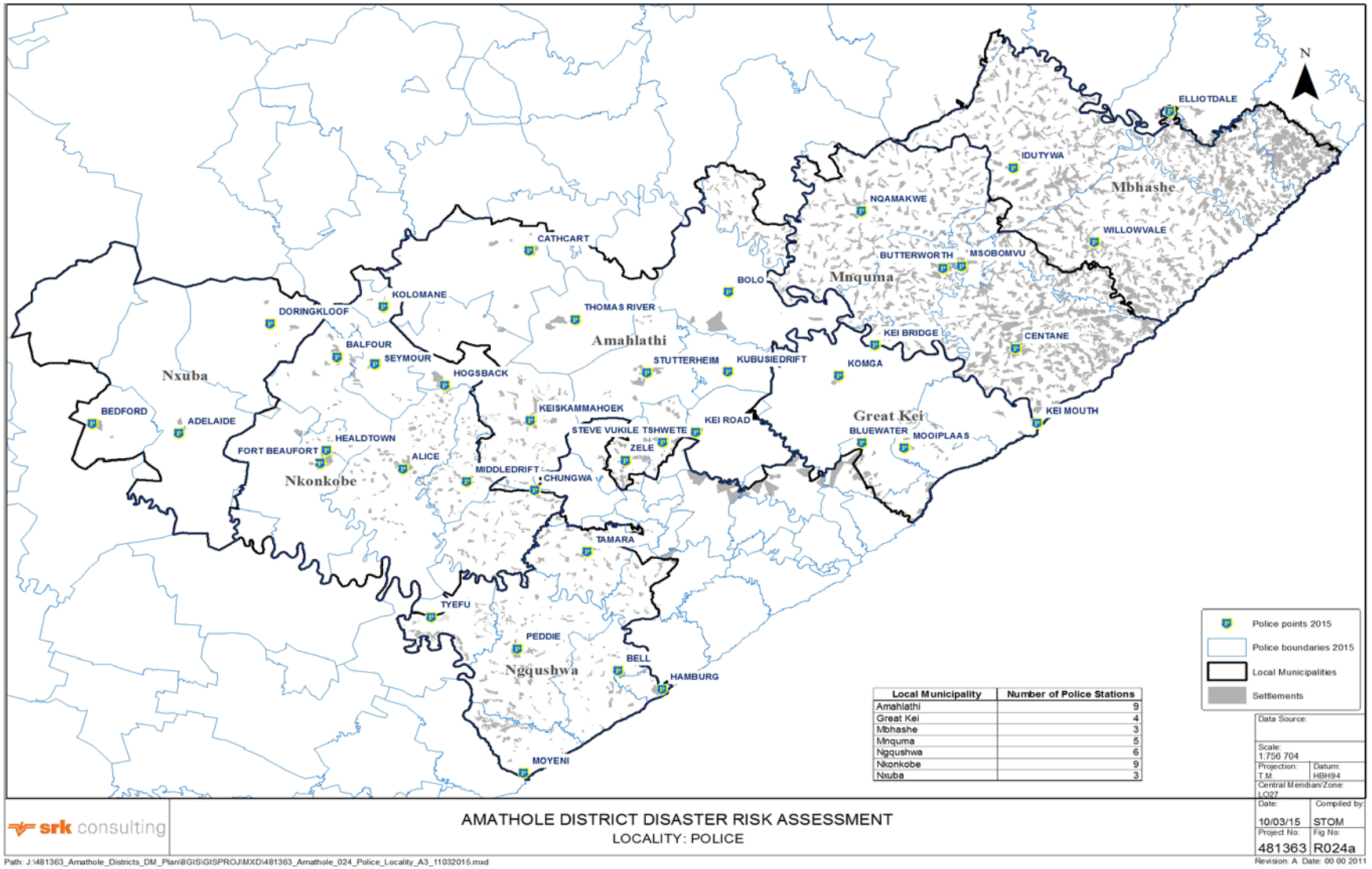


Figure 6-25: Police Stations in ADM

7 Hazard Profile

This section provides a description of the hazards assessed during the risk assessment, as well as a description of the characteristics of the ADM in relation to each of the hazards.

7.1 Disaster Risk Assessment done in 2006

Previous Disaster Risk Assessment was completed in October 2006 by Abongi Bemvelo Environmental Management (Abongi Bemvelo Environmental Management, 2006).

The top 10 risks as identified by the research and community consultation in 2006 are:

1. Community-wide human disease
2. Livestock loss to animal disease
3. Human-life loss to lightning
4. Livestock loss to drought
5. Livestock loss to veld fires
6. Homes damaged by tornadoes
7. Pasture-loss to drought
8. Homes damaged by lightning
9. Road closure by floods
10. Homes damaged by structural fires.

The assets most at risk identified in risk assessment done in 2006 are:

- Rural and urban communities
- Livestock
- Homes
- Pastures
- Eskom RED Network
- Telkom Network
- Public Buildings
- Crops
- Estuaries
- Water courses
- Groundwater
- Roads

7.2 Historical overview of past incidents

The following tables contains historic incidents (disasters and incidents of note) that was received from the NDMC

Table 7-1: SRS Data from NDMC

Id	Hazard	Severity	Incident	Incident date	Incident Place
825	Snow	Low	Heavy snowfalls occurred on a number of occasions during the month e.g. over Eastern and North-Eastern Cape Natal and the Drakensberg as well as over South-Eastern and Eastern Transvaal. Mountain passes e.g. the Lootsberg Pass and the Wapadsberg Pass	1990/01/08	Underberg Himeville Matatiele Jamestown Dordrecht Indwe and Elliot
870	Extreme Temperature	Low	A heatwave over most of the country broke several records the highest being 43.6°C in Douglas the previous record being 42.2°C in 1983. 5 people died of heatstroke 3 in the Boland where grape fruit and vegetable crops were severely damaged. In Natal	1993/01/01	Douglas(EC)
404	Storm	Low	Heavy wind and hailstorm destroyed houses shops school trees uprooted and damaged crops 1 person is died and 3 injured.	1999/02/21	Alice
502	Fire	Low	Fire in the town (Hogsback)	2000/07/08	Hogsback
506	Fire	Low	Veld fires damaged 7 homes in Duncan Village 4 homes in Willowvale and 2 homes in Idutywa.	2000/07/08	Mboya Village (Willowvale) Duncan Village (East London) Kwatayi & Mhlontlo Village (Idutywa)
513	Wind	Low	73 People affected when roofs and walls were destroyed by gale force winds.	2000/07/14	Keiskammahoek (rural areas and 3 farms in the area)
499	Fire	Low	R8m damages to pine forest plantation caused by fire.	2000/09/06	Stutterheim (Kubusi Forests)
460	Storm	Low	32 Houses damaged and 3 shops destroyed by hailstorm.	2000/11/03	Fort Beaufort TLC
573	Tornado	Low	19 Homes damaged by tornado.	2001/08/31	Mbhashe Mfezane Village Amathole District
573	Tornado	Low	19 Homes damaged by tornado.	2001/08/31	Mbhashe Mfezane Village Amathole District
573	Tornado	Low	19 Homes damaged by tornado.	2001/08/31	Mbhashe Mfezane Village Amathole District
636	Storm	Low	4 People in a Tuck Shop when lighting struck killed 3 and injured 1 person.	2001/11/18	Msintsana Admin Area Engcobo
554	Rain	Low	Nine days of continuous heavy rain and floods. 2 People missing.	2001/11/20	Cathcart (Amatole)
545	Flood	Low	People travelling in a bakkie were swept away by a flooded Kei river in the north east of Cathcart 6 people dead.	2001/12/05	Cathcart (Amatole)
418	Storm	Low	Several houses were destroyed by hail storm.	2002/03/09	Ngqwele NgxwalaneMlaka Laka Khulile Kwalini Zwelitsha and Perksdale

Id	Hazard	Severity	Incident	Incident date	Incident Place
779	Fire	Low	Approximately 30 houses and buildings around the School and materials intended for the building of a new School were burnt. 1 death 7 people injured. Farms in the Amabele Wriggleswade and Kei Road areas suffered damaged ranging from grazing fences hay	2003/08/19	Heckela and Mqwali
776	Fire	Low	In the Katberg and Mpofu game reserve areas 1 700 hectares of the forest lost to fire. This represents in excess of 80% of the total plantation. Also with the help of Nkonkobe fire services the forest compound was saved with the loss of only one cabin.	2003/08/19	Katberg and Mpofu
776	Fire	Low	In the Katberg and Mpofu game reserve areas 1 700 hectares of the forest lost to fire. This represents in excess of 80% of the total plantation. Also with the help of Nkonkobe fire services the forest compound was saved with the loss of only one cabin.	2003/08/19	Katberg and Mpofu
1204	Rain	Low	The municipal area was affected with heavy rain storm and 9 houses damaged	2004/12/21	Ngqushwa
1202	Storm	Low	Hailstorm ravaged two villages (Ntonga and Phewuleni) and damages still being assessed at Ntselamazi and Fort Beaufort	2004/12/22	Ntonga; Phewuleni
1125	Storm	Low	A storm caused damages in the Manahlathi area. Damages were widespread over both rural villages and in Amahlathi town. Ndakana village has been badly affected with in excess of 70 homes affected. Some injuries were reported but the details are not yet k	2005/02/07	Manahlathi

7.3 Discussion of Hazard Events in the ADM

This section contains a description on various hazards within the ADM. The hazard description includes an overview of the information gathered during the consultations workshops as well as information collected from other sources.

The information contained in the tables is based on stakeholder perception and has not been verified. This information should therefore be considered in light of the above. An analysis was done based on the stakeholder perception data received. The result of the hazard assessment, based only on stakeholder perception data, is shown in Table 7-2.

Table 7-2: Workshop perspective on Hazards in ADM 2013

ADM District Wide Workshop perception	
Hazard	Precedence
Hydro-meteorological - Drought	1
Transport Hazards - Road Transportation	2
Disease / Health - Disease: Human	3
Fire Hazards - Veld/Forest Fires	4
Civil Unrest - Crime	5
Disease / Health - Disease: Animal	6
Disease / Health - Disease: Plants	7
Infrastructure Failure / Service Delivery Failure - Electrical	8
Transport Hazards - Air Transportation	9
EC121: Mbhashe Workshop perception	
Hazard	Precedence
Transport Hazards - Road Transportation	1
Hydro-meteorological - Drought	2
Civil Unrest - Demonstrations / Riots	3
Environmental Degradation - Erosion	4
Transport Hazards - Rail Transportation	5
Civil Unrest - Xenophobic Violence	6
EC122: Mnquma Workshop perception	
Hazard	Precedence
Transport Hazards - Road Transportation	1
Hydro-meteorological - Drought	2
Civil Unrest - Demonstrations / Riots	3
Environmental Degradation - Erosion	4
Transport Hazards - Rail Transportation	5
Disease / Health - Disease: Human	6
Fire Hazards - Veld/Forest Fires	7
Disease / Health - Disease: Animal	8
Pollution - Air Pollution	9
Transport Hazards - Water Transportation (Incl. Marine Accident)	10
EC123: Great Kei Workshop perception	
Hazard	Precedence
Civil Unrest - Crime	1
Geological Hazards - Rock-fall	2
Transport Hazards - Road Transportation	3
Hydro-meteorological - Drought	4
Civil Unrest - Demonstrations / Riots	5

ADM District Wide Workshop perception	
Hazard	Precedence
Environmental Degradation - Erosion	6
Transport Hazards - Rail Transportation	7
Disease / Health - Disease: Human	8
Fire Hazards - Veld/Forest Fires	9
Disease / Health - Disease: Animal	10
Disease / Health - Disease: Plants	11
Infrastructure Failure / Service Delivery Failure - Electrical	12
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)	13
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	14
Hydro-meteorological Hazards - Extreme Temperatures	15
Infrastructure Failure / Service Delivery Failure - Sanitation	16
Pollution - Water Pollution (Fresh and Sea)	17
Fire Hazards - Formal & Informal Settlements / Urban Area	18
Hazardous Material - Spill/Release (Storage & Transportation)	19
Structural Failure - Bridge Failure	20
EC124: Amahlathi Workshop perception	
Hazard	Precedence
Transport Hazards - Road Transportation	1
Hydro-meteorological - Drought	2
Transport Hazards - Rail Transportation	3
Disease / Health - Disease: Human	4
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)	5
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	6
EC126: Ngqushwa Workshop perception	
Hazard	Precedence
Fire Hazards - Veld/Forest Fires	1
Transport Hazards - Road Transportation	2
Hydro-meteorological - Drought	3
Disease / Health - Disease: Human	4
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	5
Civil Unrest - Crime	6
Environmental Degradation - Erosion	7
Disease / Health - Disease: Animal	8
Disease / Health - Disease: Plants	9
Environmental Degradation - Deforestation	10
Pollution - Land Pollution	11
EC126: Ngqushwa Workshop perception	

ADM District Wide Workshop perception	
Hazard	Precedence
Hazard	Precedence
Fire Hazards - Veld/Forest Fires	1
Transport Hazards - Road Transportation	2
Hydro-meteorological - Drought	3
Disease / Health - Disease: Human	4
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	5
Civil Unrest - Crime	6
Environmental Degradation - Erosion	7
Disease / Health - Disease: Animal	8
Disease / Health - Disease: Plants	9
Environmental Degradation - Deforestation	10
Pollution - Land Pollution	11
EC128: Nxuba Workshop perception	
Hazard	Precedence
Hydro-meteorological - Drought	1
Environmental Degradation - Deforestation	2
Hydro-meteorological Hazards - Extreme Temperatures	3
Transport Hazards - Road Transportation	4
Disease / Health - Disease: Human	5
Civil Unrest - Crime	6
Environmental Degradation - Erosion	7
Pollution - Land Pollution	8

Table 7-3: 2015 Workshop perspective

		Vulnerability										
Hazard	**Precedence**	**EC121: Mbhashe**	**EC122: Mnquma**	**EC123: Great Kei**	**EC124: Amahlathi**	**EC126: Ngqushwa**	**EC127: Nkonkobe**	**EC128: Nxuba**	**Vulnerability Rating**	**Municipal Capacity**	**Service Capacity**	**Risk**
Hydro-meteorological - Drought	1	0.4900	0.4700	0.4200	0.4400	0.4100	0.4100	0.4000	4.6400	13	23	5.54
Disease / Health - Disease: Human	2	0.4700	0.4500	0.1200	0.1400	0.2100	0.1500	0.1100	3.25	10	12	5.02
Transport Hazards - Road Transportation	3	0.1700	0.1700	0.1700	0.1700	0.1800	0.1700	0.1700	3.8	12	13	5.01
Civil Unrest - Crime	4	0.2400	0.2300	0.3800	0.4100	0.3200	0.4000	0.4000	4.5	14	15	4.65
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)	5	0.3400	0.2900	0.2600	0.3000	0.2500	0.2200	0.1900	3.45	14	10	4.6
Fire Hazards - Formal & Informal Settlements / Urban Area	6	0.4500	0.4000	0.1900	0.3500	0.2100	0.3100	0.1100	3.7	16	16	4.39
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	7	0.3200	0.2600	0.2200	0.2000	0.2000	0.1800	0.1500	3.28	12	12	4.37
Fire Hazards - Veld/Forest Fires	8	0.4700	0.4300	0.1500	0.4800	0.2600	0.4400	0.1500	3.98	17	17	4.33
Disease / Health - Disease: Animal	9	0.4000	0.2700	0.2500	0.2000	0.1500	0.2500	0.2000	3.32	8	27	2.94
Pollution - Water Pollution (Fresh and Sea)	10	0.3800	0.3100	0.2500	0.2100	0.2200	0.1800	0.1900	3.34	29	33	1.67

7.4 Transport Hazards

Transportation hazard events, such as motor vehicle accidents, are considered a regular event in the majority of urban and rural areas in South Africa. This is due to the fact that these events are often considered high frequency, low severity hazard events. However, low frequency, high severity events do occur, and these are the events that are in the ambit of disaster management. For the purpose of this assessment, transport disasters were divided into the following three categories:

- Air Transportation;
- Rail Transportation; and
- Road Transportation;

7.4.1 Air Transportation

Even though major casualty incidents related to air transportation hazards are rare, the potential risk presented by air transportation remains present. This risk can also increase with an increase in air traffic due to economic and urban developments or special events leading to an increase in air travel to and from major urban nodes in the region.

In order to represent the hazard spatially, information with regard to the location of airfields/airports in the ADM as well as flight paths were used. This flight path as well as buffer areas around the airport and local airfields are deemed to be high hazard areas for potential aircraft accidents. The result of the hazard mapping is shown below:

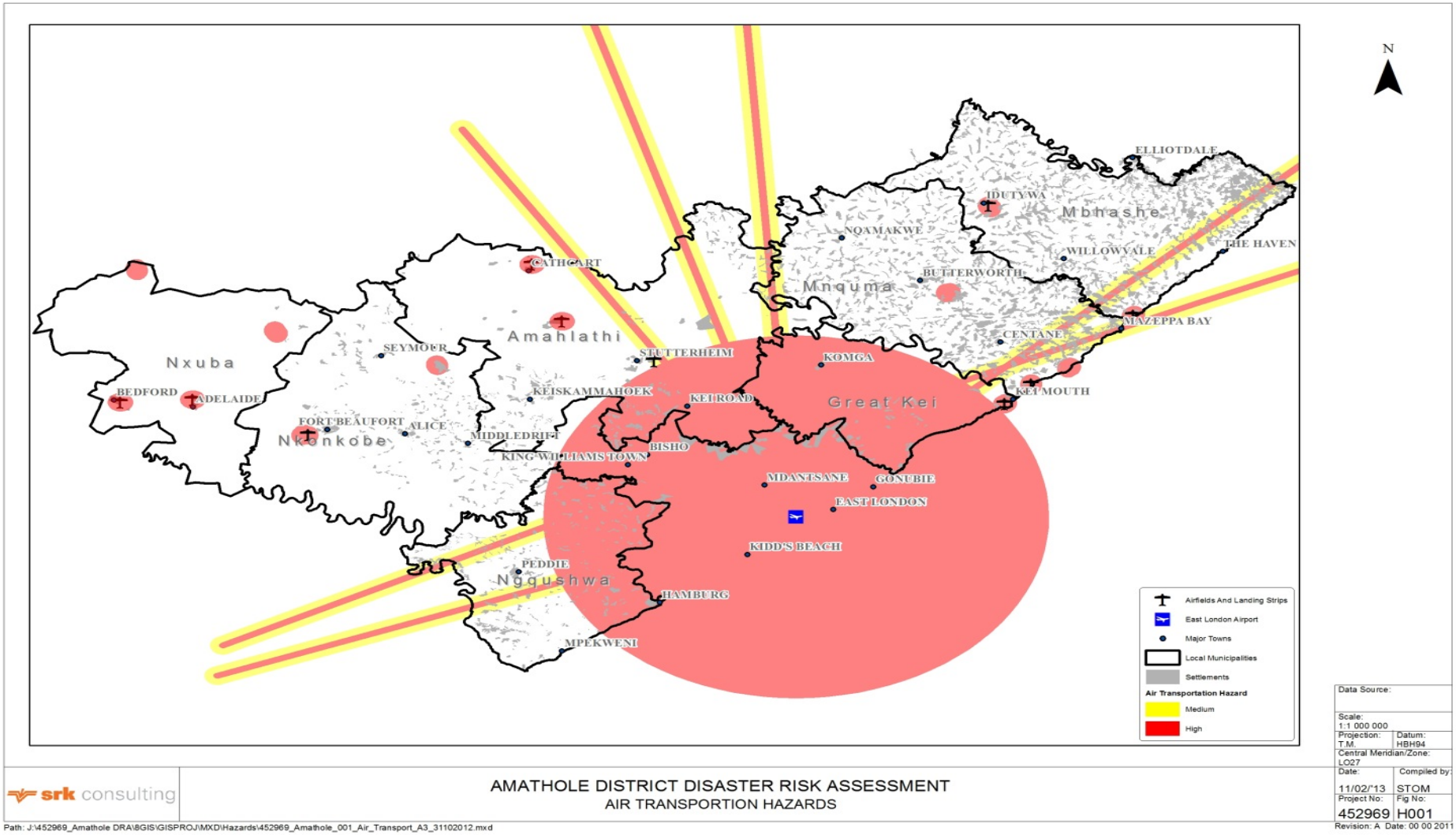


Figure 7-1: Air Transport Hazard in the ADM

The international airport situated in Buffalo City and numerous flight paths cross the area of ADM

7.4.2 Rail Transportation

Rail transportation hazards can represent a disaster risk especially if a large number of passengers or hazardous material is involved. Incidents involving trains and road vehicles, or hazard events such as structural failure can also lead to mass casualty or high fatality events.

It was however found that the most rail lines in ADM are mainly used for freight transport and the infrastructure for passengers is limited.

7.4.3 Road Transportation

According to the WHO (2009) *"over 90% of the world's fatalities on the roads occur in low-income and middle-income countries, which have only 48% of the world's registered vehicles. Road traffic fatality rates in low-income and middle-income countries (21.5 and 19.5 per 100 000 population, respectively) are double the rates in high-income countries (10.3 per 100 000). Pedestrians, cyclists, and riders of motorized two-wheeler and their passengers are considered "vulnerable road users", and account for around 46% of global road traffic deaths. Globally, road traffic crashes cause over 1.27 million deaths a year. Road traffic fatalities are predicted to rise to the fifth leading cause of death by 2030, resulting in an estimated 2.4 million fatalities per year. This projected increase in ranking would be due to a combination of an increase in road traffic deaths and reductions in deaths due to some other health conditions"*.

The severity or the impact of single incident usually low, it can however in extreme circumstances cause a disastrous event that can exceed the capacity to deal with the relevant incident. What should however not be forgotten is the accumulative ability of incidents to consume resources and thereby diminishing the capacity to deal with any further incidents.

The GIS mapping of road and rail transportation hazards is shown below:

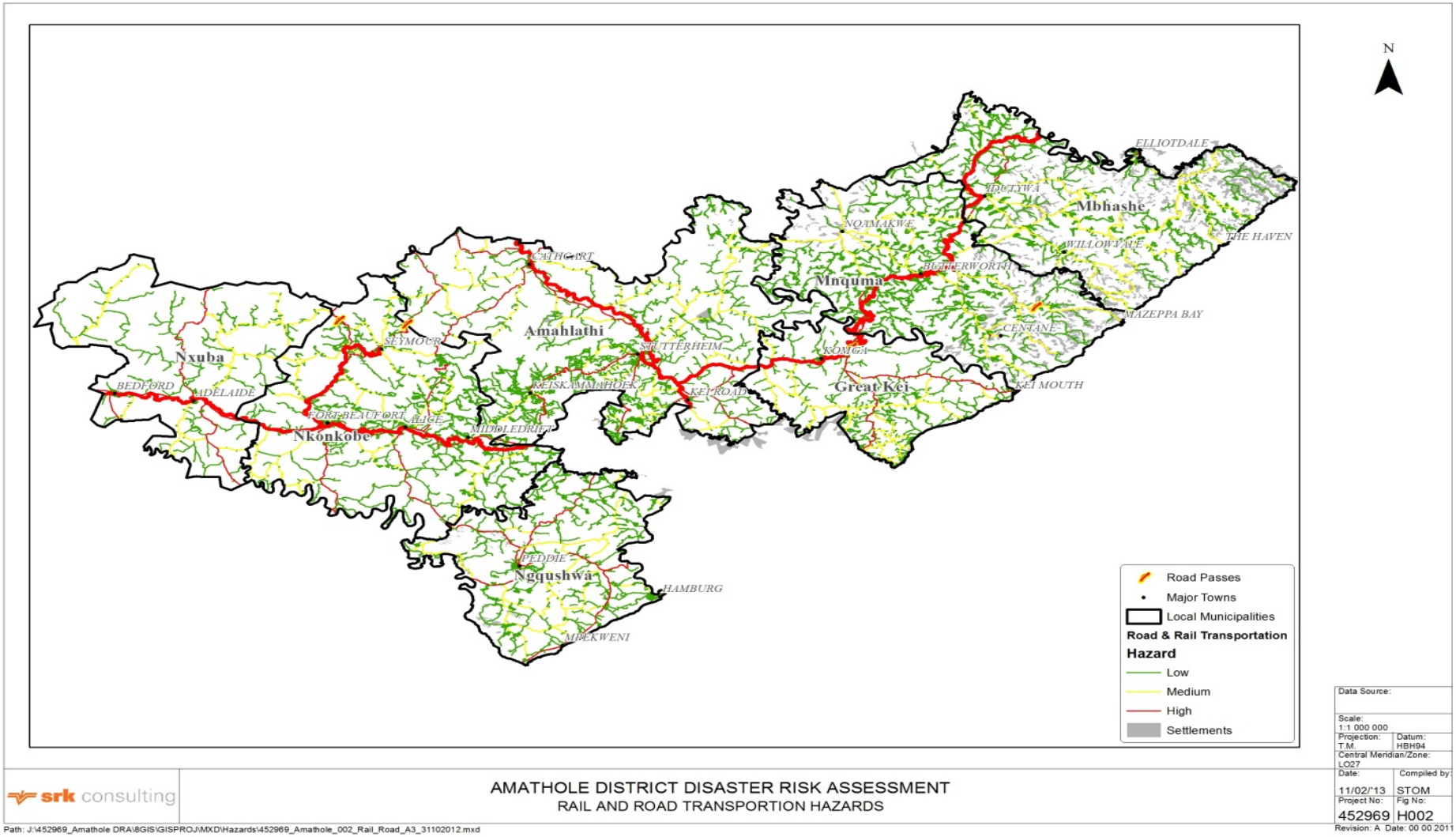


Figure 7-2: Road and Rail Transport Hazard

The above figure illustrates the various transportation routes across the district.

7.5 Civil Unrest

Civil unrest and mass disturbances can occur at any time, and normally lead to destruction of property and concerns about public safety and security. For the purpose of this assessment civil unrest hazards were divided into six categories, namely

- Demonstrations and riots;
- Refugees and Internally displaced persons;
- Xenophobic violence;
- Terrorism;
- Armed Conflict; and
- Crime.

The hazard map associated with civil unrest is shown in Figure 7-3.

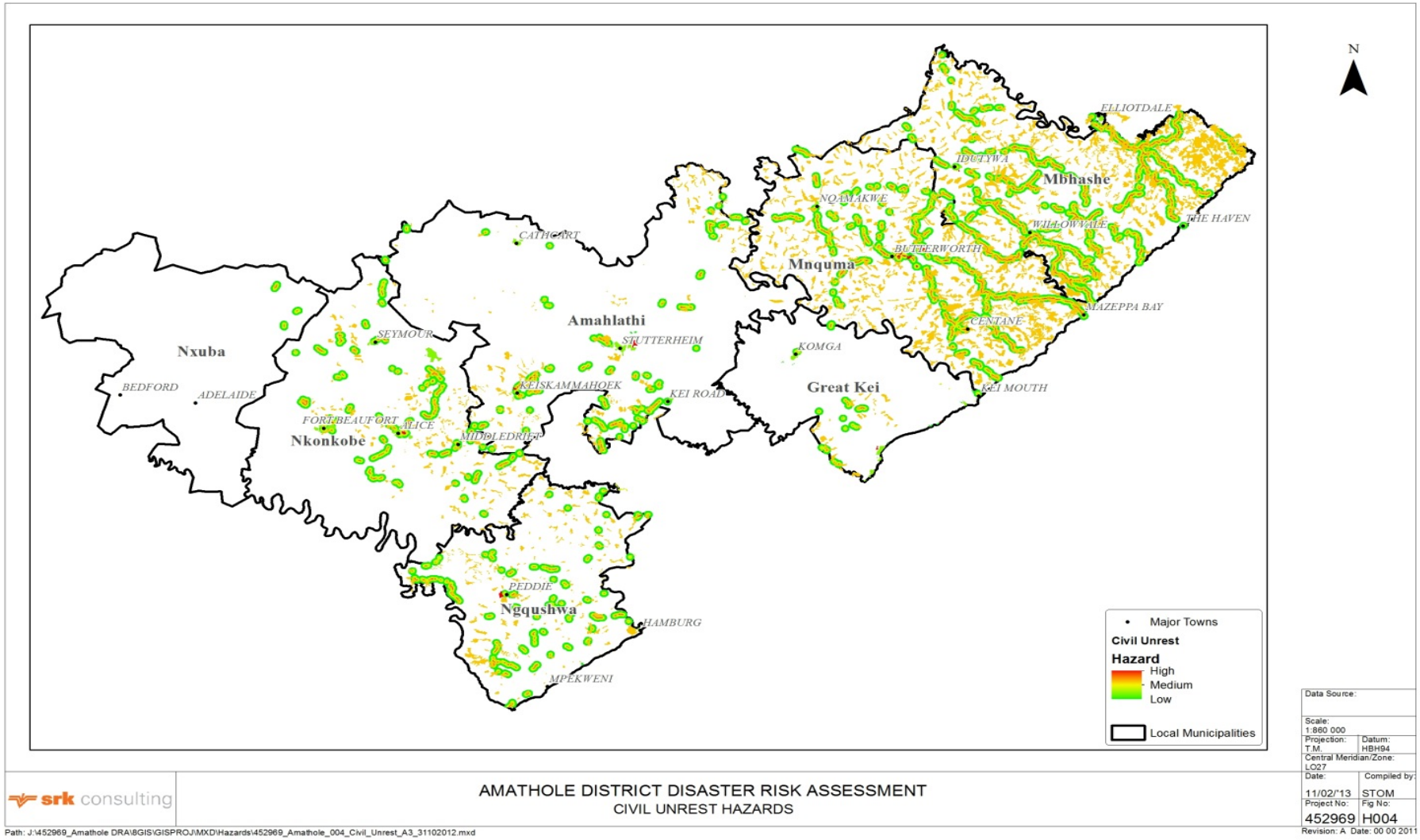


Figure 7-3: Civil unrest hazard

Figure 7-3 represents the results of the Civil Unrest hazard mapping for the ADM. Areas identified as high civil unrest hazard areas include industrial areas, government buildings and major transport routes, as well as areas identified by representatives from the ADM during stakeholder consultations.

7.5.1 Xenophobic Violence

As discussed in the previous section, South Africa has experienced an influx of immigrants from neighbouring countries. This has increased the potential risk of xenophobic violence. According to the UNHCR refugees, immigrants and asylum-seekers generally tend to settle in the main urban centres. However, unemployment in such centres is often already a concern for local residents, and an influx of immigrants might aggravate the situation. In many areas of South Africa the competition for employment and resources has led to frustration and boiled over into violence affecting many communities.

7.5.2 Demonstrations / Riots

Demonstrations and riots are a common occurrence in South Africa although incidents where these events escalate to physical violence, injuries and damage to property are less frequent. Areas that are considered likely to be affected by demonstrations and rioting are public buildings, the CBD, industrial areas, specific formal and informal settlements and main transportation routes.

Service Delivery Protests are frequently seen, South Africa has even been accredited of being “the protest capital of the world” (Wikipedia, 2013)

7.5.3 Crime

In

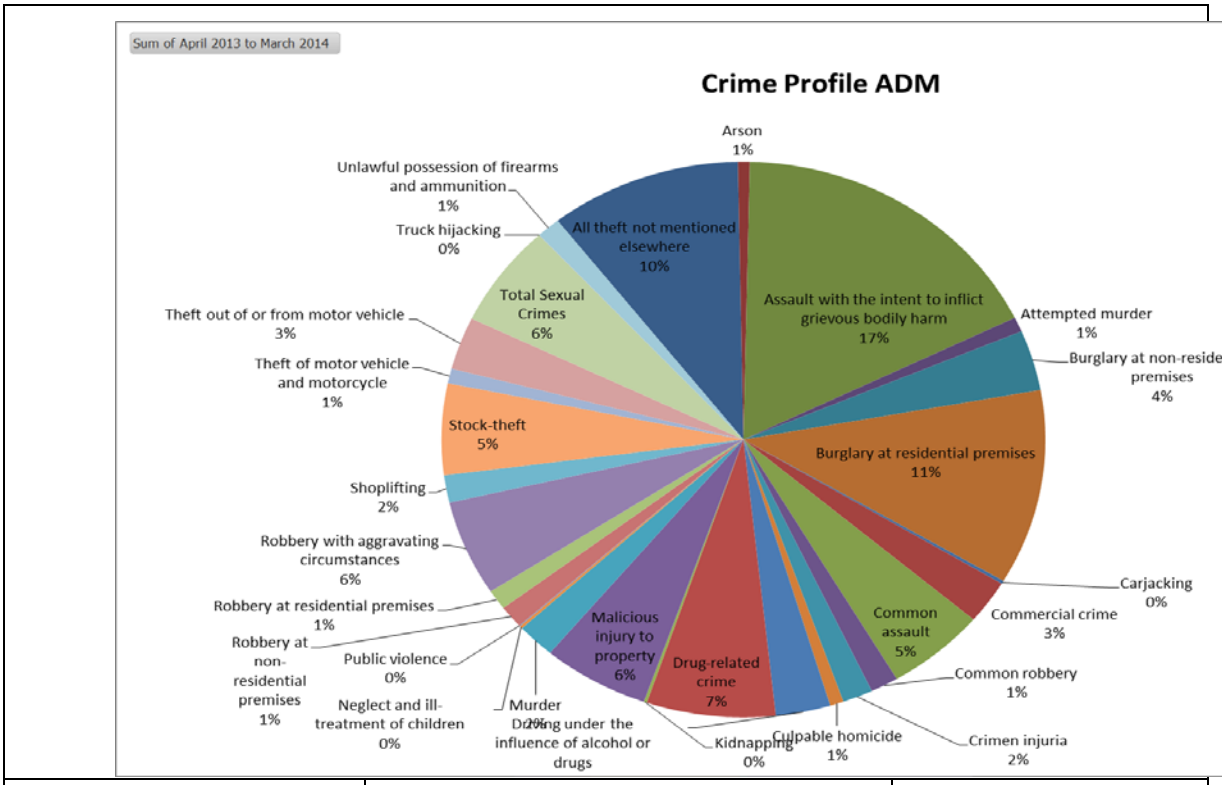


Figure 7-4 reported crime profile in ADM can be seen.

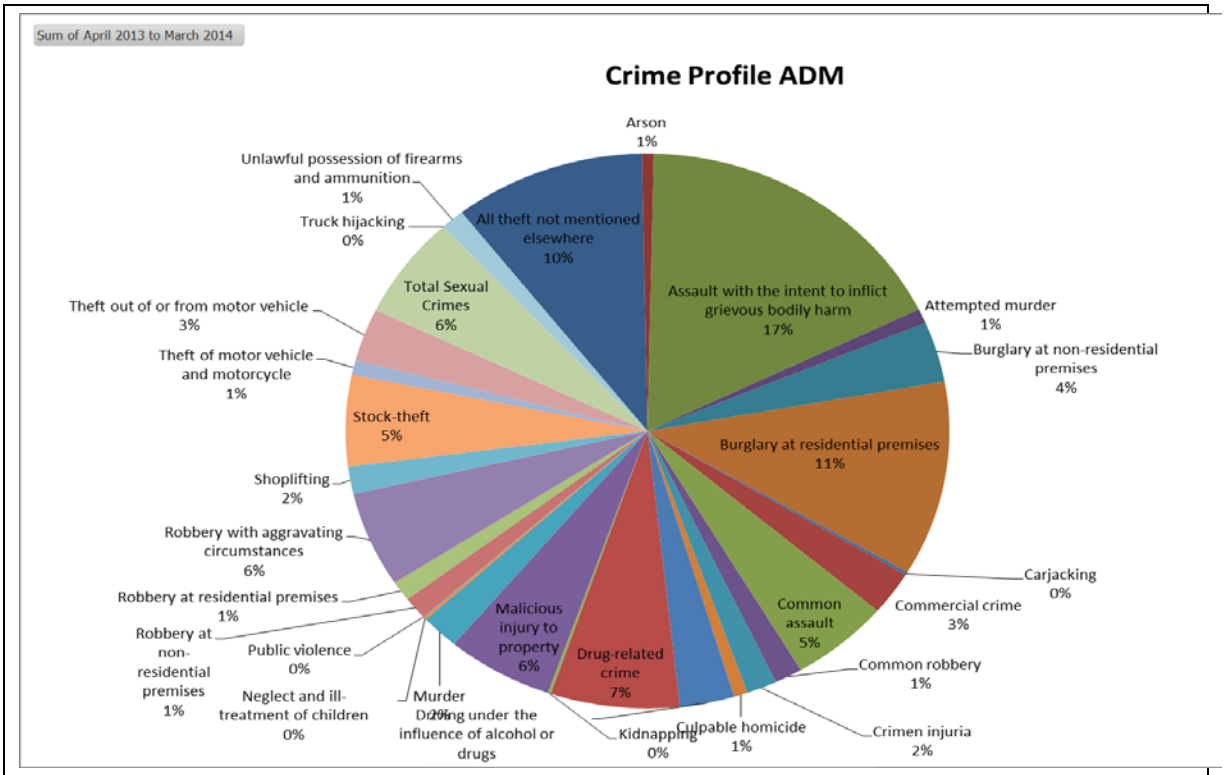


Figure 7-4: Crime Profile ADM (South African Police Service, 2014)

The following graph gives a comparison between the percentages of the population (total for ADM) in the different local municipal areas in comparison the percentage of reported crime.

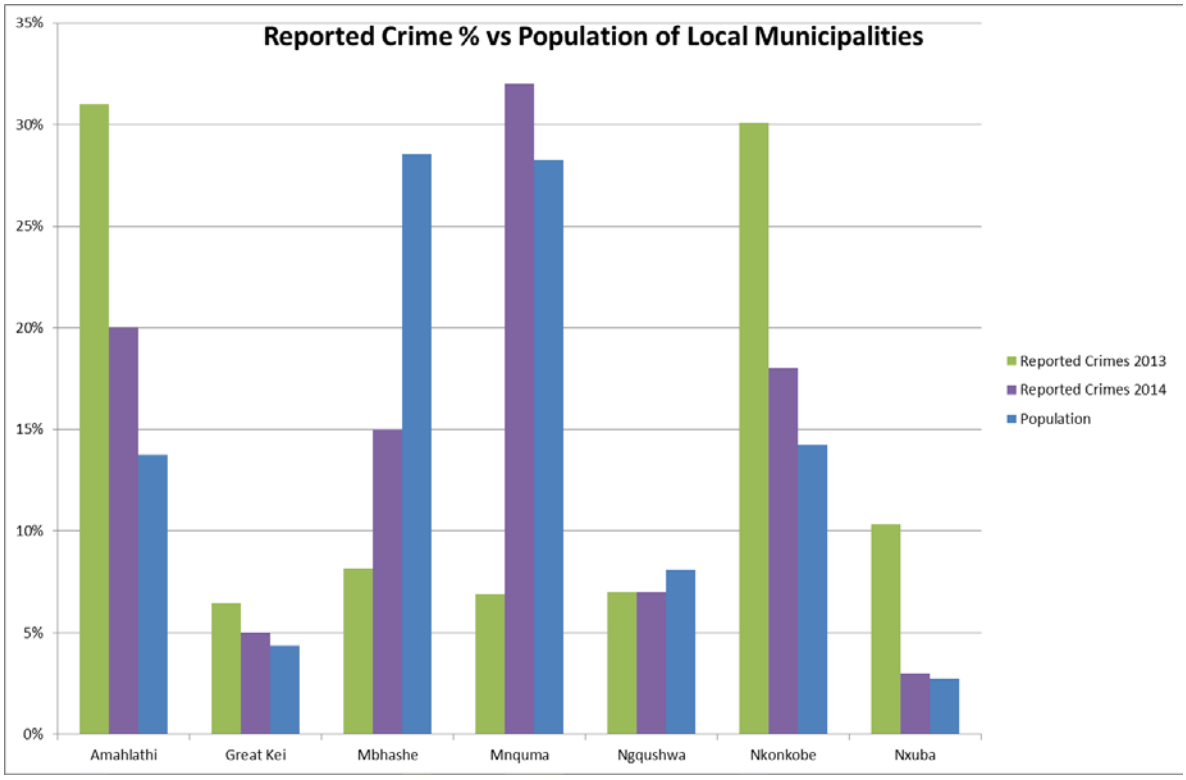


Figure 7-5: Population Percentage compared with reported crime percentage (South African Police Service, 2014)

From this graph it is apparent that drastic changes have occurred from 2013 to 2014.

7.6 Environmental Degradation

For the purpose of this assessment, environmental degradation was divided into four sub-categories. They included:

- Deforestation;
- Erosion;
- Land Degradation; and
- Loss of Biodiversity.

Environmental degradation may result from a variety of factors, including overpopulation and the resulting overuse of land and other resources. Intensive farming, for instance, depletes soil fertility, thus decreasing crop yields. Pollution is also a well-known cause of environmental degradation. Sources of pollution include mines, power generating facilities (especially those burning fossil fuels), industry and agriculture (Miller, 1999).

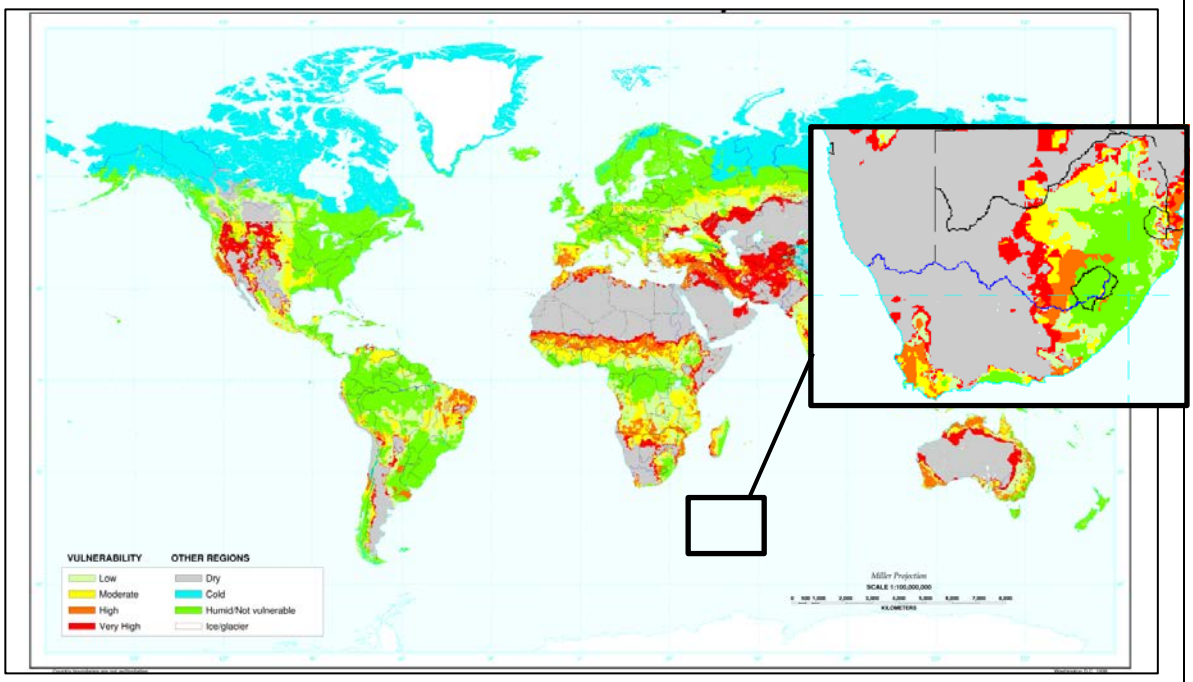
In many parts of the world, environmental degradation is an important cause of poverty. Environmental problems have led to shortages of food, clean water, materials for shelter, and other essential resources. As natural resources are degraded, people who live directly off the environment suffer most from the effects. Environmental degradation is often not considered a disaster risk, but environmental degradation hazards can contribute to slow-onset disasters, with less dramatic results than other rapid-onset disaster such as fires or floods. Various environmental degradation hazards are discussed in more detail below:

7.6.1 Desertification

Desertification is defined by the U.N. Convention to Combat Desertification as "*land degradation in arid, semiarid and dry sub humid areas resulting from various factors, including climatic variations and human activities.*" Land degradation is in turn defined as the reduction or loss of the biological or economic productivity of drylands. Desertification does not refer to the expansion of existing deserts. It occurs because dryland ecosystems are extremely vulnerable to over-exploitation and inappropriate land use. Poverty, political instability, deforestation, overgrazing, and bad irrigation practices can all undermine the land's fertility. [1,2]

[1] Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Desertification Synthesis. World Resources Institute, Washington, DC.

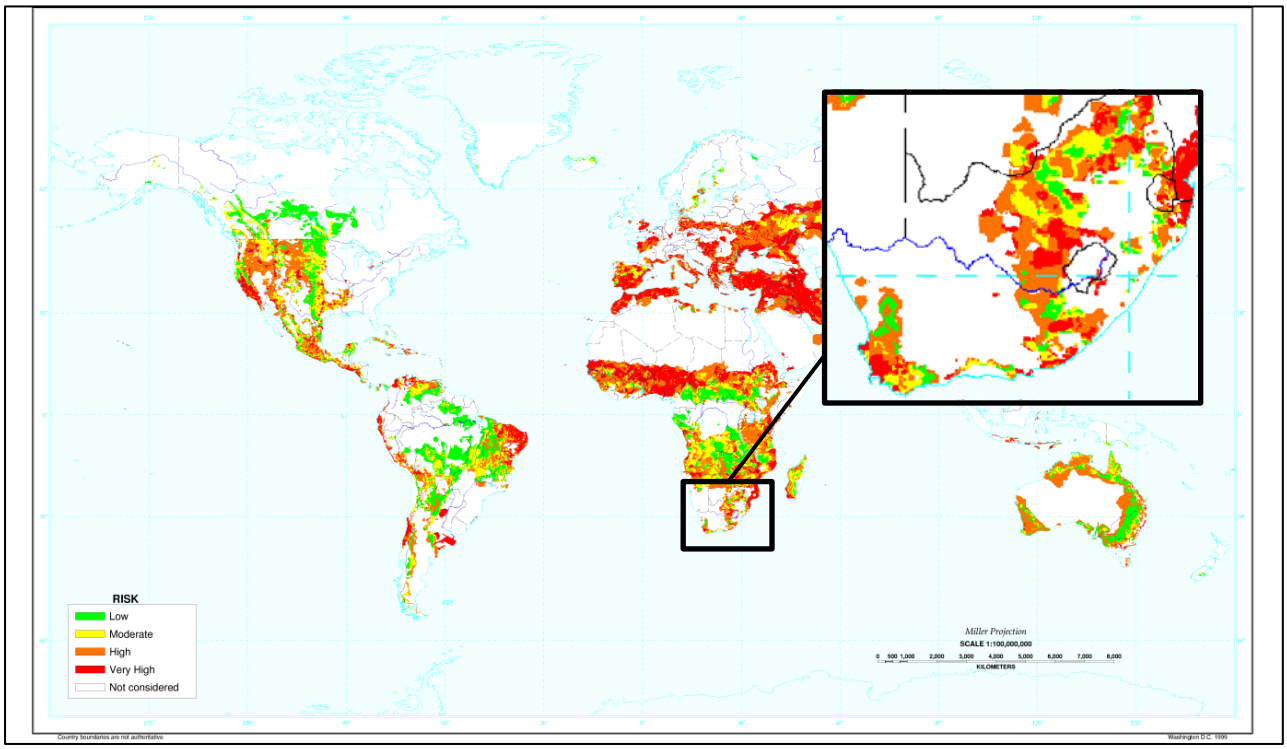
[2] Food and Agriculture Organization of the United Nations. Retrieved from: http://www.fao.org/desertification/intro_txt/en/desert.htm [October 11, 2011]



srk consulting	**ADM Disaster Risk Assessment** Global Desertification Vulnerability Map	Project No. 481363

Figure 7-6: Global Desertification Vulnerability Map[3]

[3] Soil map and soil climate map, USDA-NRCS, Soil Survey Division, World Soil Resources, Washington D.C. Retrieved from: http://soils.usda.gov/use/worldsoils/mapindex/desert.html [October 11, 2011]

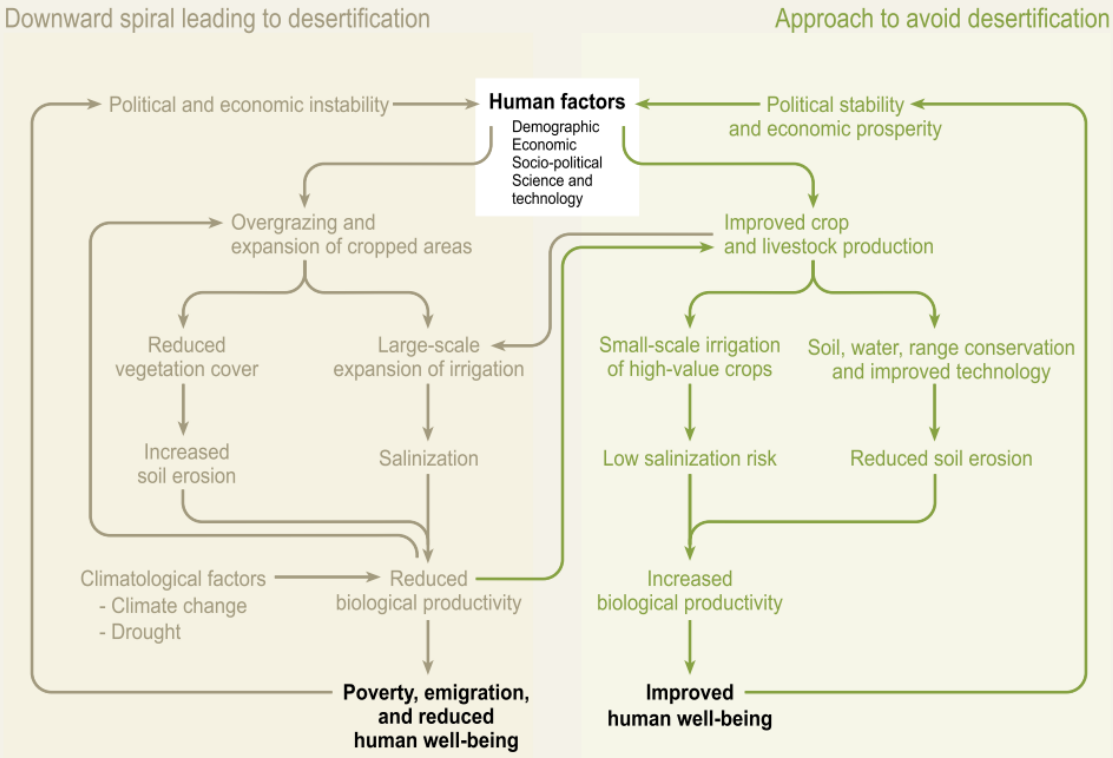


srk consulting	**ADM Disaster Risk Assessment** Risk of Human Induced Desertification Map	Project No. 481363

Figure 7-7: Risk of Human Induced Desertification Map[4]

[4] Desertification map, USDA-NRCS, Soil Survey Division, World Soil Resources, Washington D.C. Population density map, Tobler, W., V. Deichmann, J. Gottsegen, and K. Maloy. 1995. The global demography project. Technical Report TR-95-6. National Center for Geographic Information analysis. Univ. Santa Barbara, CA. 75 pp. Retrieved from: http://soils.usda.gov/use/worldsoils/mapindex/dsrtrisk.html [October 11, 2011]

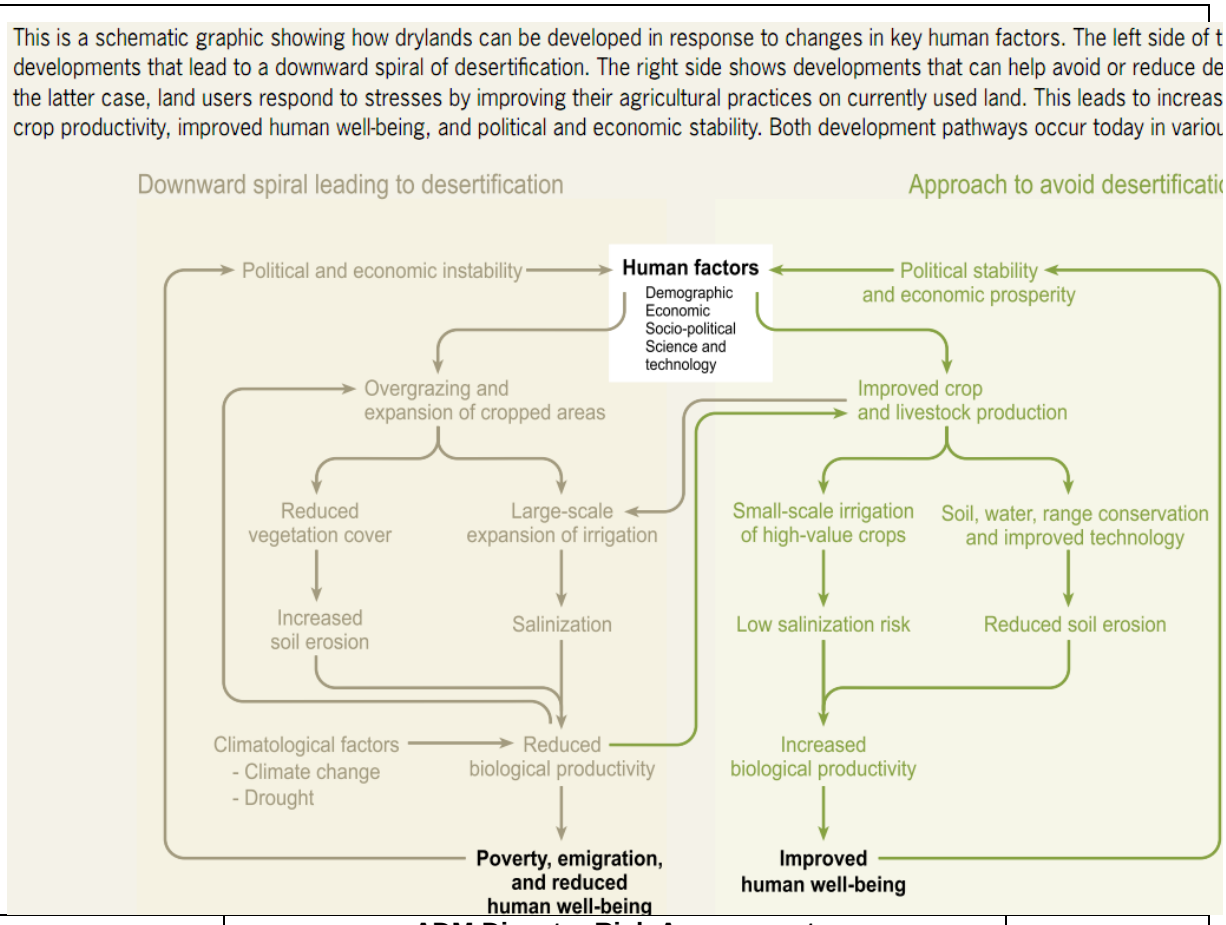
This is a schematic graphic showing how drylands can be developed in response to changes in key human factors. The left side of the Figure shows developments that lead to a downward spiral of desertification. The right side shows developments that can help avoid or reduce desertification. In the latter case, land users respond to stresses by improving their agricultural practices on currently used land. This leads to increased livestock and crop productivity, improved human well-being, and political and economic stability. Both development pathways occur today in various dryland areas.



srk consulting	**ADM Disaster Risk Assessment** Schematic Description of Development Pathways in Drylands	Project No. 481363

Figure 7-8: Schematic Description of Development Pathways in Drylands[5]

[5] Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Desertification Synthesis. World Resources Institute, Washington, DC.



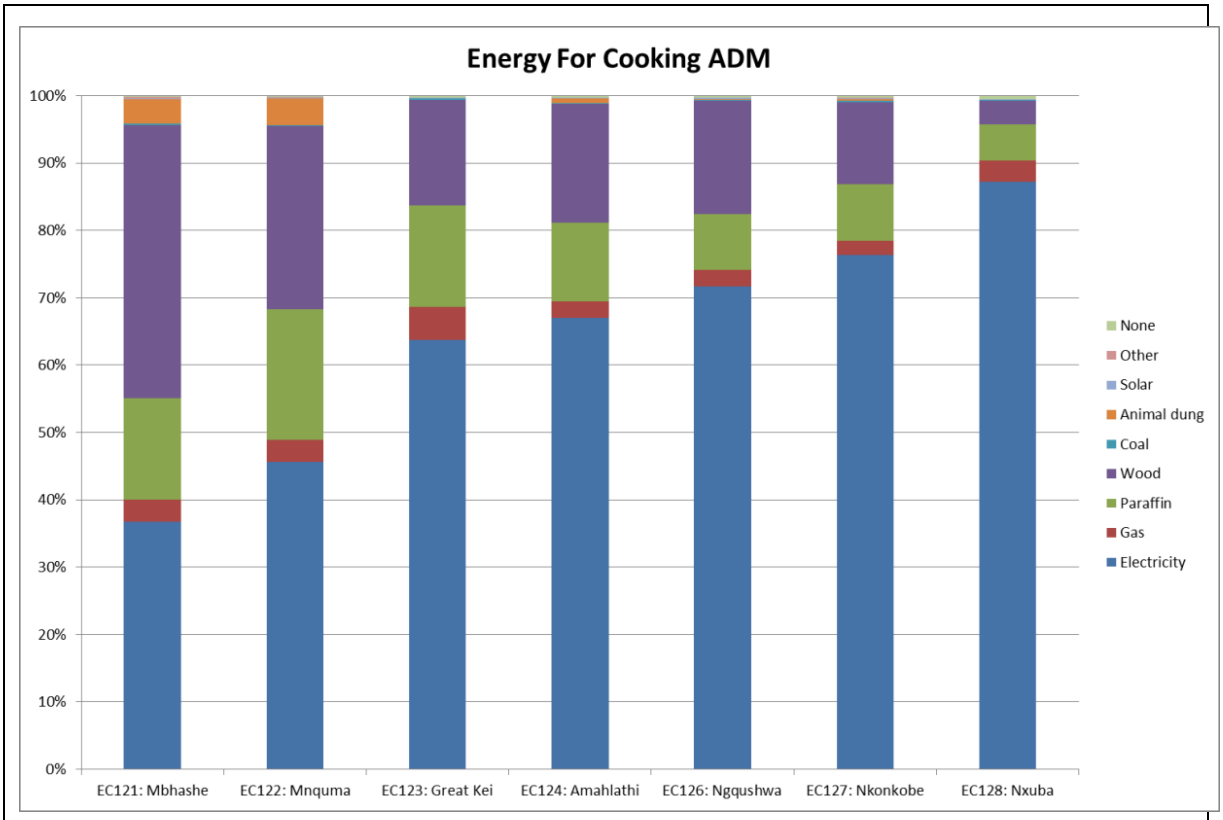
srk consulting	**ADM Disaster Risk Assessment** Schematic Description of Development Pathways in Drylands	Project No. 481363

Figure 7-8 represents a schematic description of development pathways in drylands. These different pathways can lead to an increase or decrease in desertification.

7.6.2 Deforestation

Deforestation is the term used to describe the removal of a forest or trees. In some areas it is very apparent such as the cutting down of a rain forest. In other areas it is not as apparent such as the continued cutting of trees in a broader area for fire wood (Wikipedia, 2013).

The figure below shows the energy for cooking in ADM.



srk consulting	**ADM Disaster Risk Assessment** High percentage of wood used for cooking ADM	Project No. 481363

Figure 7-9: High percentage of wood used for cooking ADM

The high percentage of wood used for a cooking may be indicative that deforestation is a growing problem which might exasperate other hazards such as drought.

7.6.3 Erosion

Erosion, including soil, wind and water erosion, is often not considered as a major disaster hazard, but, as is the case with a number of environmental degradation hazards, uncontrolled erosion can cause severe damage to the environment, and lead to a general reduction in environmental quality. Erosion in the vicinity of infrastructure, such as roads, pipelines and electricity infrastructure, can also lead to the eventual destruction of the infrastructure.

Soil erosion can result from a number of causes, including overstocking and overgrazing as well as inappropriate farming techniques. The effect of erosion can include an on-site loss of agricultural potential and localized environmental damage. Water erosion, on the other hand, can cause problems in watercourses. This is due to the downstream movement of sediment, causing the silting up of reservoirs and flooding (DoA, 2006). The sandy nature of the coastal areas is also at risk of erosion especially if the natural plant cover is stripped (SEA Report, 2000).

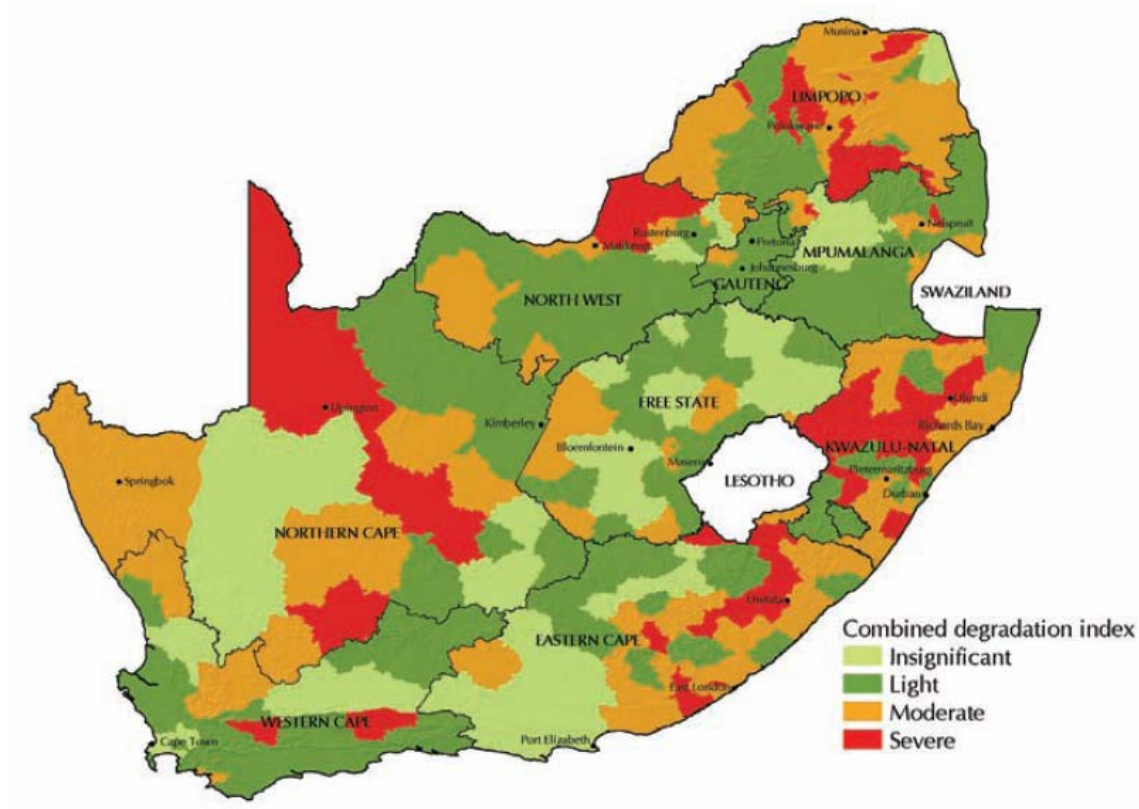
7.6.4 Land Degradation

In terms of the United Nations Convention to Combat Desertification, land degradation refers to the reduction or loss of biological or economic productivity of agricultural lands, woodlands, and forests. This reduction is mostly result from human activities (DEAT, 2006).

It has been estimated by UNEP that more than a quarter of the African continent is in the process of becoming useless for cultivation because of land degradation. One of the causes of degradation is population pressure, which forces farmers to cultivate marginal land (ICSU, 2007).

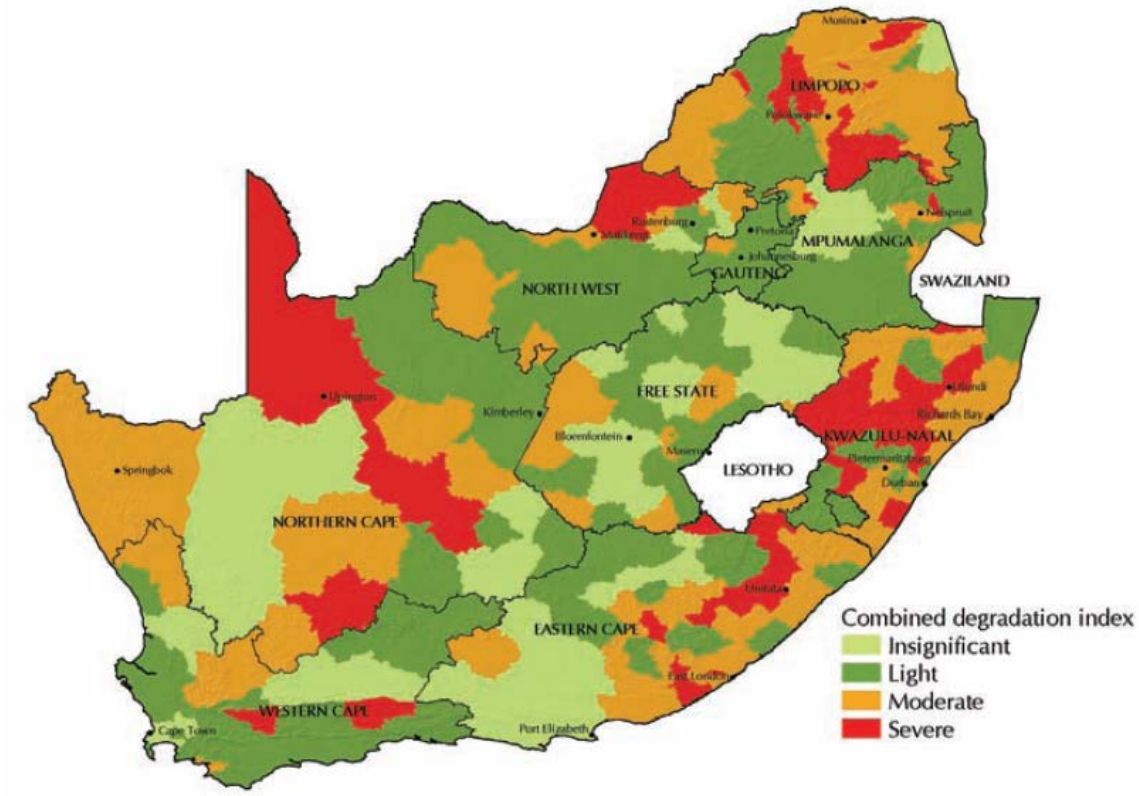
According to ICSU (2007): *"The rural poor, the overwhelming majority of Africa's population, destroy their own environment, not out of ignorance but simply for survival. Peasant farmers preoccupied with survival over-crop marginal land because there is no alternative employment and no better technologies that they can afford. Pastoralists overstock to improve their chances of surviving the next drought. Rural dwellers strip trees and shrubs for wood because they need fuel. In the context of the short-term basic needs of an individual, each decision is rational; in the long run, the effects are disastrous."*

Areas of severe degradation (that is, degradation of both soil and vegetation) and desertification in South Africa are perceived to correspond closely with the distribution of communal rangelands, specifically in the steeply sloping environments adjacent to the escarpment in Limpopo, KwaZulu-Natal, and the Eastern Cape (



srk consulting	**ADM Disaster Risk Assessment** Distribution of land degradation based on Combined Degradation Index	Project No. 481363

Figure 7-10). Many communal areas in the Limpopo, North West, KwaZulu-Natal, and Mpumalanga provinces are also severely degraded. The commercial farming areas with the most severe degradation are located in the Western and KZN provinces. Wind and water erosion are the major natural causes of soil degradation, while change in species composition, loss of plant cover, and bush encroachment are the most frequent forms of vegetation degradation (DEAT, 2006).

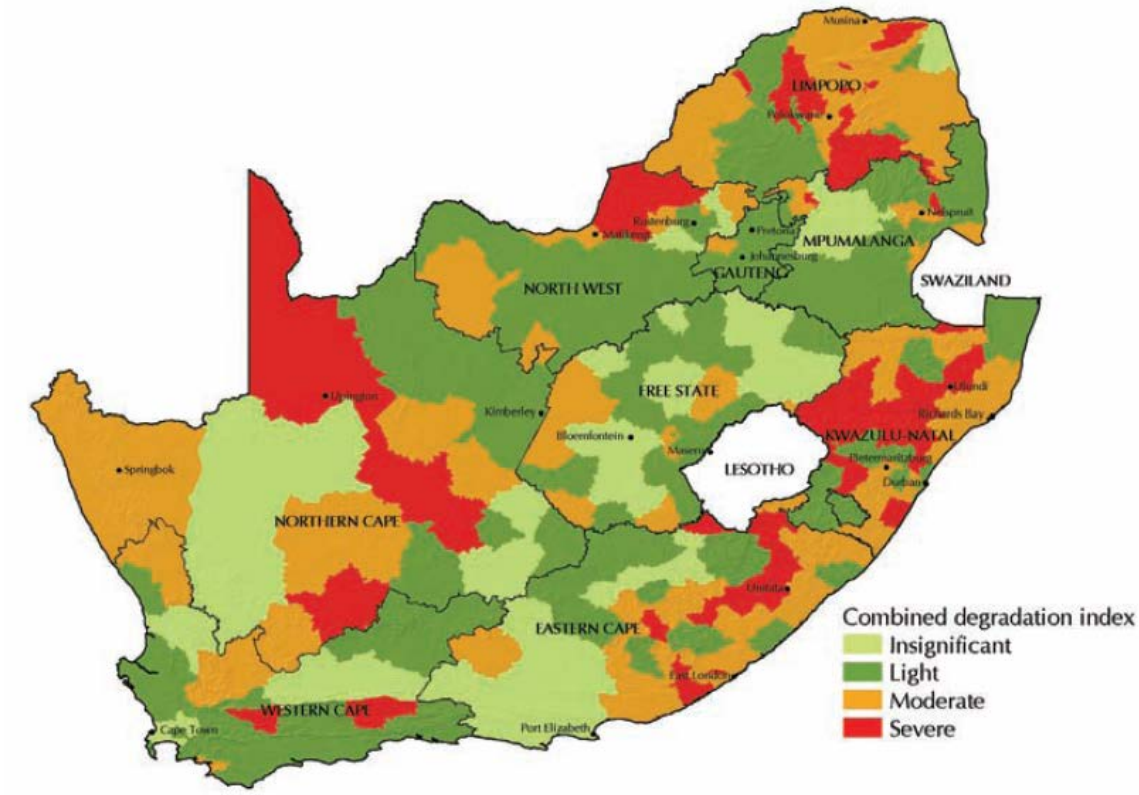


srk consulting	**ADM Disaster Risk Assessment** Distribution of land degradation based on Combined Degradation Index	Project No. 481363

Figure 7-10: Distribution of land degradation based on Combined Degradation Index[6].

Based on

[6]DEAT, 2006



srk consulting	**ADM Disaster Risk Assessment** Distribution of land degradation based on Combined Degradation Index	Project No. 481363

Figure 7-10, it would appear as if the ADM is located in an area classified as having a moderate to severe degradation index.

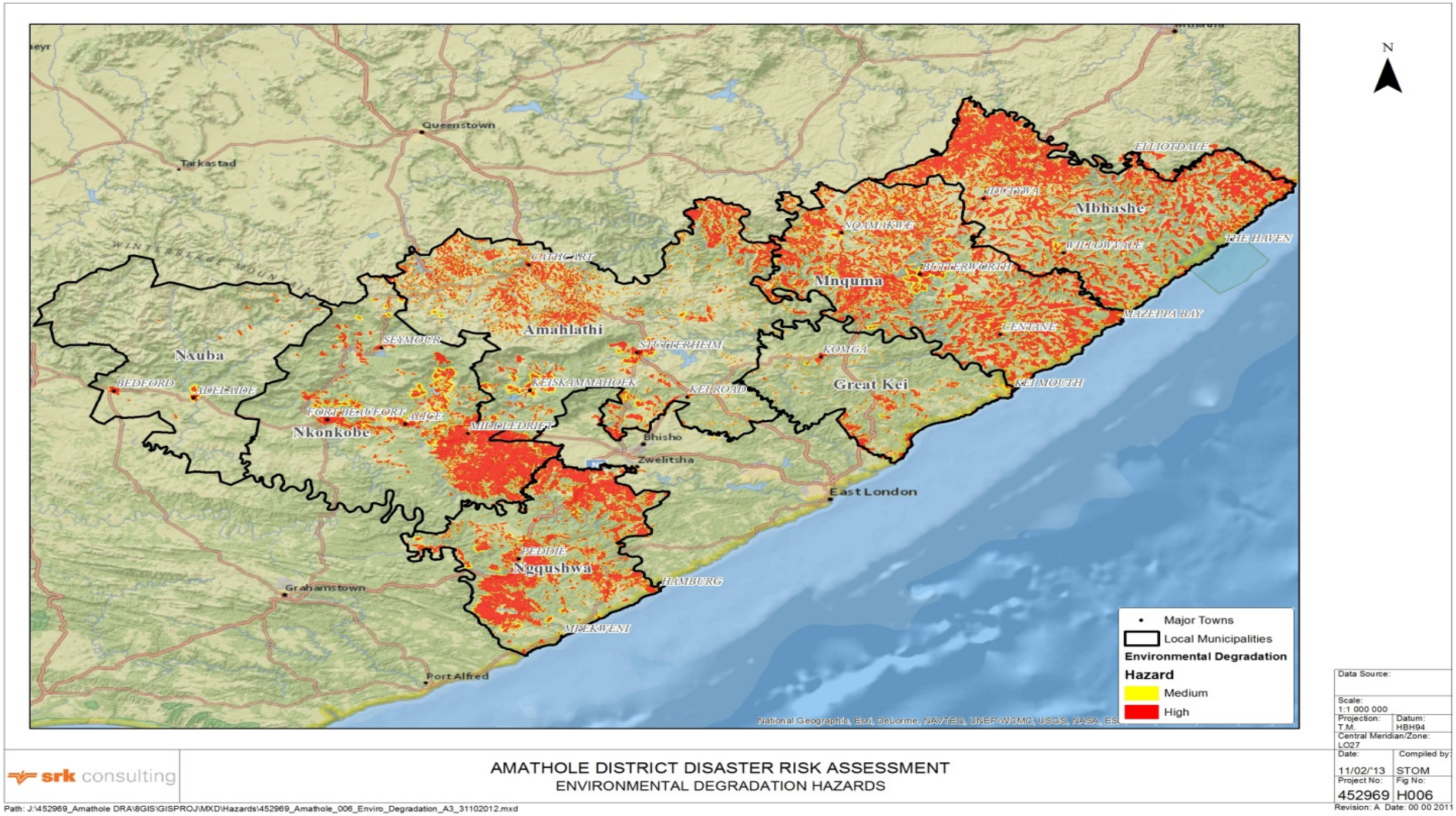


Figure 7-11: Environmental Degradation Hazard

Figure 7-11 represents the environmental degradation hazard for the various local municipalities in the ADM.

7.7 Disease / Health - Disease: Animal

The large amount of farming and the prevalence of subsistence farming highlight the fact that high level of vulnerability to animal diseases exist within ADM.

An overview of animal disease outbreaks reported with NDMC and the result of the GIS based animal disease hazard mapping is shown in Figure 7-12.

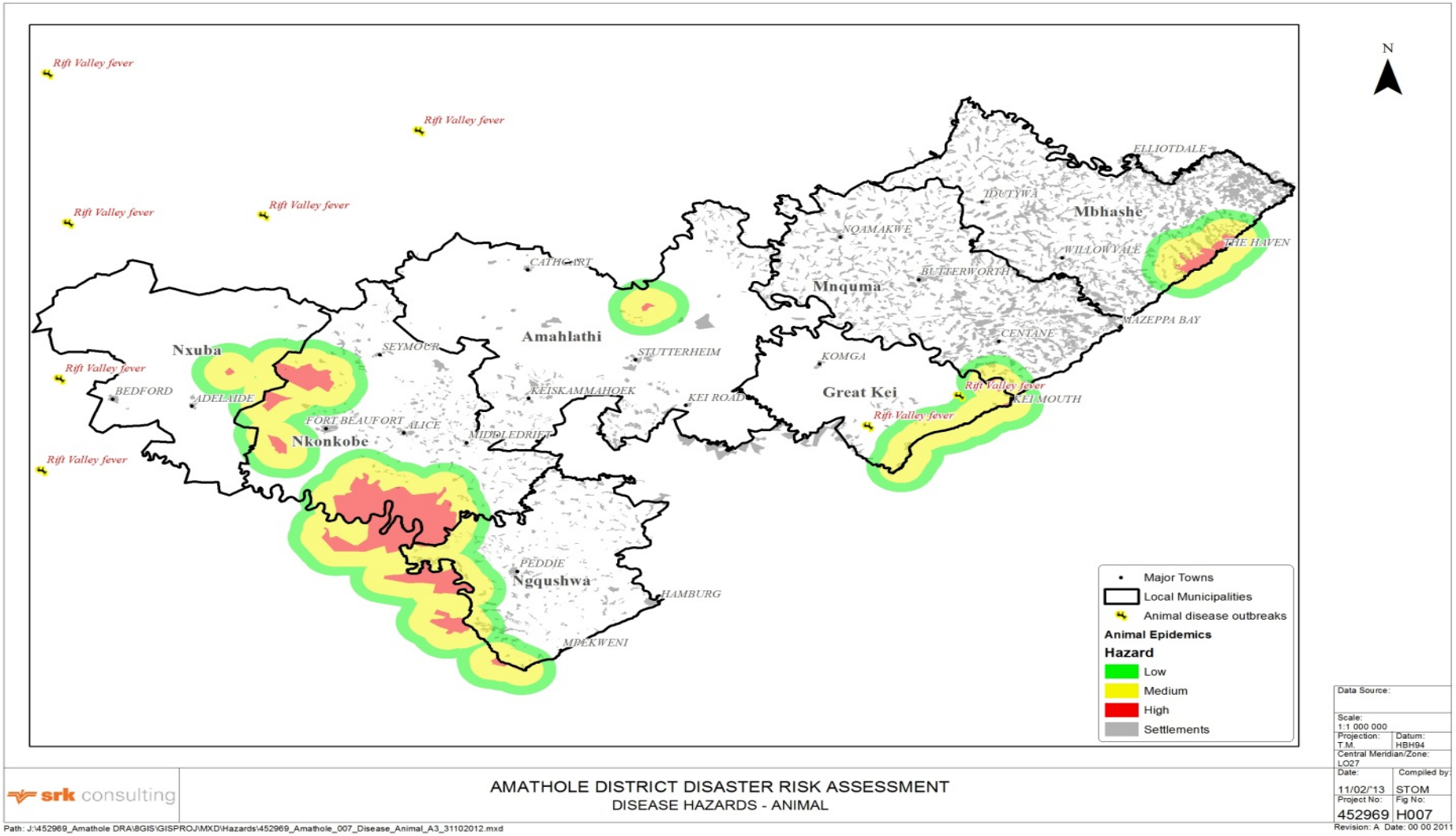


Figure 7-12: Animal Disease Outbreaks and Animal disease hazard

7.7.1 Foot-and-mouth disease

Foot-and-mouth disease or hoof-and-mouth disease is an infectious and sometimes fatal viral disease that affects cloven-hoofed animals, including domestic and wild game. The virus causes a high fever for two or three days, followed by blisters inside the mouth and on the feet that may rupture and cause lameness (Wikipedia, 2013).

The foot-and-mouth disease virus can be transmitted in a number of ways, including close-contact animal-to-animal spread, long-distance aerosol spread and fomites, or inanimate objects, typically fodder and motor vehicles. Control measures include quarantine and destruction of infected livestock, and export bans for meat and other animal products to countries not infected with the disease (Wikipedia, 2013).

7.7.2 Classical swine fever

Classical swine fever is a highly contagious disease of pigs and wild boar. Swine fever causes fever, skin lesions, convulsions and usually (particularly in young animals) death within 15 days.

7.7.3 Rift Valley fever

Rift Valley fever is a virus that primarily affects domestic livestock, but it can be passed to humans. It is spread by bite of infected mosquitoes. About 1% of the human sufferers of this disease die (Wikipedia, 2013). There is a preventative vaccination for Rift Valley Fever.

In April 2010, the Ministry of Health South Africa had reported 87 human cases infected with Rift Valley fever, including two deaths in Free State, Eastern Cape and Northern Cape provinces. Most of these cases reported direct contact with infected livestock and or were linked to farms with confirmed animal cases of Rift Valley Fever. The human cases are: farmers, veterinarians and farm workers. All cases were confirmed with Rift Valley Fever test conducted at the National Institute of Communicable Diseases (NICD) in Johannesburg, South Africa (Wikipedia, 2013).

An on-going outbreak of Rift Valley fever virus (RVFV) infection is affecting sheep, goats, cattle and wildlife on farms within Free State, Eastern Cape, Northern Cape, Western Cape, Mpumalanga, North West, and Gauteng provinces. As of 29 March 2010, about 78 farms reported laboratory-confirmed animal cases, with extensive livestock deaths.

Outbreak investigations by the Department of Health and the Department of Agriculture, Forestry and Fisheries are on-going, and are being supported by the South African Field Epidemiology and Training Programme and NICD. The Department of Health and the Department of Agriculture are taking measures to enhance disease surveillance among cattle and in managing the control of disease outbreaks.

7.7.4 Avian Influenza

Avian influenza, known informally as avian flu or bird flu — refers to "influenza caused by viruses adapted to birds. Most human contractions of the avian flu are a result of either handling dead infected birds or from contact with infected fluids. While most wild birds mainly have only a mild form of the H5N1 strain, once domesticated birds such as chickens or turkeys are infected, it could become much more deadly because the birds are often within close contact of one another.

7.8 Disease / Health - Disease: Human

The estimated overall HIV prevalence rate is approximately 10, 6%. The total number of people living with HIV is estimated at approximately 5, 38 million in 2011. An estimated 16, 6% of the adult population aged 15–49 years is HIV positive (Statistics South Africa, 2012).

However, the burden of disease also includes other diseases. Several notable diseases in South Africa have strong environmental links. Hepatitis and cholera are most often transmitted through contaminated water, whereas typhoid fever is often associated with lack of clean water supply and sanitation facilities, unplanned urbanization, and increased movement of migrant workers (DEAT, 2006). The large dependency on water sources such as rivers and streams notably influences the vulnerability to water borne diseases in ADM.

According to the DEAT (2006), Statistics South Africa figures show that tuberculosis (TB) was the most dominant contributor to the growth in mortality between 1997 and 2002. Commonly referred to as a 'disease of poverty', TB has the highest prevalence among South Africa's poor. Between 1997 and 2001, TB contributed to 8% of deaths and was identified as one of the five leading underlying causes of death among South Africans. A total of 224 420 cases of TB were registered during 2002, representing an increase of 16% from 2001 and an incidence of 494 cases per 100 000 people (DEAT, 2006).

South Africa is burdened by one of the worst TB epidemics in the world. The human immunodeficiency virus (HIV) is one of the most important factors responsible for exacerbating the TB epidemic. The estimated percentage of people infected with TB who are also HIV-positive is estimated to be around 53%. A serious challenge in the fight against TB is the emergence of the multi-drug resistant TB (MDR-TB) and the extremely drug resistant TB (XDR-TB) strains (DoH, 2008).

As in any other region of South Africa, the poor experience above normal rates of infectious disease. Malnutrition lowers the body's resistance to illness and illness aggravates malnutrition. Inadequate services and shelter or housing also creates conditions that promote disease. Without decent protection, many of the poor are exposed to severe and dangerous weather as well as to bacteria and viruses carried by other people and animals (Colgan, 2002).

The pattern of disease differs dramatically between First and Third World countries. The major killers in the First World are cancer (15%) and circulatory diseases (32%), whereas in the Third World cancer accounts for (4%) and circulatory diseases (15%). The big killers in the poor countries are infectious, parasitic and respiratory diseases, often worsened by the effects of malnutrition and the HIV/Aids epidemic. These diseases cause forty four percent (44%) of deaths in the Third World compared to eleven percent (11%) in the First World (Harrison, 1993; Colgan, 2002).

Disease also has major economic implications through the costs of caring for the ill, ill people not being able to go to work, and the loss of breadwinners in many families. A family's well-being is strongly linked with the physical health of its members so when an economically active family-member becomes ill or disabled, the entire family faces an economic as well as a physical burden.

The GIS human disease and health hazard map for the ADM are shown below:

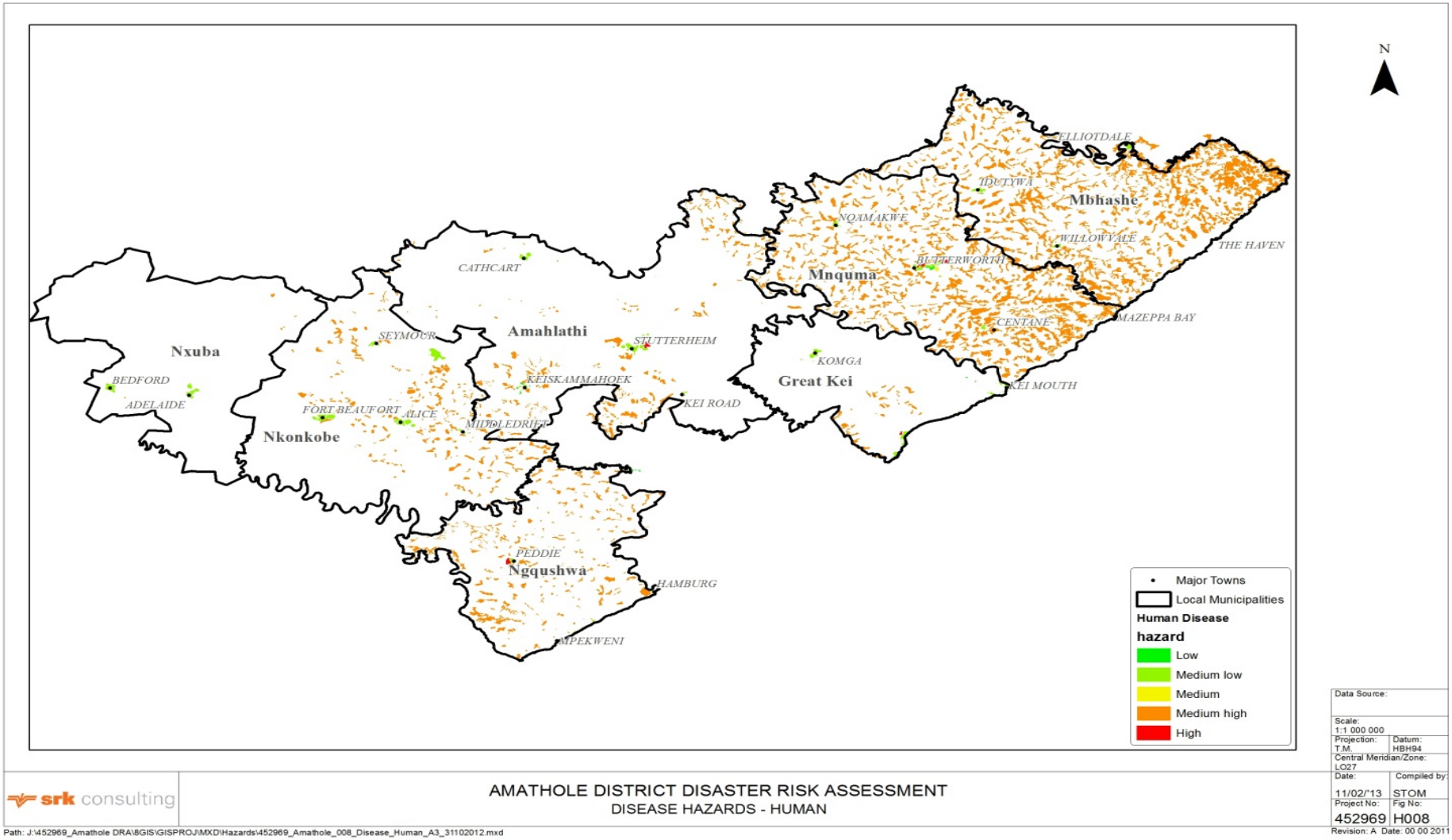


Figure 7-13: Human Disease Hazard

Figure 7-13 identifies areas where high concentration of people can be found, as a relatively higher hazard associated with human disease as in areas where fewer people are located.

7.9 Fire Hazards

Fire hazards are considered a risk for both urban and developed areas as well as rural and undeveloped areas. Fire can be considered both a naturally occurring hazard, caused by lighting or other natural processes, and also a man-made hazard. For the purpose of this disaster risk assessment, fire hazards were divided into the following two categories:

- Formal & Informal Settlement and Urban Fires; and
- Veld and Forest Fires.

7.9.1 Veld, Forest Fires and Wild Fire

Much of sub-Saharan Africa is susceptible to fires, which destroy pastures, crops, buildings, and infrastructure. Even though natural fires can be ignited by lightning, human beings are mostly responsible for veld fires (ICSU, 2007).

The large area affected by fires has implications for short-term productivity and long-term land degradation processes, which eventually contribute to famine during drought periods. Combined with intense drought, these fires destroy biodiversity and reduce the regeneration capacity of the vegetation. Although fires cause few deaths, valuable resources are lost, thereby contributing to poverty. Pasture is destroyed, and animals have to be moved or funds allocated to purchase their feed. According to the Air Pollution Information Network Africa (APINA), fires also affect air quality and generate greenhouse gases. In addition, they can affect hydrological processes such as run-off and may lead to soil erosion (ICSU, 2007).

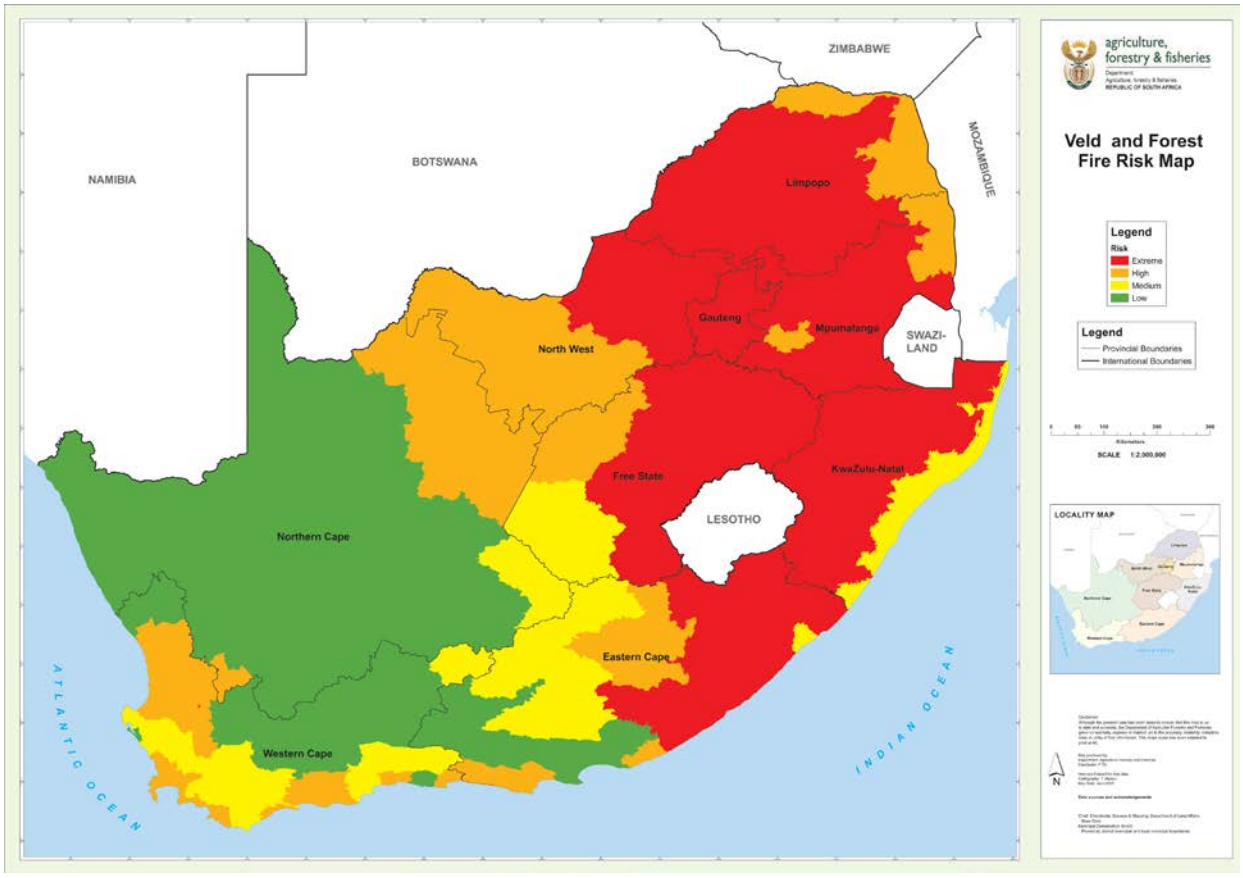
The risk associated with veldfires in South Africa is substantial, and veldfires cause severe losses to life, property and the environment in most areas of the country. However, this risk has two parts: first, that arising from wildfires (i.e. unwanted veldfires) that cause damage to assets, and, second, the risk arising from ecologically inappropriate fire regimes in environments where fire plays an ecological role. As in most countries with wildfires, the risk can be managed to acceptable levels at acceptable cost, provided a comprehensive approach, based on integrated natural resource management within a proper development planning and management framework, is adopted and applied consistently (Kruger, *et al.,* 2006).

Kruger, et al., (2006) compiled a risk classification, in order to classify vegetation types and categorize each metropolitan and local municipality in South Africa according to classes of wildfire risk. It also deals with the environmental risk associated with inappropriate fire regimes. *"These two dimensions of risk need to be examined together, since experience in South Africa and elsewhere have shown that managing the two dimensions separately leads inevitably to long-term environmental and resource degradation, rising costs of wildfire suppression and intractable problems in maintaining a safe environment." (*Kruger*, et al.,* 2006).

The term 'wildfire risk' was used as the standard sense, i.e. it is the chance of a fire igniting, spreading and causing damage to one or more assets, measured in terms of likelihood and consequence to the assets.

The risk classification was based in the first place on information on the prevailing natural vegetation in any part of the country. For each vegetation type, the likelihood of wildfires occurring in that vegetation was established, and the consequences that arise in modern times when such wildfires occur. This combination of likelihood and consequence allows the risk to be rated. Then, using the

spatial distribution of vegetation types, a risk class was assigned to each metropolitan and local municipality.



srk consulting	**ADM Disaster Risk Assessment** Provinces classified according to levels of veld fire risk	Project No. 481363

Figure 7-14: Provinces classified according to levels of veld fire risk (CSIR, 2010)

Based on this assessment, the ADM is located in an area classified as being at extreme risk to veldfires. Representatives from the ADM also provided information with regard to veld fire hazards. Information collected from the individuals is shown in Figure 7-15

Veld fires are not the only form of fire that can pose a risk to the ADM, but formal and informal settlement and urban fires can also pose a serious risk to the ADM.

7.9.2 Formal & Informal Settlements / Urban Fires

Informal settlements often do not comply with local requirements for conventional (formal) townships and are consequently areas of increasingly high risk with regard to fire. This is also due to the following general characteristics of informal settlements (CM, s.a.):

- Informal settlements often have inadequate infrastructure;
- The informal settlement and surrounding environment is often considered unsuitable;
- Informal settlement are often characterised by population densities that are uncontrolled and unhealthy high;
- There is often poor access to health and educational facilities as well as employment opportunities in informal settlements;
- Informal settlement often have a lack of effective governance and management; and

- Individual dwellings within informal settlements are often considered inadequate.

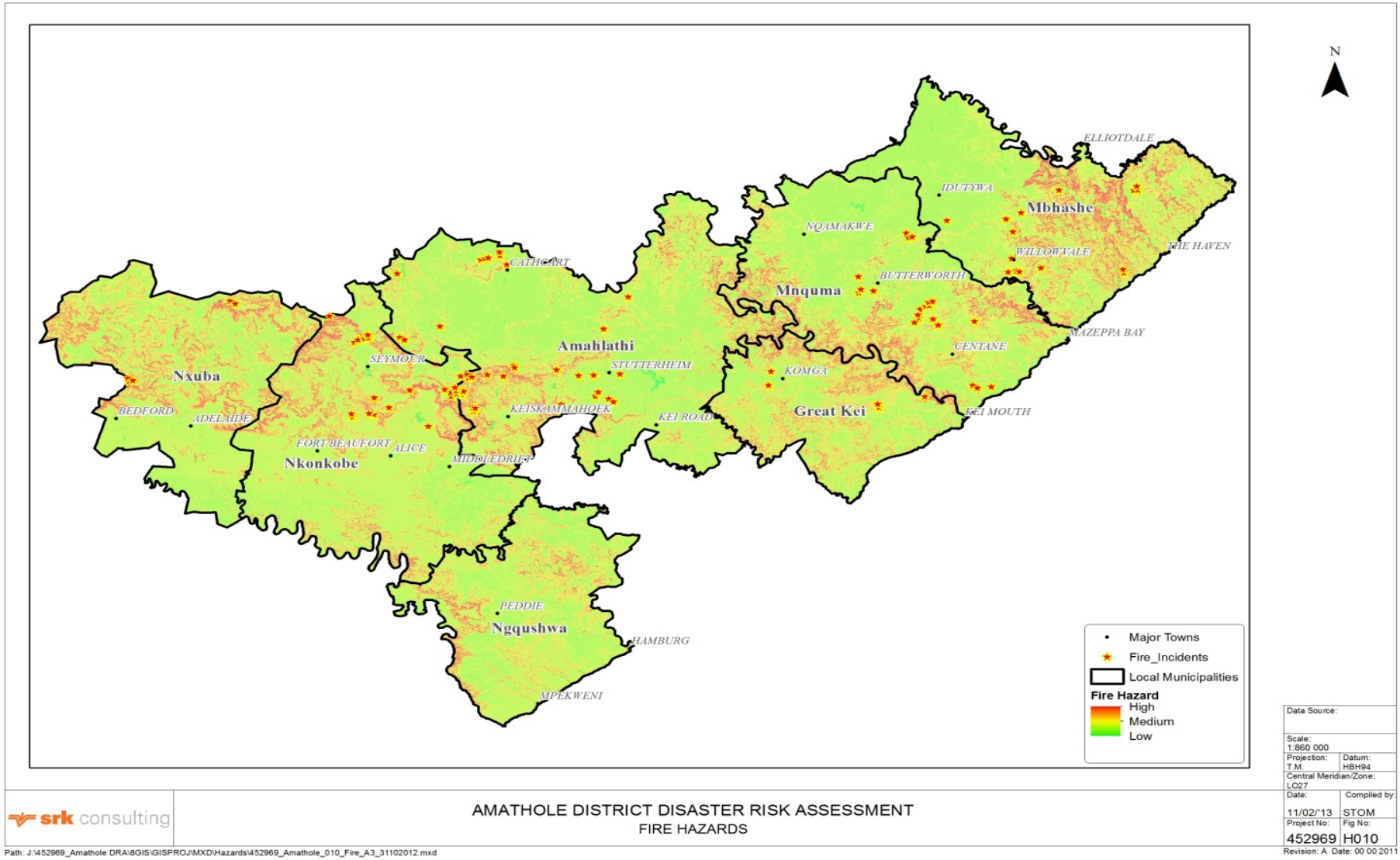


Figure 7-15: Fire Hazard map for ADM and fire related incidents reported to the NDMC

The Fire hazard modelling for the ADM was based on the land-use/land-cover map of the ADM. The various land-use categories were classified in terms of fire related factors, such as the perceived burn load, ignition factors and control measures. Higher loads and ease of ignition would increase fire hazard while control or manageability measures would decrease the hazard rating.

For example areas of natural grassland and irrigated areas might have similar fuel loads, but it can be assumed that the irrigated areas would be less likely to ignite as they are regularly watered and also more manageable due to the supporting infrastructure in place. Therefore irrigated areas would receive a lower hazard rating than grassland.

7.10 Floods (River, Urban & Dam Failure)

Also see Section 7.12 for more information on the Hydro-meteorological hazards in the ADM. This section also contains additional information on flooding in the ADM.

Floods are among the most devastating natural hazards in Africa, whereas flash floods are among the greatest hazards arising from tropical cyclones and severe storms. Floods and flash floods cause loss of life, damage to property, and promote the spread of diseases such as cholera. From 1900 to 2006, floods in Africa killed nearly 20 000 people, affected nearly 40 million more, and caused damage estimated at about US$4 billion (ICSU, 2007). While the primary cause of flooding is abnormally high rainfall, there are many human-induced contributory causes such as:

- land degradation;
- deforestation of catchment areas;
- increased population density along riverbanks;
- poor land use planning, zoning, and control of flood plain development;
- inadequate drainage, particularly in cities; and
- inadequate management of discharges from river reservoirs (ICSU, 2007).

Flooding can also be caused by the failure of dams, both constructed and natural.

7.10.1 River & Urban Flooding

A flood is generally a normal event for any river or stream that could occur over a period of time varying from several times a year to once every few hundred years. Floods are caused when excess water from heavy rainfall, snowmelt or storm surge accumulates and overflows the river or stream's normal path onto its banks and adjacent floodplains (Miller, 1997).

Several factors determine the severity of floods, including rainfall intensity and duration. A large amount of rainfall in a short time span can cause flash flooding. A small amount of rain can also cause flooding if the soil is saturated from a previous wet period, or if the rain is concentrated in areas where the surface is impermeable, such as in developed areas where most of the surface is covered with concrete, tar and other building materials (Federal Emergency Management Agency, 1997).

Topography and groundcover are also contributing factors for floods. Water runoff is higher in areas with a steep slope and low vegetation density. Urbanization of floodplains and manipulation of stream channels have increased both the frequency and magnitude of floods in many areas. Floods are most common in the season of highest precipitation (Miller, 1997).

7.10.2 Dam Failure Flooding

Dam failures are comparatively rare, but can cause immense damage and loss of life when they occur. More information on dams can be seen under section 7.18 Structural Failure. Figure 7-16 represents the results of the flood hazard mapping for the ADM.

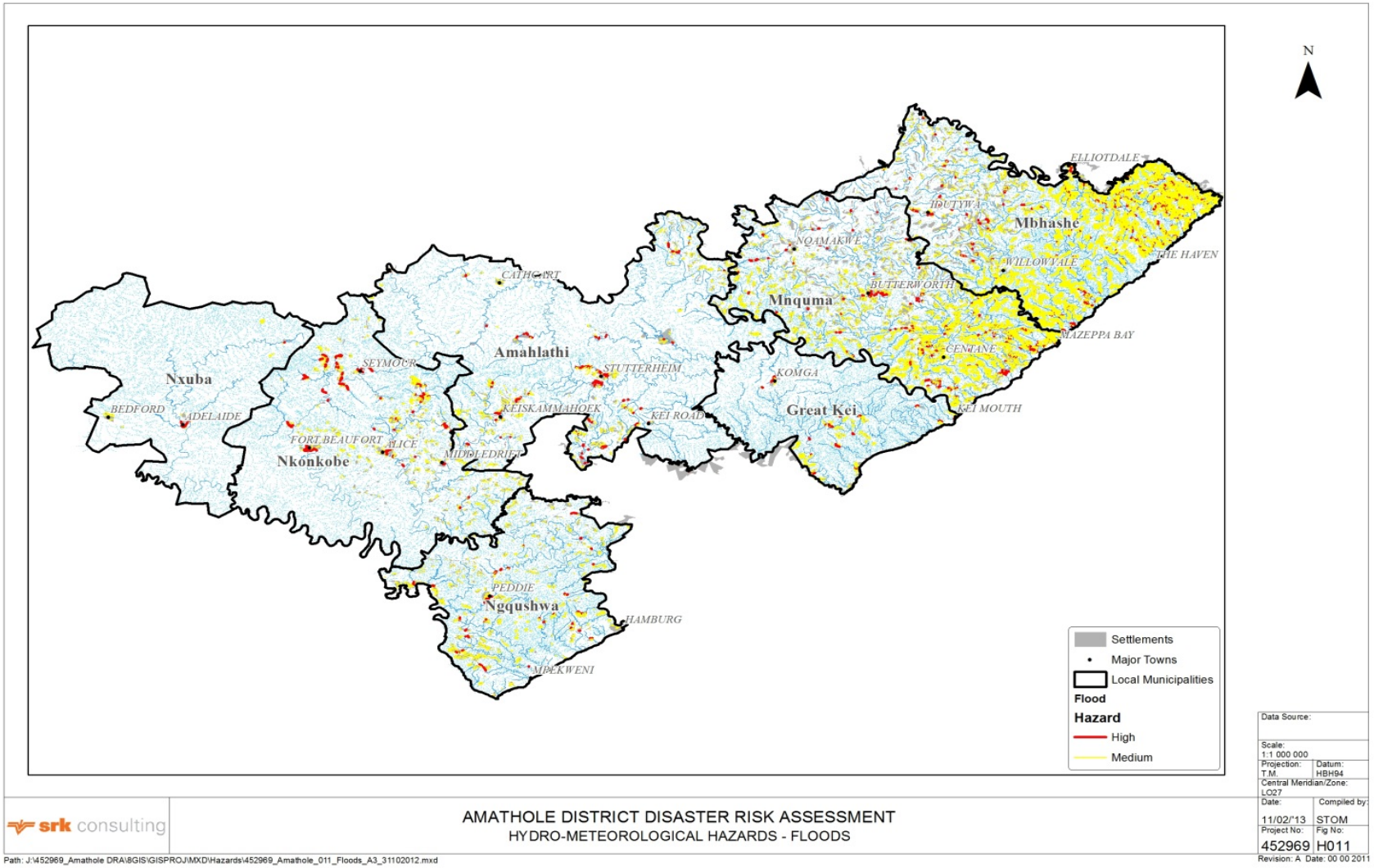


Figure 7-16: Flood Hazard

7.11 Geological Hazards

Disasters due to geological hazards have a far smaller impact on sub-Saharan Africa than those due to hydro-meteorological hazards (ICSU, 2007). Earthquakes account for 2%, and landslides and volcanic hazards account for 1% of the number of hazards occurring on the African continent, however, the impact of these hazards may change in future (ICSU, 2007). For the purpose of this assessment, geological hazards were divided into three categories, namely:

- Earthquakes;
- Landslides, mud flows and rock-falls; and
- Subsidence.

7.11.1 Earthquake

ICSU (2007) describes the risk of earthquakes in the southern African region as follows:

"Sub-Saharan Africa is largely a stable intra-plate region characterized by relatively low levels of seismic activity, with earthquakes randomly distributed in space and time. The only parts of sub-Saharan Africa that do not display the characteristics of an intra-plate region are the East African Rift System and the Cameroon Volcanic Line, where earthquakes are associated with active fault zones and volcanic activity.

Earthquakes also occur occasionally in the Cape Fold Belt in South Africa. In this region, the most destructive recorded earthquake was a M6.3 event that took place on 29 September 1969 in the Ceres–Tulbagh region of the Western Cape, which killed 12 people. Aftershock activity had virtually ceased when a M5.7 event occurred on 14 April 1970, causing further damage in the towns of Ceres and Wolseley.

The impoundment of reservoirs has also been known to trigger earthquakes. Seismicity has been associated with the Gariep Dam in South Africa and the Katse Dam in Lesotho. Mining-related earthquakes pose a significant hazard to mineworkers in the gold and platinum mining districts of South Africa. Thousands of mineworkers have perished during the last century as a result of rock bursting. No member of the public has suffered fatal or even serious injuries due to mining-related earthquakes, although some events have damaged surface structures. The M5.3 event on 9 March 2005 near Stilfontein (South Africa), for example, caused serious damage to schools, commercial properties, apartment blocks, the civic centre, and 25 houses.

However, African research institutions have limited capability to mitigate and respond to earthquake hazards and disasters. Currently, no earthquake warning system in the region comes close to the required level of reliability. A sustainable earthquake disaster mitigation strategy requires the compilation of base maps of known faults, as well as efforts to detect possible unknown faults. It is also necessary to build interactive databases of high-risk areas and integrate them with population distribution, seismic history, and vulnerability to hazards and disasters" (ICSU, 2007).

South Africa as a whole does not normally get large tremors except in the Witwatersrand where they result from mining activities (Markman, 2010Landslides/Mud flows/Rock-fall and Subsidence

Mass movements, which include a range of natural phenomena such as landslides, mudflows, erosion, and siltation, are affected by rock and soil types, rainfall patterns, topography, and vegetation. Human factors that contribute to mass movements include overpopulation, deforestation, and poor land management practices. Landslides and mudflows can cause considerable loss of life, and damage to croplands and infrastructure such as highways, railways, and pipelines (ICSU, 2007).

7.12 Hydro-meteorological Hazards

According to the World Meteorological Organization, ninety percent (90%) of all natural disasters worldwide are related to weather, climate and water (Sampson, 2007).

In sub-Saharan Africa, hydro-meteorological events account for most of the disasters, and they impact on nearly every country. They include floods, tropical cyclones, storm wave surges, droughts, extremely high temperatures (global warming), wildfires, sand or dust storms, and landslides and avalanches. According to ICSU (2007) in the period 1975–2002, disasters of hydro-meteorological origin constituted 59% of the total number of natural disasters that occurred in sub-Saharan, with floods accounting for 27%, droughts for 21%, windstorms (particularly tropical cyclones) for 9%, and wildfires for 1%. An alarming trend is the increasing number of people affected by natural hazards of hydro-meteorological origin, with drought, flooding, and windstorms accounting for 90% of the total number of people affected. Global climate change will continue to alter the risk associated with hydro-meteorological hazards (ICSU, 2007).

7.12.1 Drought

Future projections show a net overall global drying trend, and the proportion of the land surface affected by extreme drought is predicted to increase from 1% at present to 30% by the end of the 21st century. The drying trend is related to anthropogenic emissions of greenhouse gasses and sulphate aerosols into the atmosphere (Burke *et al.*, 2006). Although droughts under current climate conditions affect many parts of the globe, they are a particular concern in sub-Saharan Africa. A large part of sub-Saharan Africa is susceptible to drought. In southern Africa, severe droughts (such as those of 1982–1983 and 1997–1998) have been linked to the El Niño–Southern Oscillation (ENSO) phenomenon. Nearly all climate change projections signal greater chances of severe droughts over southern Africa, particularly in the central and western areas (IPCC, 2001; Scholes & Biggs, 2004 in ICSU, 2007). According to ICSU (2007) the most serious result of drought is famine. Drought and famine are not sudden events but rather the end result of long-term degradation of the environment due to poor land use and irrational exploitation of natural resources.

According to Sampson (2007) in a South African context, the concept of drought is not easily defined. The South African Weather Service defines drought on the basis of the degree of dryness in comparison to “normal” or average amounts of rainfall for a particular area or place and the duration of the dry period. This is what is termed a meteorological drought. The common practice to date has been to use the percentage of normal rainfall as an indicator of drought. Less than 75% of normal rainfall is regarded as a severe meteorological drought but a shortfall of 80% of normal will cause crop and water shortages, which will ultimately affect social and economic factors. Normal rainfall for a particular place is calculated using rainfall figures for at least 30 years. Other climatic factors such as high temperature, high wind, low soil moisture and low relative humidity can significantly aggravate the severity of drought conditions and these should also be taken into account. Assessing the severity of a drought period and the magnitude of the impact based purely on the definition of a “percentage of normal rainfall” is extremely difficult and so it has become necessary to look at introducing other “drought indices” to assist decision-makers (Sampson, 2007).

According to Mortimer (1998) drought can be defined in several different ways. Drought always implies a reduction in rainfall, but this reduction can have variable impacts depending on the length of the drought and the deviation from the expected or average rainfall of an area. Drought can therefore have several different definitions:

- **Meteorological drought** is usually identified when there is a reduction in the expected or average rainfall of an area.
- **Hydrological drought** implies a deficiency in ground and surface water conditions, often linked only indirectly to rainfall because of interregional water transfers by rivers or pipelines or storage in dams or reservoirs.

- **Agricultural drought** is a deficiency defined in relation to a particular crop and its requirements. For example, we know how much rain is needed to produce a certain amount of a specific crop type and any rainfall less than that expected or outside the specific crop's growing season, would lead to a drop in production.
- **Ecological drought** is a situation in which the rainfall is insufficient to support normal growth of the natural vegetation (Mortimer, 1998).

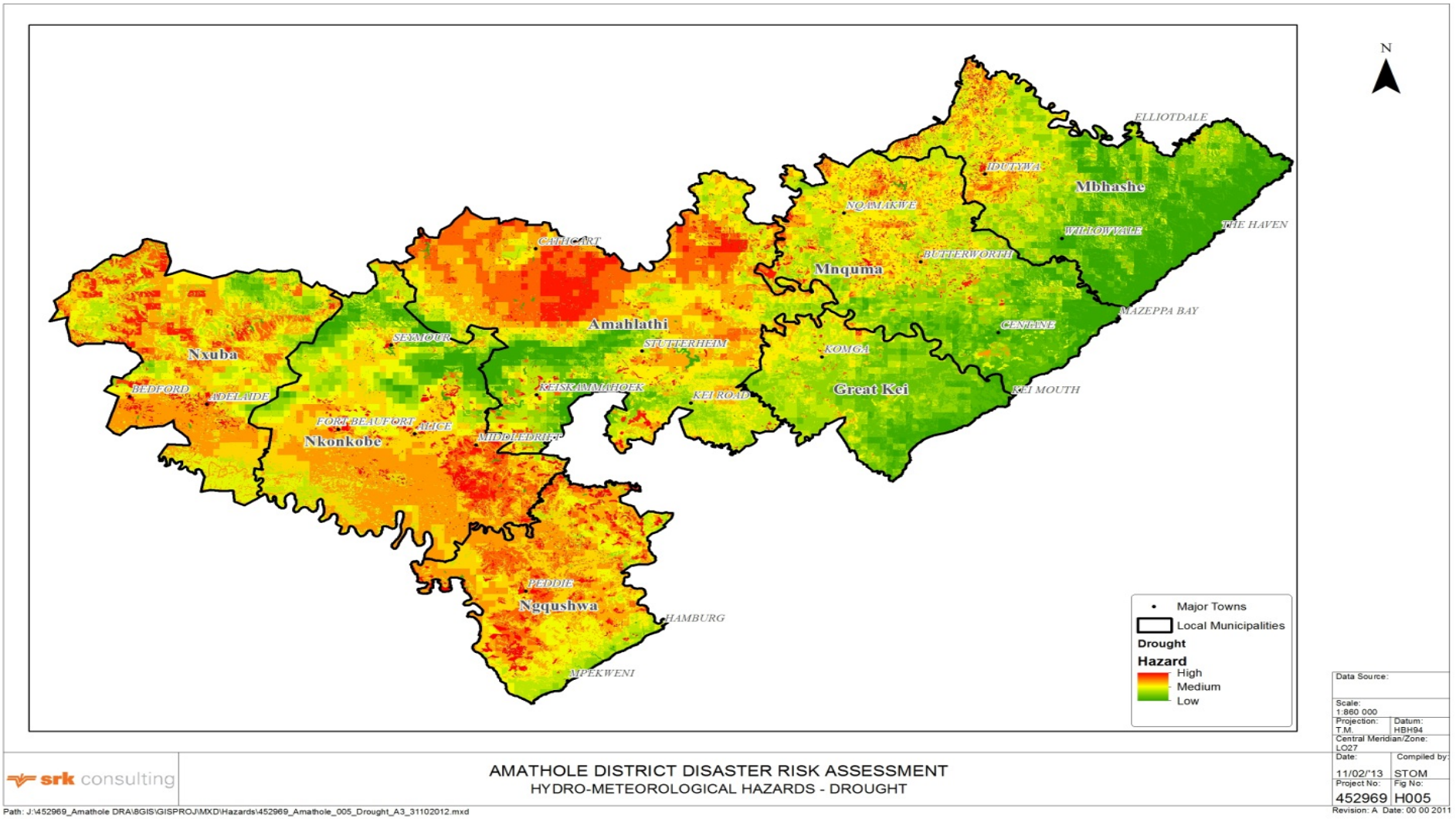


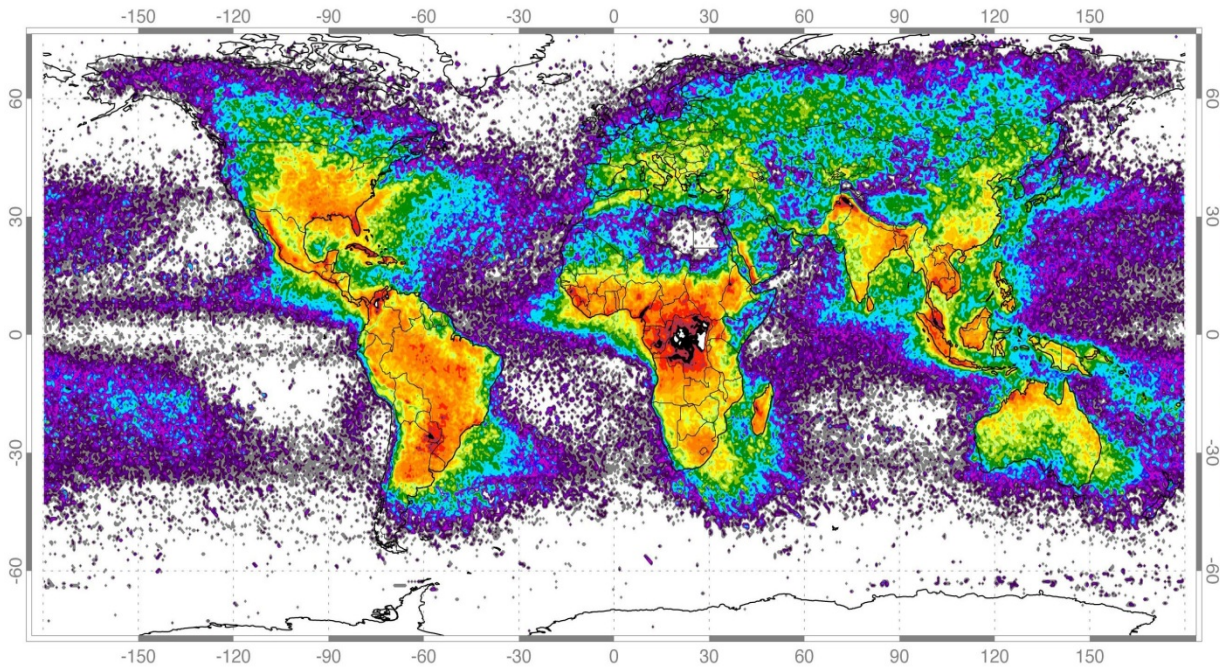
Figure 7-17: Drought hazard in ADM

A local drought disaster in ADM was declared in June 2009 and a provincial disaster was declared in September 2009. The drought also had numerous secondary effects such as erosion and economic losses. Drought also increases the vulnerability to numerous other hazards such as veldfires.

7.12.2 Severe Storms (Tornado, Wind, Hail, Lightning, Fog)

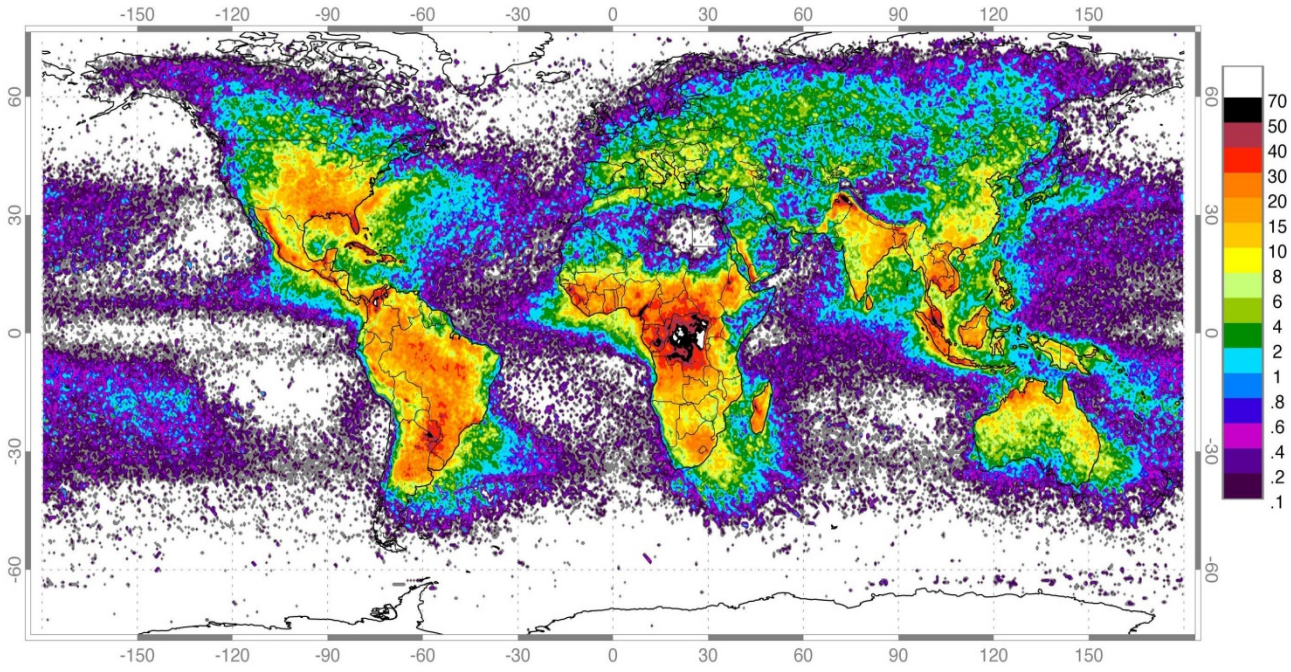
Severe storms can cause wide spread damage, destruction and loss of life. For the purpose of this assessment, severe storms will be considered to include high winds, hail, lightning and fog hazards.

The result from a previous study on lightning density is shown in



srk consulting	**ADM Disaster Risk Assessment** Annual Flash Rate (flashes / km2 / year)	Project No. 481363

Figure 7-18. The figure represents the number of flashes per square kilometre per year.



srk consulting	**ADM Disaster Risk Assessment** Annual Flash Rate (flashes / km^2 / year)	Project No. 481363

Figure 7-18: Annual Flash Rate (flashes / km^2 / year)[7]

The result from another study on lightning strikes is shown in Figure 7-19 below.

[7] April 1995 – February 2003. Courtesy of NASA's Lightning Imaging Sensor (LIS) Instrument Team and the Global Hydrology Resource Center (GHRC). Retrieved from http://thunder.nsstc.nasa.gov/images/HRFC_AnnualFlashRate_cap.jpg [October 18, 2011]

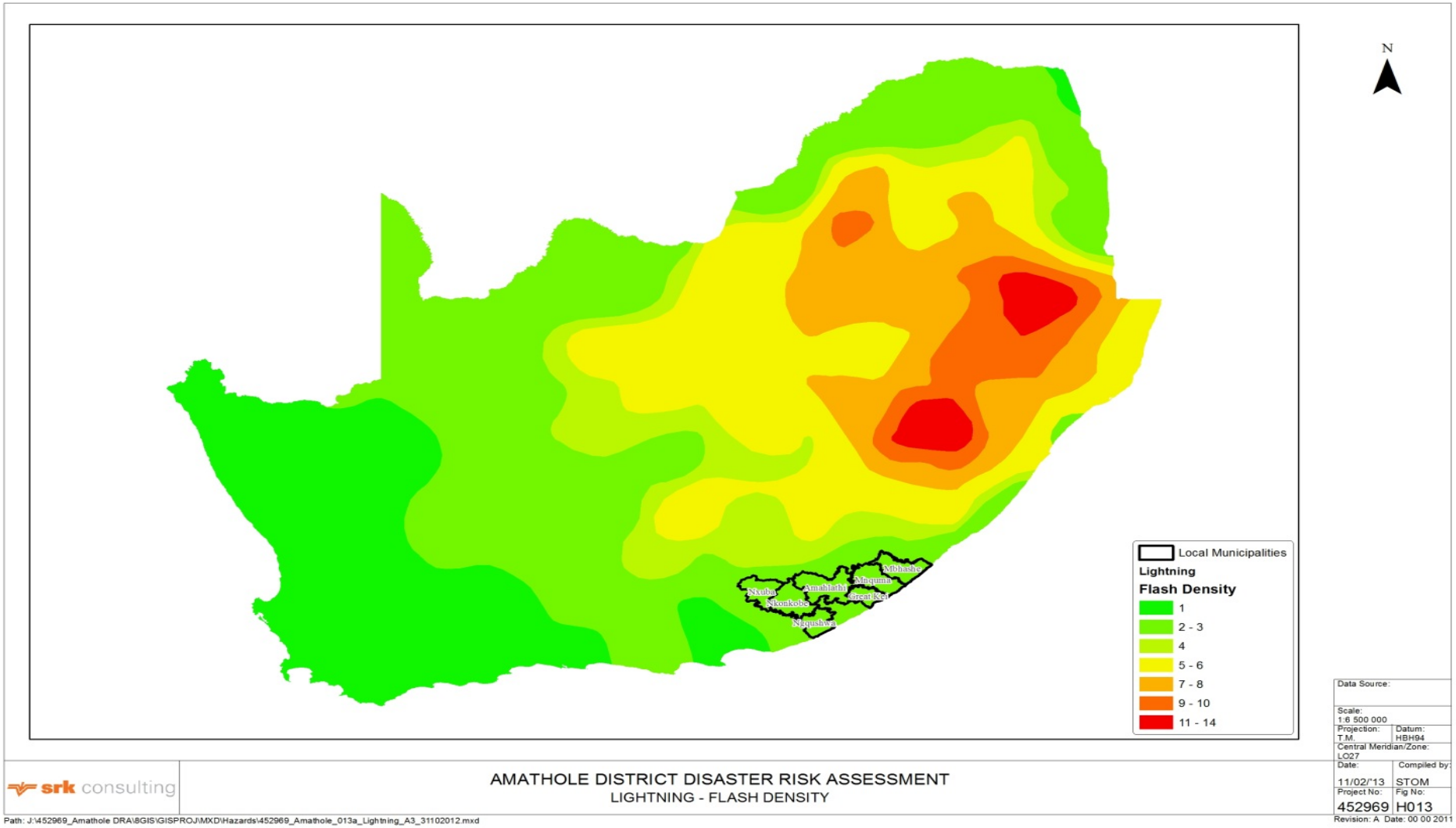
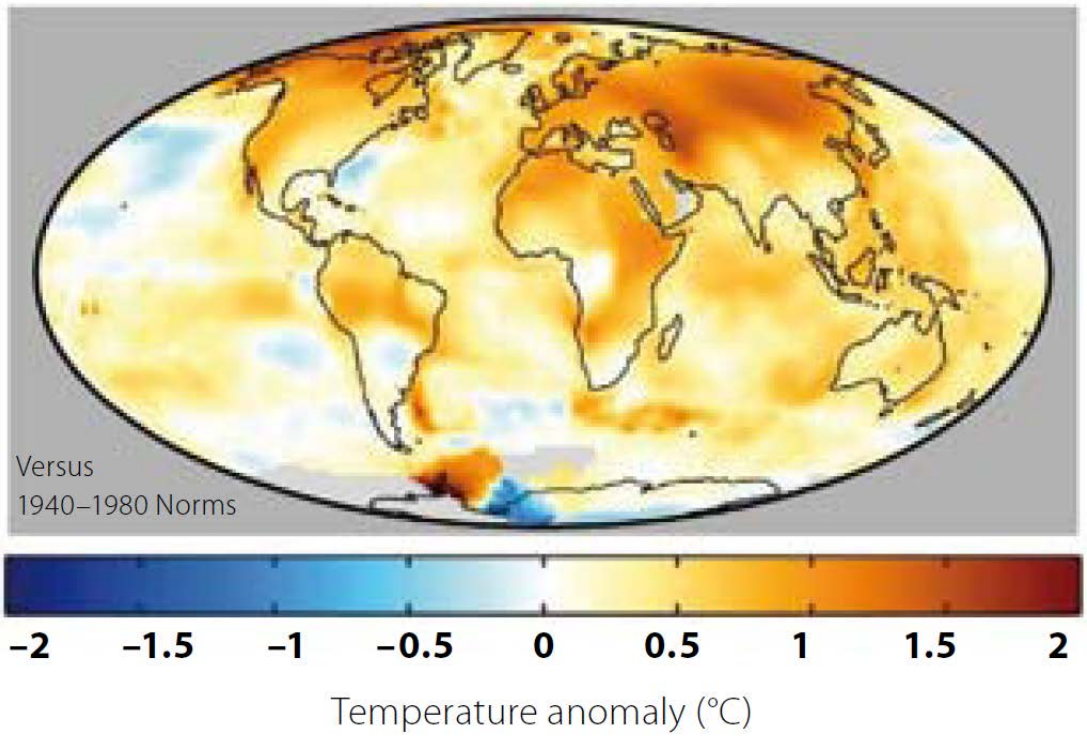


Figure 7-19: Density of Lightning strikes in South Africa

The above figure indicates that the ADM is located in an area with a relatively low in lightning density. This figure only represents the density of lightning strikes, and not the average vulnerability of communities to the lightning strikes.

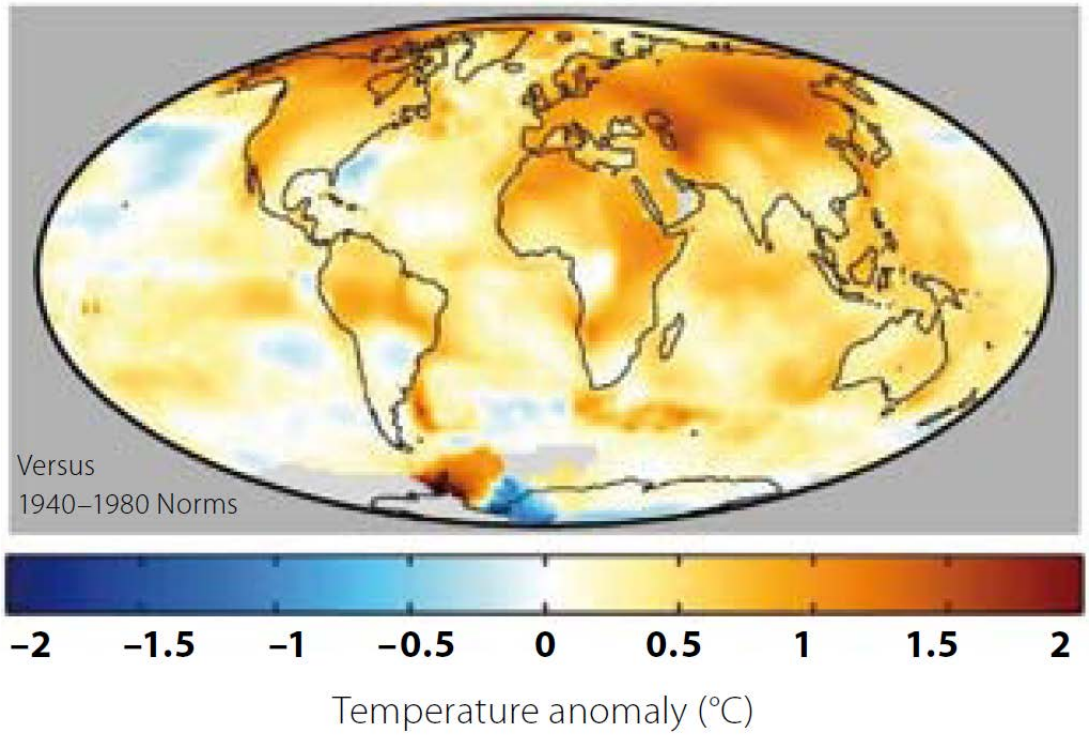
7.12.3 Extreme Temperatures

Extreme temperature hazards include an extreme increase or decrease in temperature which can cause disruption to communities. Extreme temperature hazards not only impact on the health and well-being of humans, especially vulnerable groups, but also cause damage to infrastructure (ICSU, 2007). As shown



srk consulting	**ADM Disaster Risk Assessment** Global Mean Temperature Anomaly	Project No. 481363

Figure 7-20, studies on climate change reveal that Africa, like the rest of the world, became warmer during the past century, and temperatures are expected to continue rising in the future. Extreme events such as heat waves are predicted to be among the hazards that will be associated with climate change (Diaz *et al.*, 2004 in ICSU, 2007).



srk consulting	**ADM Disaster Risk Assessment** Global Mean Temperature Anomaly	Project No. 481363

Figure 7-20: Global Mean Temperature Anomaly (1995 – 2004)[8]

Climate change studies focusing on heat wave trends in Africa are lacking. However, indications for other parts of the world such as North America and Europe are that global warming will lead to more intense, frequent, and longer lasting heat waves during the 21st century (Meehl & Tebaldi, 2004 in ICSU, 2007). The problem of hazards such as heat waves in Africa will be exacerbated by changes in lifestyle linked to urbanization and general lack of preparedness for such events (ICSU, 2007).

7.13 Hazardous Material (Spill / Release / Fire / Explosion)

Hazardous material, including hazardous waste, is a major concern for authorities all over South Africa, including the ADM. Facilities such as large industries and hospitals can produce hazardous waste, which should be transported and disposed of in a safe manner. However, large industries are not the only source of hazardous material. Trucks delivering fuel to local petrol stations can also pose a hazard related to the spillage, or explosion of hazardous material. Apart from the risk to human life and health, spillage of hazardous material can also cause extensive damage to the environment.

For the purpose of this assessment, hazardous material will be considered in the context of the spillage or release as well as fires or explosion of hazardous material. These events should also be considered not only at the site or facility where the hazardous materials are manufactured, stored or utilized, but also during transportation to, and from the facilities.

[8] *IPCC (2001) in ICSU (2007)*

A substance may be considered hazardous if it is flammable, explosive, toxic, corrosive, radioactive and cryogenic, or readily decomposes to give off oxygen at elevated temperatures. There are thousands of substances that possess one or more of these qualities and can therefore be considered as hazardous. Multiple hazards can be associated with many substances and the intermixing of chemicals can further complicate the behaviour and hazardousness of a substance (Irvin and Strong, 1997).

Compressed gases are especially hazardous as they often involve multiple hazards, such as poisons, oxidizers, cryogenics and the hazard of the pressure in the storage container itself. If the container fails it could be turned into a projectile or an explosive device. Flammable liquids are slightly less hazardous than gases, but are the cause of more incidents as they are more abundant. Commonly encountered flammable liquids include: petrol, oil, diesel, paraffin, benzene, alcohols, pesticides and jet fuel (Burke, 2003).Industrial activities all over the world generate large volumes of hazardous waste and by-products that need to be stored, transported or disposed of safely (Johnson, 1999). During consultations with representatives in the ADM, hazardous material was not specifically identified as a concern in the ADM. The GIS mapping of hazardous material hazards was done by identifying main transportation routes, and location of industrial facilities. The result of the hazard mapping is shown below:

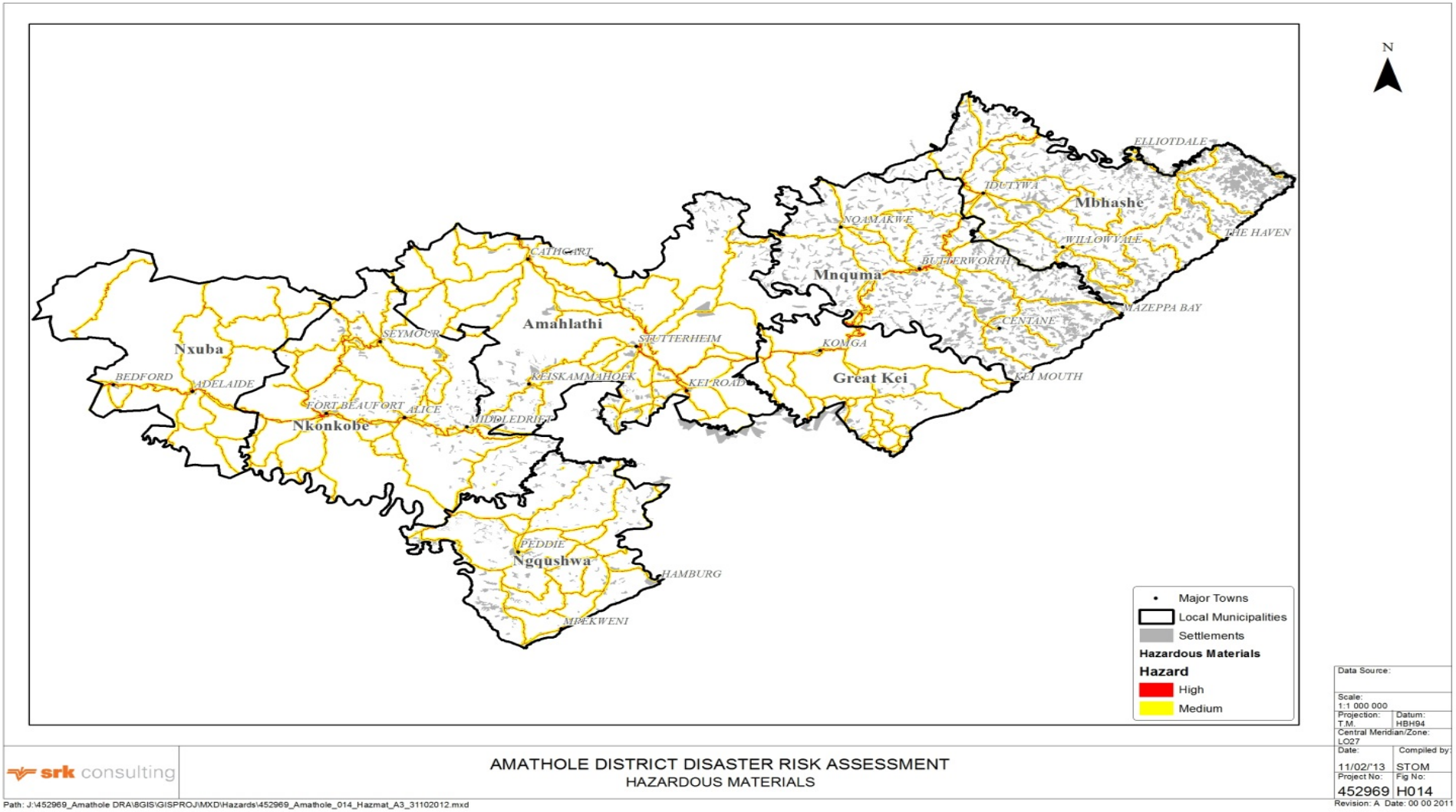


Figure 7-21: Hazardous Material hazard

It should be noted that complete information associated with pipelines transporting hazardous material through the ADM has not been received, and should be taken into account when considering the hazard levels associated with hazardous material in the ADM.

7.13.1 Methyl bromide

Is extensively used by the forestry, and the area around Keiskammahoek was indicated as an area of specific concern (Amathole District Municipality, 2013).

Methyl bromide also known as Bromomethane is a fumigant used when exporting solid wood (Wikipedia, 2013). The chemical is frequently transported on dangerous dirt roads around forestry industry in Amahlathi.

7.14 Infestations

Infestation hazards, including plant infestation (intruder plants), animal infestation, insect infestation and over population are often not considered as a traditional disaster risk, but can still cause extensive environmental damage, or serious losses to agricultural related crops. These hazards are discussed in more detail below.

7.14.1 Plant Infestations (Intruder Plants)

An 'alien' species is one that has been introduced by humans, deliberately or accidentally, into an area in which it did not previously occur. In today's globalized world, species often spread effortlessly among countries and continents. While not all alien species thrive in their new environments, some do, becoming 'invasive' by spreading at the expense of indigenous species and causing significant changes to habitats and ecosystem functioning.

One of the main reasons why alien species flourish is that they are no longer controlled by their natural predators and pathogens (diseases) with which they have co-evolved in their natural range. Correspondingly, indigenous species are at a competitive disadvantage when they encounter such alien species (having had no evolutionary history of them) and are easily out-competed. Invasive alien species can occur on land, in the ocean, or in freshwater systems, and can be drawn from any group of organisms.

Alien plant invasions have a major impact on biodiversity, ecosystem services, agriculture, forestry, the economy and human welfare. These invasions are also recognized as having the largest impact on biodiversity after direct habitat destruction (Agricultural Research Council, 2010).

Invasive alien plants have invaded over 10 million hectares (ha) of South Africa. Over 750 tree species and 8 000 herbaceous species have been introduced, with some 1 000 introduced species now naturalized (that is, neither indigenous nor invasive) and 200 considered invasive.

Of those considered invasive, 117 are categorized as 'major invaders', and 84 are considered 'emerging invaders'. 'Major invaders' are those species that are well established, and that already have a substantial impact on natural and semi-natural ecosystems. 'Emerging invaders' currently have less influence, but have attributes and potentially suitable habitat that could result in increased range and consequences in the next few decades. Plants constitute most of the invasive species in South Africa, making up 63% of the 319 species listed as harmful, and they threaten 55% of the Red Data-listed plants in the country. According to the Working for Water Programme, the impacts of invasive alien plant infestations are expected to double within 15 years if left uncontrolled.

According to the National Invasive Alien Plant Survey, 2010 (Agricultural Research Council, 2010) if all the alien vegetation across the country could be condensed into a single area, it would be twice the size of the Kruger National Park. It would cost an estimated R34 billion to remove. 600000 hectares (condensed area) of the Eastern Cape is infested with black, green and silver wattles.

Figure 7-22 provides an overview of alien invasive plant density in ADM (Agricultural Research Council, 2010).

Plant infestation also exasperates other hazards such as drought.

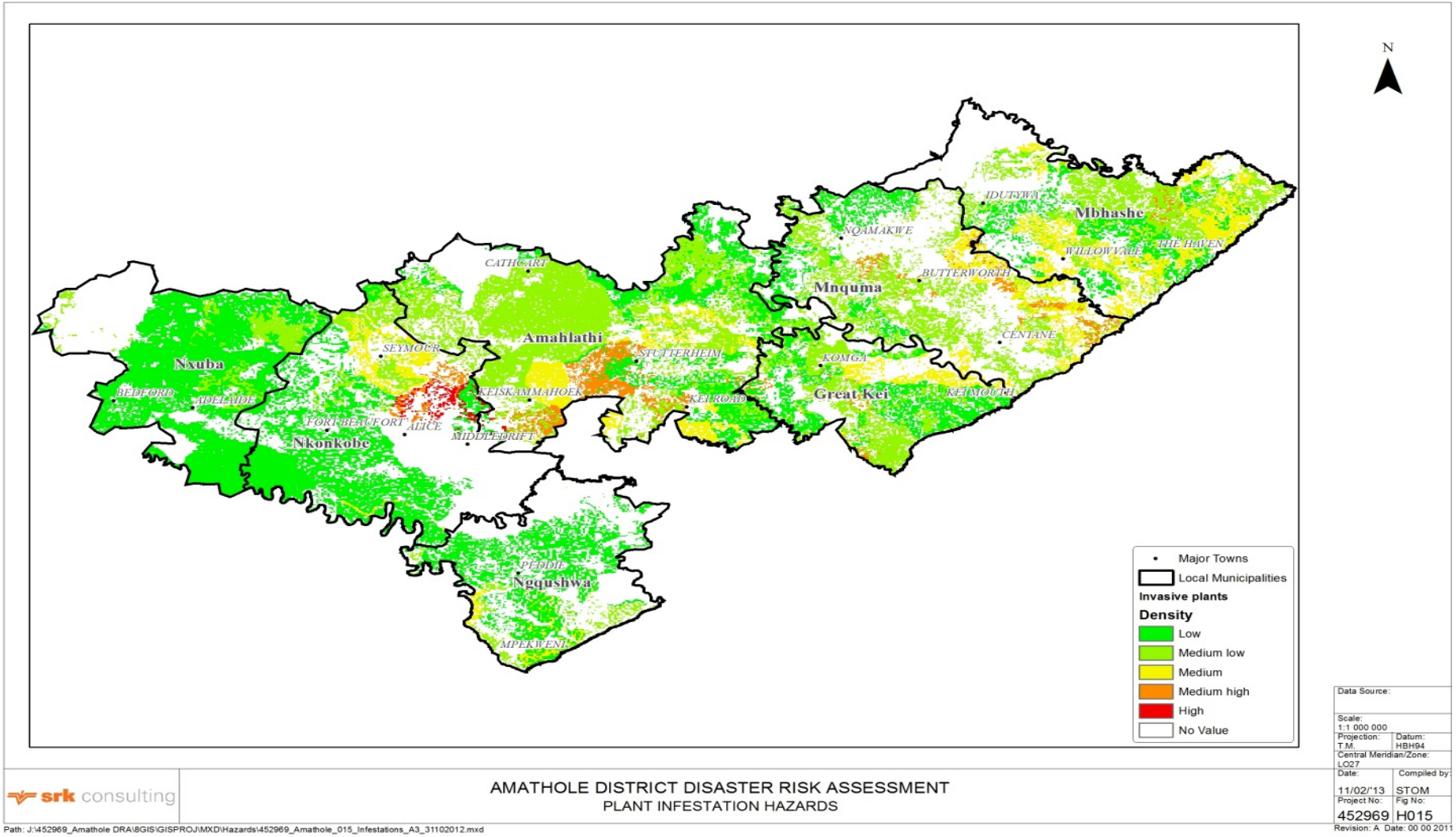


Figure 7-22: Invasive plants in ADM

7.14.2 Algal Bloom (Red Tide)

Red tide is a common name for a phenomenon known as an algal bloom (large concentrations of aquatic microorganisms) when it is caused by a few species of dinoflagellates and the bloom takes on a red or brown colour. Red tides are events in which estuarine, marine, or fresh water algae accumulate rapidly in the water column, resulting in coloration of the surface water. It is usually found in coastal areas.

Red tide is also potentially harmful to human health. Humans can become seriously ill from eating oysters and other shellfish contaminated with red tide toxin. Karenia brevis blooms can potentially cause eye and respiratory irritation (coughing, sneezing, tearing, and itching) to beachgoers, boaters and coastal residents. People with severe or persistent respiratory conditions (such as chronic lung disease or asthma) may experience stronger adverse reactions.

7.15 Infrastructure Failure / Service Delivery Failure

Infrastructure and service delivery failure hazards are related to the failure of infrastructure systems and processes such as electricity provision, water provision, sanitation systems, information technology and communication systems, and transportation infrastructure.

This failure can be caused by inadequate design, inadequate future planning, and a lack of proper maintenance or uncontrollable phenomena such as flooding or fires. The failure of services can lead to an increased risk of disaster, e.g. disruption of water can lead to community members drinking polluted water, which can lead to an outbreak of disease. However, an unrelated disaster event can also disrupt service delivery, e.g. flooding can damage communication systems or roads, which can disrupt disaster response and recovery efforts.

It is therefore important that infrastructure is designed, constructed and maintained in order to ensure that disruption of the services is avoided as far as possible. The specific types of infrastructure and service delivery failure hazards are briefly discussed below.

7.15.1 Electrical

Disruption of electricity supply is a common problem in South Africa due to cable theft, maintenance problems and supply capacity limitation. Except for the disruption of communities' lives due to electrical failure, regular problems with electricity supply can also affect industry, tourism and the attractiveness of the municipality to foreign investment.

7.15.2 Sanitation

Failure of sanitation systems can increase the risk of hazards such as epidemics, environmental degradation and pollution.

In order to reduce the risk of sanitation related service delivery or infrastructure failure, it is important to ensure adequate infrastructure development and maintenance is undertaken in each of the local municipalities.

7.15.3 Water

Safe clean water is one of the most basic needs of a community. A disruption or lack of water supply and services can create multiple secondary hazards such as disease outbreaks, reduction in community health, and an increase in pollution.

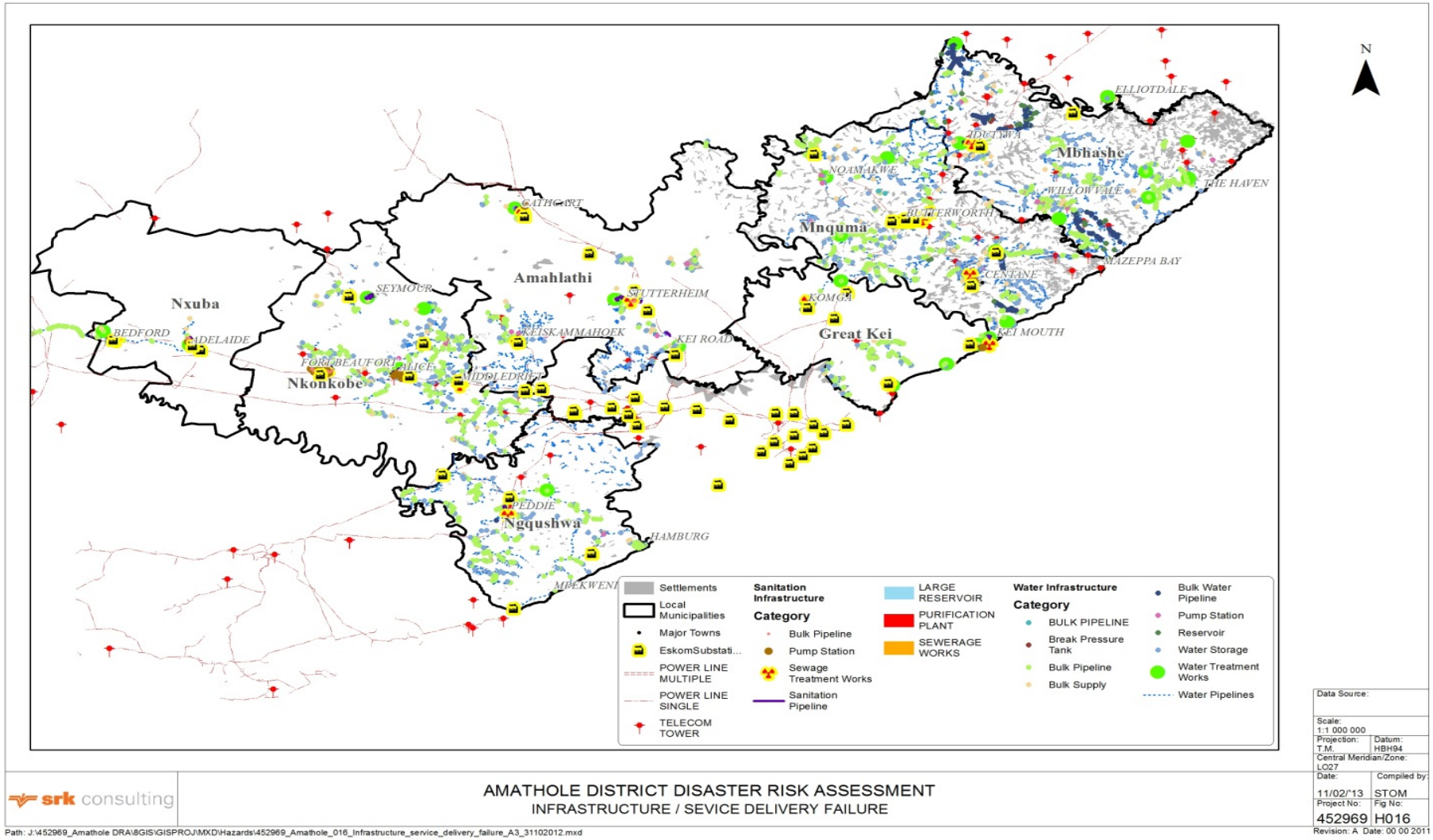


Figure 7-23: Infrastructure failure / Service delivery failure

7.16 Major Event Hazards

Major event hazards can usually be associated with cultural, religious, political, recreational, commercial or sporting events where large numbers of people gather at a venue or groups of venues. Hazards associated with these events include trampling and crushing injuries due to inadequate crown management, venue design or structural failure.

A map showing the location of facilities where large number of people can be expected is shown in Figure 7-24.

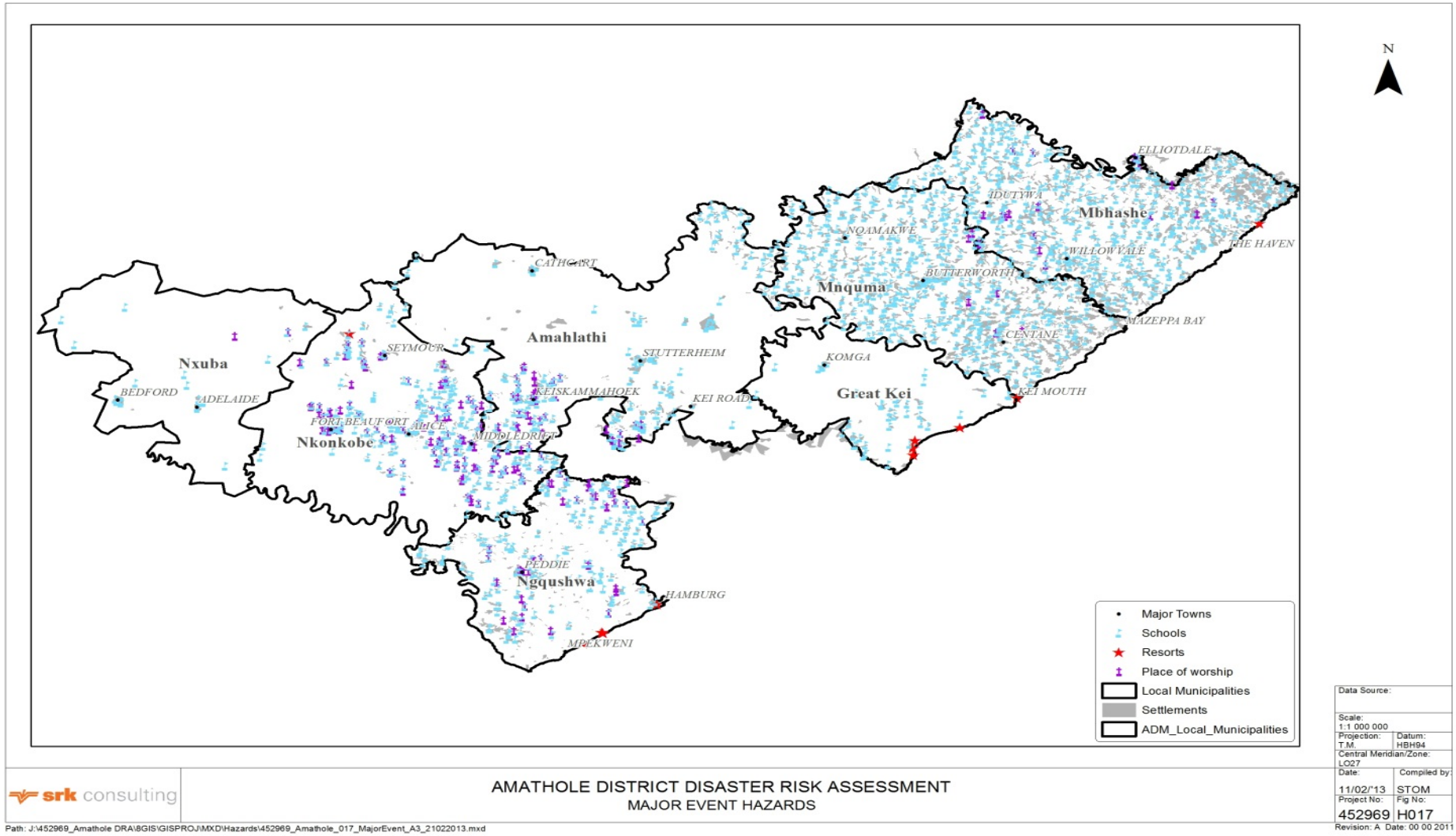


Figure 7-24: Typical facilities where large number of people can be expected to assemble

For the purpose of mapping major event hazards in the ADM, the land-use/land-cover data and points of interest of the ADM was used, and facilities or areas that are considered as possible venues for major events were identified.

7.17 Pollution

Pollution can have a detrimental impact on natural areas. Pollution not only impact on the natural beauty in an area, but also has an impact on other activities, such as agriculture. For the purpose of this assessment, pollution was divided into Air, Land and Water Pollution.

7.17.1 Air Pollution

Air pollution can occur due to a number of activities. These include:

- Fuel combustion from stationary sources – combustion of coal or oil for steam generation and industrial energy requirements as well as domestic coal and paraffin combustion for heating;
- Fuel combustion in mobile sources – cars, passenger vehicles and diesel fuel trucks and buses;
- Industrial and chemical processes – pollutants as alkali metals and fluorides from the Ferro-alloy industries and organic vapours from chemical production;
- Solid waste disposal – incineration of industrial, residential and hospital wastes;
- Land surface disturbances – construction activities, waste dumps, agricultural activities and veld fires;
- Illegal burning of garden refuse and waste material; and
- Illegal burning of electrical cables and tyres – to retrieve wire for resale.

The air pollution hazard map for the ADM is shown below.

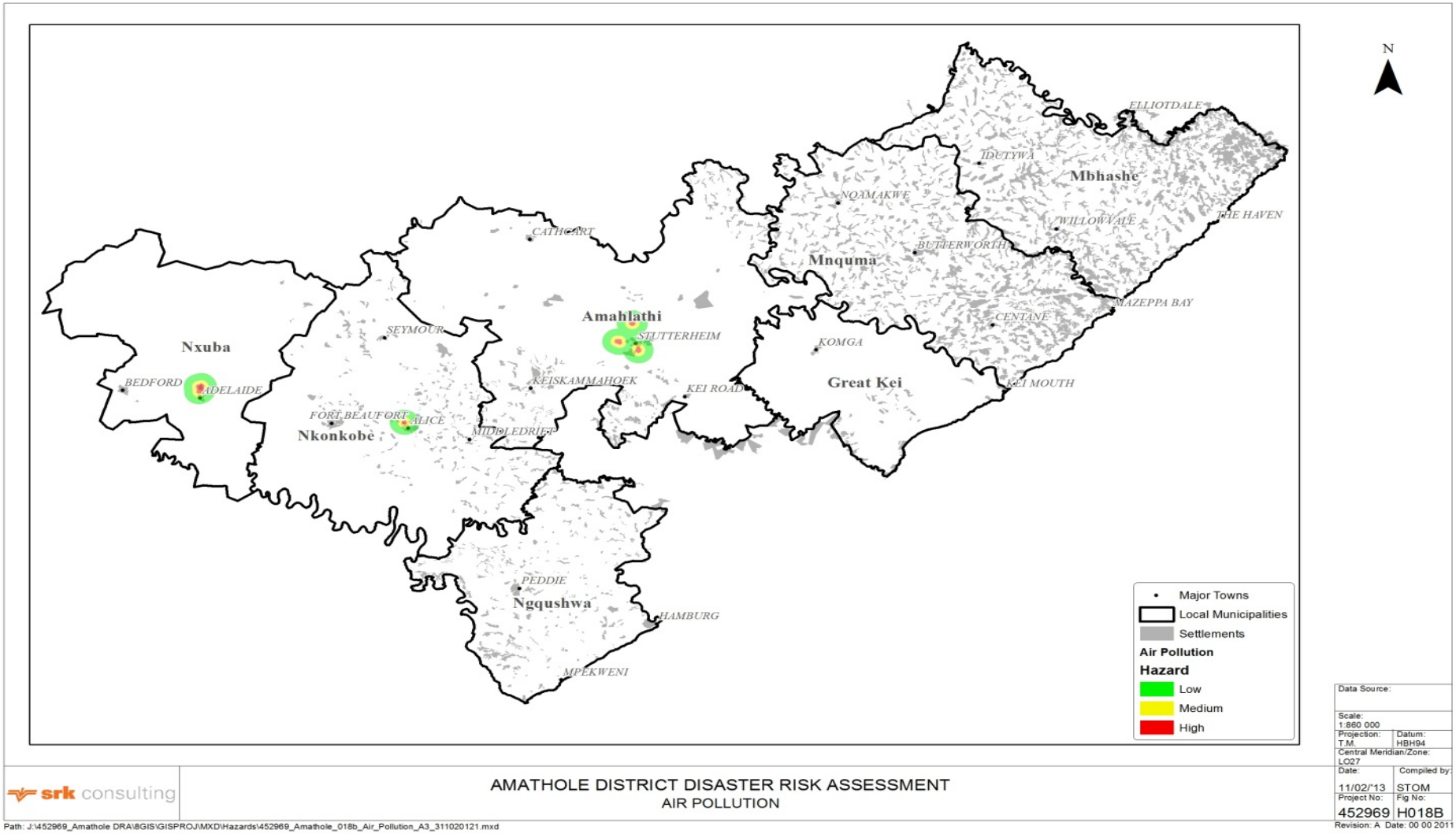


Figure 7-25: Air Pollution hazard map

7.17.2 Land Pollution

Although household waste and waste disposal sites are potential sources of land pollution, pollution from industry, health facilities, commerce and mining are generally considered to pose a much greater threat. It was however seen that ADM has a high percentage private refuse dumps which can lead to increased land pollution and water pollution.

7.17.3 Water Pollution

The provision of potable clean water to communities can significantly reduce their risk related to specific hazards such as human disease hazards. The inadequate management or treatment of sewerage can also have a severe impact on the receiving water bodies.

Mapped water and land pollution hazards in the ADM are shown below:

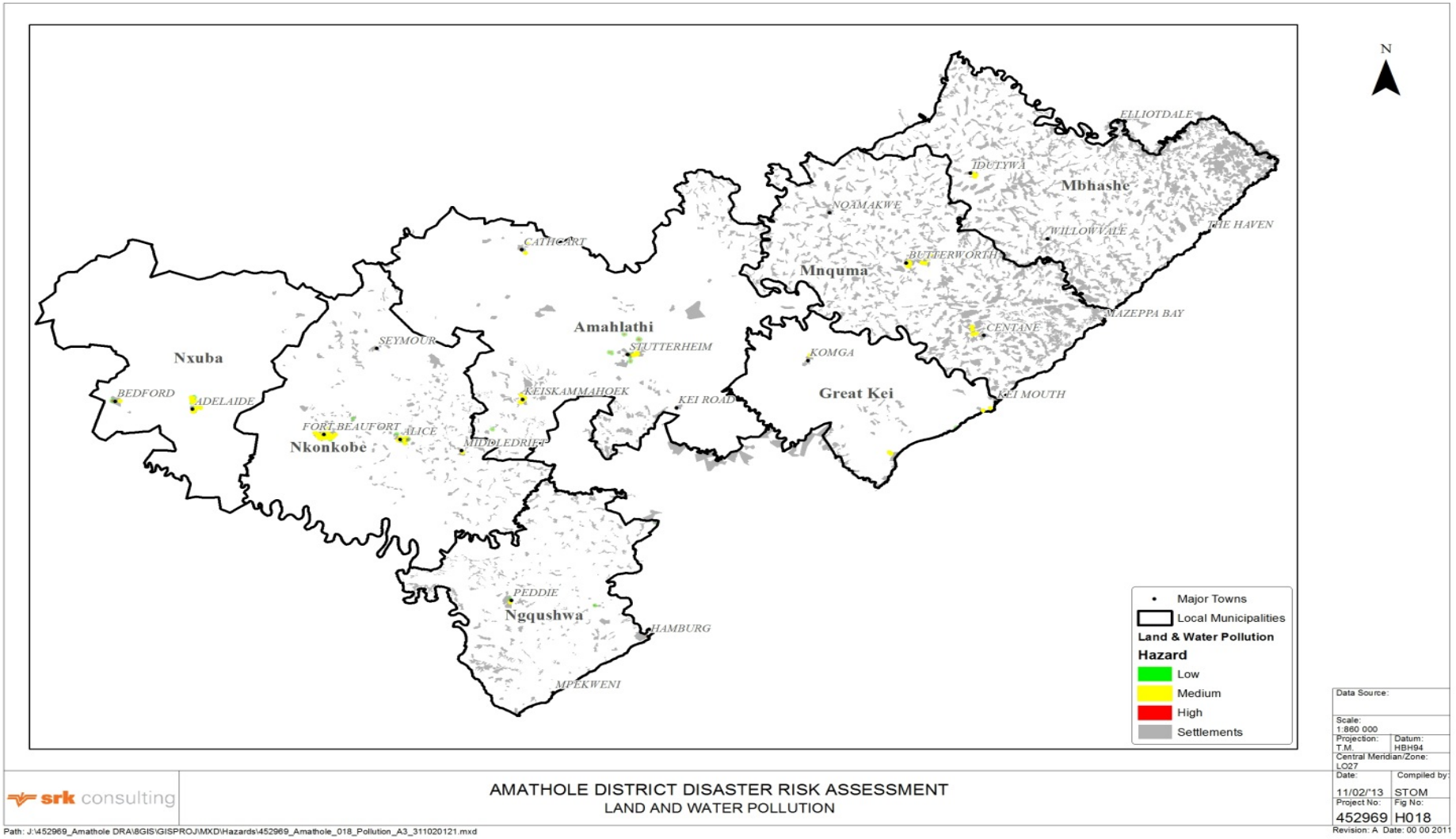


Figure 7-26: Land and Water pollution Hazard

7.18 Structural Failure

For the purpose of this study, structural failure hazards were defined as the failure of structures, such as bridges, buildings or dams due to various causes including inadequate maintenance, inadequate design, earthquakes, severe weather conditions, etc. The failure of small structures, such as single houses or small bridges does not usually constitute a disaster risk. However, the failure of larger structures such as dams, multi-lane bridges and multi-storey buildings may constitute a disaster event. No specific information, related to structural failure, was received from stakeholders during consultation sessions.

For the purpose of mapping the structural failure hazard, infrastructure such as dam walls, bridges, stadiums and other relevant infrastructure were mapped. The result of the hazard mapping is shown below:

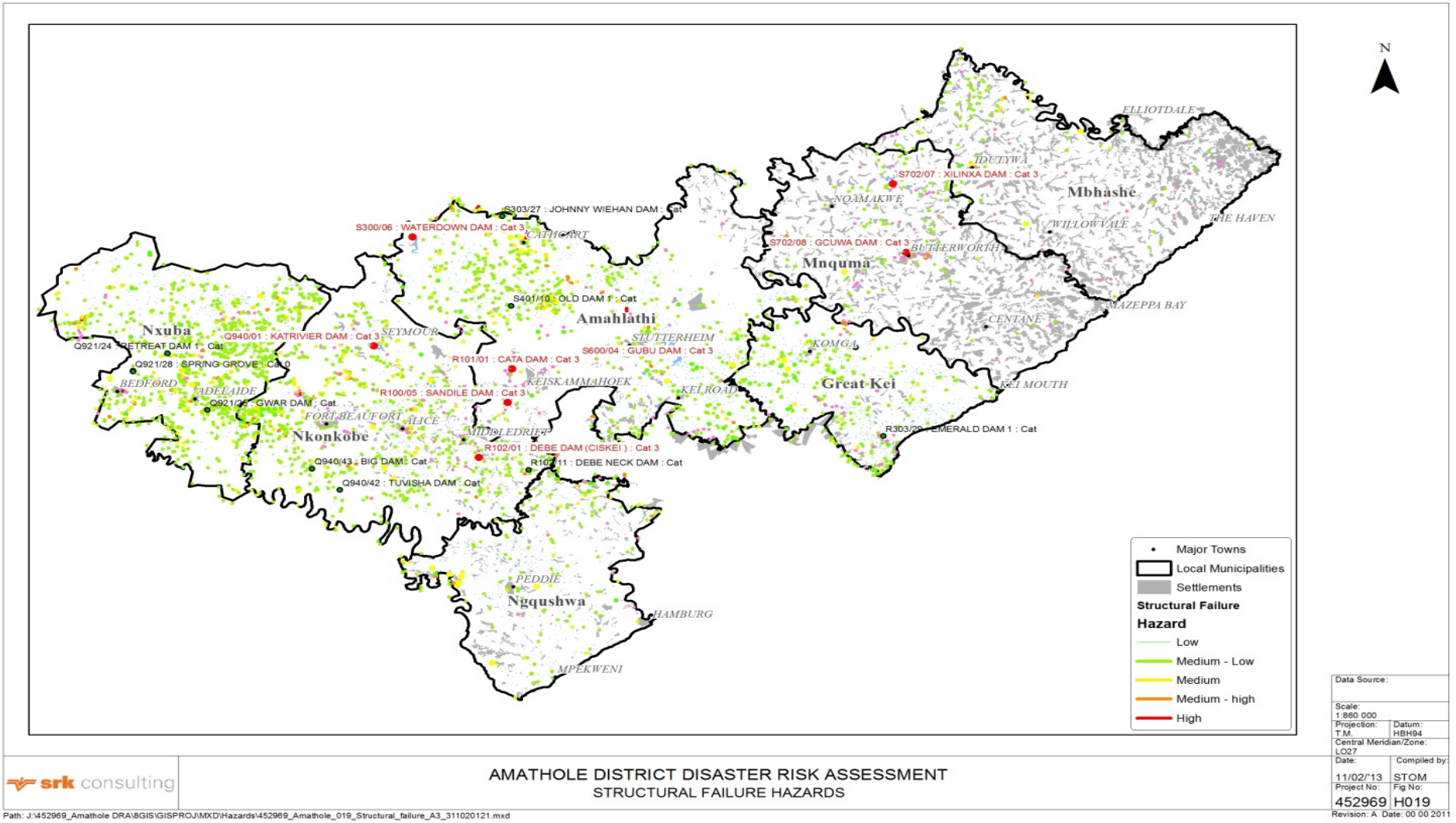


Figure 7-27: Structural Failure Hazard

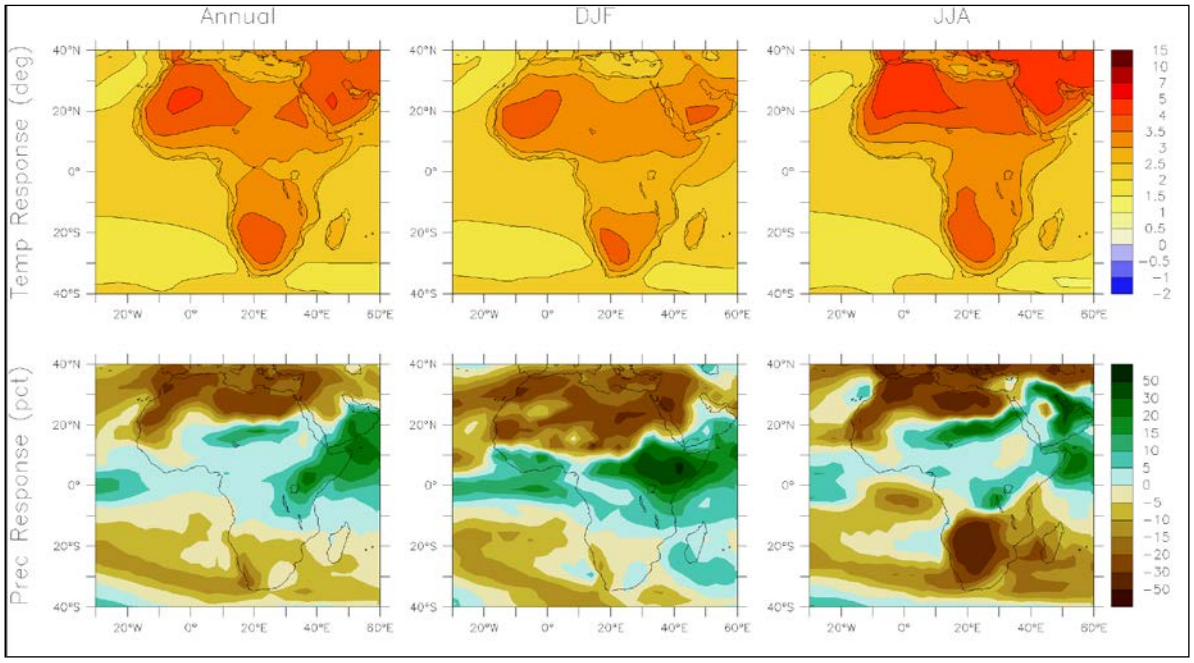
7.19 Climate Change

The Intergovernmental Panel on Climate Change (PCC 2007) definition of climate change refers to any identifiable change in climate over time that is attributed to natural variability or human activity. The United Nations Framework Convention on Climate Change (UNFCCC) definition only refers to climate change that is directly or indirectly attributed to human activity. The causes of climate change are both natural and human-induced. While the uncertainty in some of the climate change data must be acknowledged, the Intergovernmental Panel on Climate Change (2007) states that: *"Most of (>50%) the observed increased on globally averaged temperatures since the mid-20th century is very likely (conf. >90%) due to the observed increase in anthropogenic greenhouse gas concentrations and that warming is unequivocal."*

The following points summarize South Africa's contribution to climate change:

- Due to the dependence on coal for energy, South Africa is the world's 11th largest emitter of greenhouse gases;
- Its emissions grew 28% between 1990 and 2000 to 446 Mt of carbon dioxide equivalent;
- South Africa emits as much per person (9.8 tonnes CO2-eq per year) as many developed countries such as the United Kingdom; and
- The economy is carbon inefficient and intense, equivalent to that of China and well above the world average as well as the average for OECD countries.

Global circulation models present a mixed picture of the potential climate changes in Africa. However, continental models project an overall annual warming of about 3.5 to 4 degrees and a drying of about 15% in southern Africa.



srk consulting	**ADM Disaster Risk Assessment** Projected temperature and precipitation changes for Africa	Project No. 481363

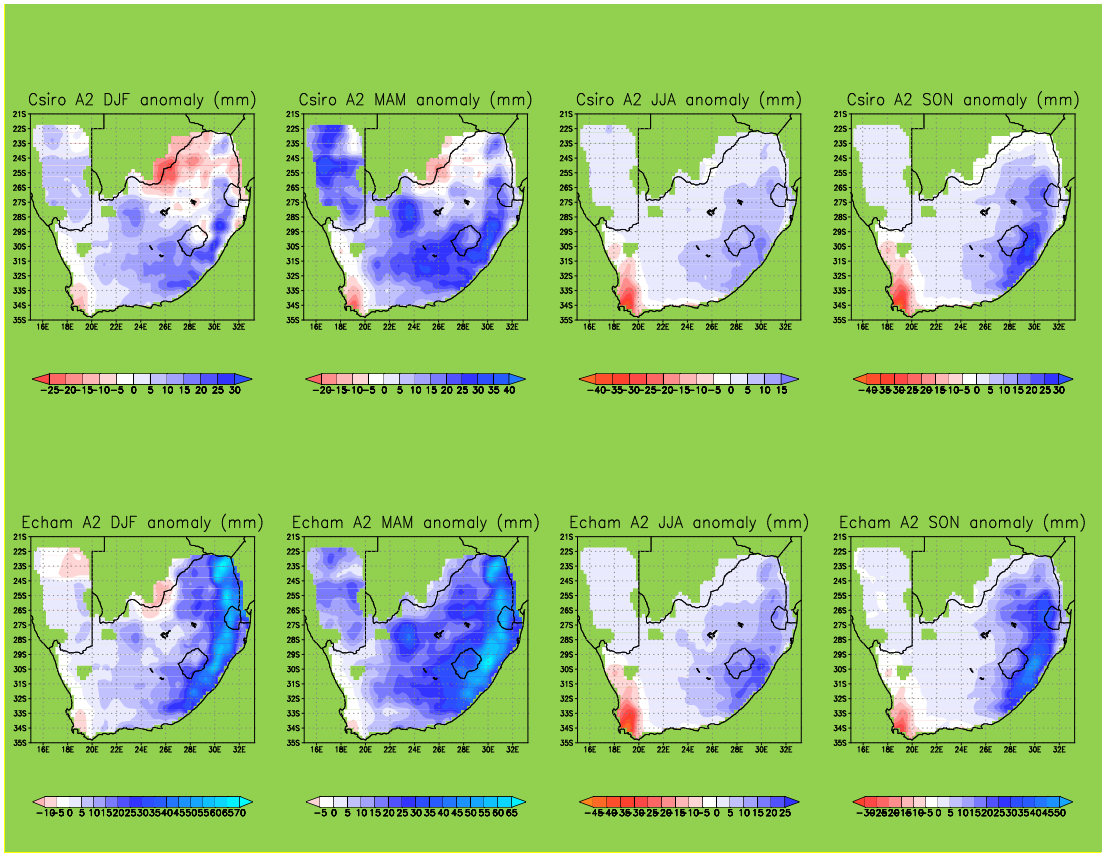
Figure 7-28: Projected temperature and precipitation changes for Africa[9]

[9] *Source: IPCC (2007) – Figure 11.2*

Regional downscaled models have been developed that offer a higher degree of confidence in their predictions (Hewitson and Crane, 2006). The results of the models are shown in Figure 7-29 below. The top and bottom rows represent the results of two different models and each of the four figures in each row represents different climate change scenarios.

The results of regional downscaled models suggest the following climate change impacts:

- A net drying on the western two-thirds of the subcontinent, south of about 10 degrees south.
- There will be increased summer rainfall in the convective region of the central and eastern plateau and the Drakensberg Mountains.
- The Western Cape is predicted to face a shorter rainfall season with a slight decrease in wintertime frontal rainfall and the eastern interior portions of the province likely to experience increased late summer rainfall.
- Ambient air temperature is predicted to increase across the country between 1 and 4 degrees Celsius, with the interior experiencing the greatest increases and the coastal zones experiencing less of an increase.



srk consulting | **ADM Disaster Risk Assessment** Regional scale projected precipitation change | Project No. 481363

Figure 7-29: Regional scale projected precipitation change[10]

The IPCC (2007) report also states that confidence has increased since the third assessment report that some weather events and extremes will become more frequent, more widespread and more intense during the 21st century. There are however large uncertainties associated with extremes due to incomplete global data sets and model uncertainties (IPCC, 2007).

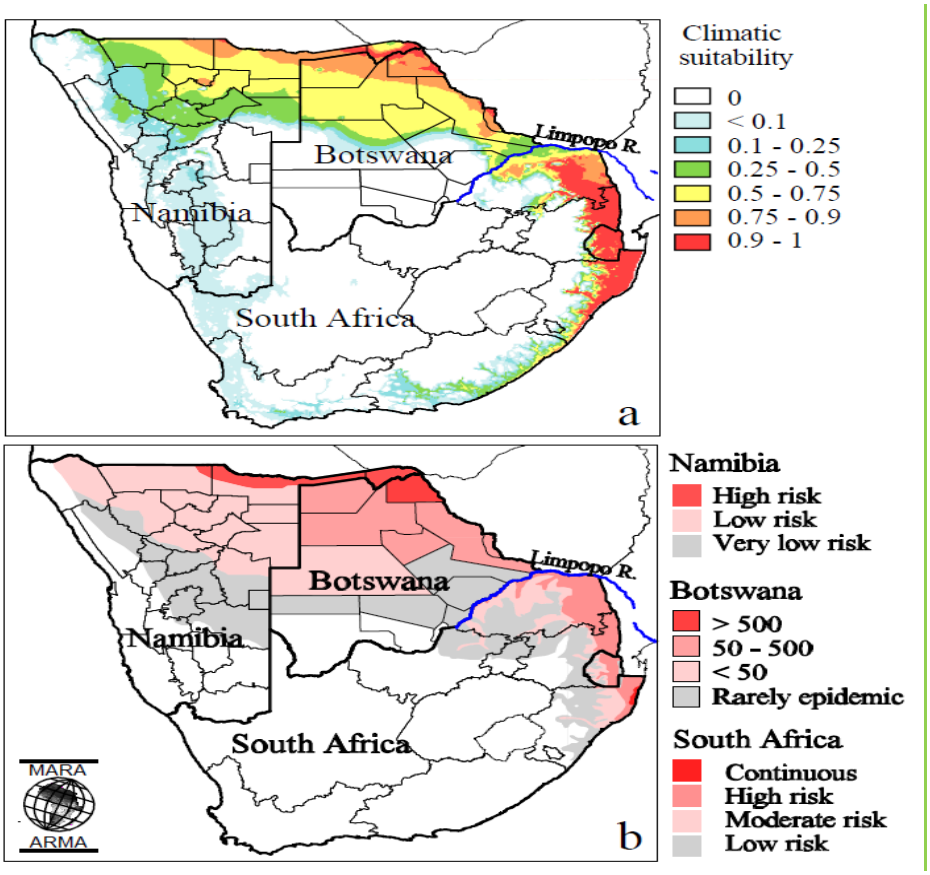
[10] *Hewitson and Crane (2006)*

Although coastal regions are less likely to experience large increases in temperature owing to the buffering capacity of the ocean, it is virtually certain (IPCC, 2007a) that there will be fewer cold days and nights and more frequent hot days and nights. Heat weaves will become more frequent and longer lasting in a warming climate (Solomon *et al.* 2007). Increased temperatures coupled with more frequent and intense extreme events such as storms are likely to have an impact on human health.

Impacts predicted (High confidence (>80%)) (IPCC, 2007) include:

- Increases in malnutrition and associated disorders;
- Increased deaths due to heat waves, floods, storms, fires and droughts;
- Increased occurrence of diarrhoeal disease; and
- Altered distribution of infectious disease vectors.

Figure 7-30 shows the projected suitable climatic areas for malaria (a) and the historical malaria risk areas (b). This illustrates the impact of climate change on disease vectors.



srk consulting	**ADM Disaster Risk Assessment** (a) Results of climatic model and (b) Historical malaria risk areas in South Africa and Namibia and annual malaria cases per district in Botswana.	Project No. 481363

Figure 7-30: (a) Results of climatic model where 0=unsuitable climate for malarial vectors and 1=suitable climate and (b) Historical malaria risk areas in South Africa and Namibia and annual malaria cases per district in Botswana. *Source: Craig and Sharp, 2000*

Based on the above, it does appear as if the risk to malaria in the ADM can be affected by climate change. There might also be an increased frequency and intensity of heat waves, storms and

floods. It will be of critical importance to anticipate the impacts of an increase in storm events, and develop an adaptive strategy that includes economic development, and provision of suitable housing and infrastructure.

GCM indicates that the frequency of heavy precipitation events is *very likely* (90 – 99% probability) to increase, which will augment flood risk (IPCC, 2007). The implications of this are that there is an increased probability of flooding. Increased run-off and associated flooding will have important implications for those people living near the rivers in the area, as well as in or near the floodplains. There is a large amount of uncertainty associated with rainfall and hence runoff predictions are at a regional scale.

Rising temperatures and changes in rainfall patterns and run-off will result in additional food insecurities. Increased temperatures are virtually certain to decrease crop yields due to heat stress and increased pest outbreaks (FAO, 2008). Increased frequency and intensity of rainfall events may result in damage to crops, soil erosion and water logging of soils which will make it difficult to cultivate the land.

7.20 Oceanographic

7.20.1 Oceanographic – Tsunami

A tsunami is a series of water waves caused by the displacement of a large volume of a body of water, typically an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions (including detonations of underwater nuclear devices), landslides, glacier carvings, meteorite impacts and other disturbances above or below water all have the potential to generate a tsunami (Wikipedia, 2013).

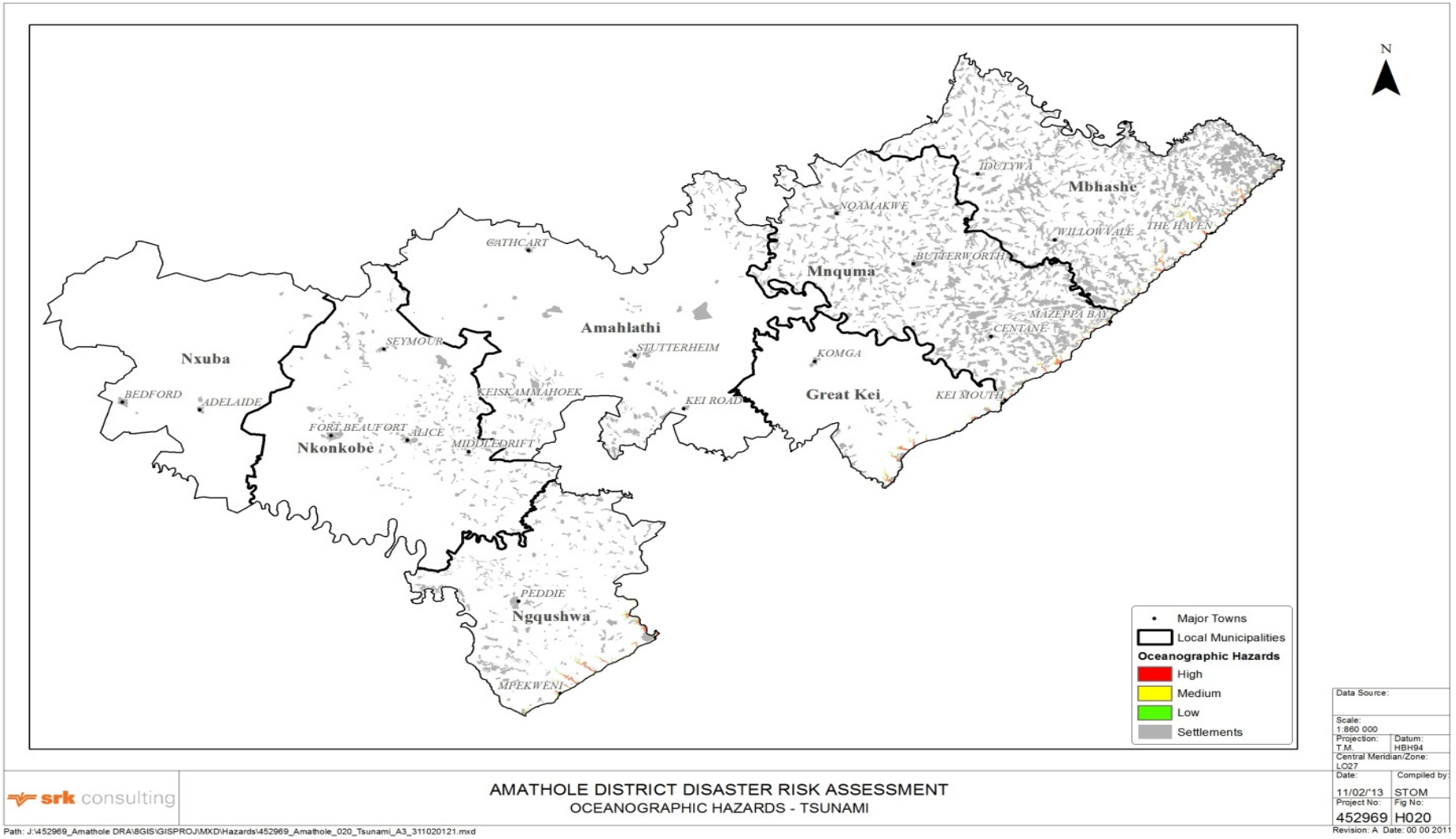


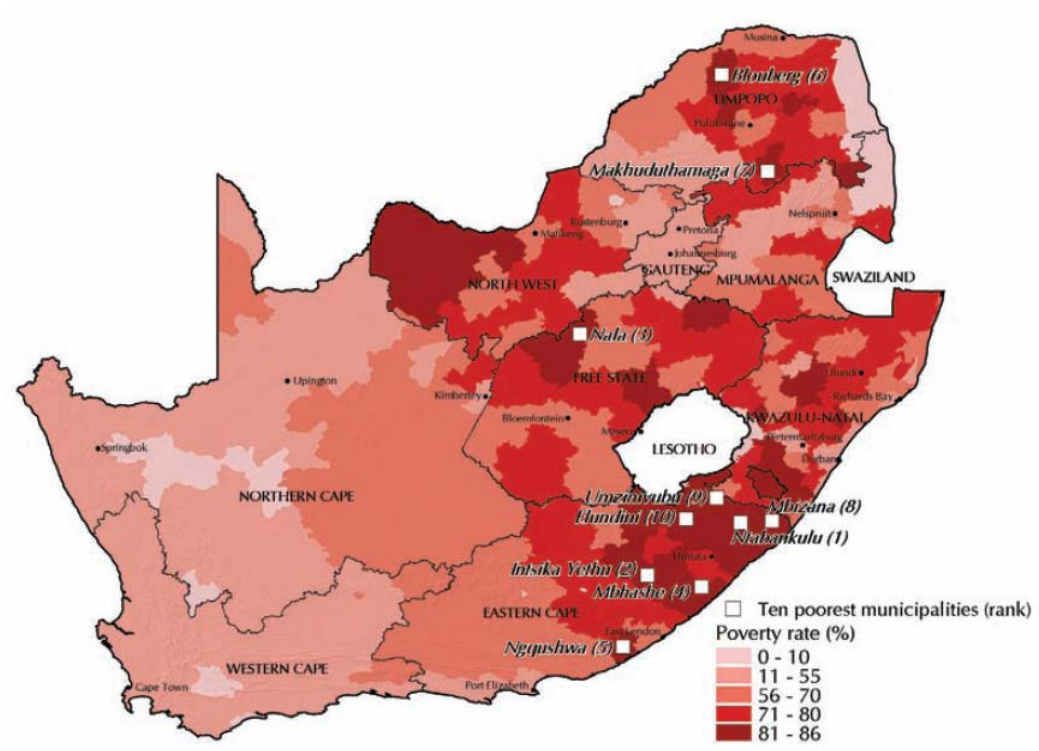
Figure 7-31: Tsunami Hazard ADM

8 Vulnerability Profile of the ADM

In the context of this study, vulnerability can be described as the degree to which an individual, a household, a community, an area or a development may be adversely affected by the impact of a hazard. Conditions of vulnerability and susceptibility to the impact of hazards are determined by physical, social, economic and environmental factors or processes.

It is also important to remember that vulnerability is dynamic, not static, as the vulnerability of communities change due to improvements or degradation of social, environmental and economic conditions, as well as interventions specifically aimed at reducing vulnerability, such as disaster mitigating actions (Zschau and Küppers, 2003).

For the purpose of this study, the vulnerability of the area of the ADM is discussed under two sections. The first section examines general characteristics of the area based on quantitative and qualitative data, and refers to some of the characteristics of the ADM area in the context of the "Progression of Vulnerability" as proposed by Wisner (2004). The second section deals with the spatially represented vulnerability, based on different types of spatial data.



srk consulting	**ADM Disaster Risk Assessment** Distribution of Poverty across South Africa showing the Ten Poorest Municipalities.	Project No. 481363

Figure 8-1: Distribution of Poverty across South Africa showing the Ten Poorest Municipalities

8.1 Vulnerability Considerations in ADM

In a developing country such as South Africa, poor people tend to be the most vulnerable to environmental disturbance, because they have fewer resources to help them to cope with disaster. They have low incomes, restricted choices regarding location and employment, are less able to afford food or to save and accumulate assets, and are often powerless Both global and local consequences of environmental damage impact upon poor people (DEAT, 2006).

Vulnerability is, however, not the same as poverty, and it is therefore important to distinguish between 'Vulnerability' and 'Poverty'. Rising poverty certainly contributes to rising vulnerability, but poor people may not necessarily be vulnerable if they live in relatively stable circumstances, with good infrastructure, communications, and social support systems. Poverty in this context may be a state of deprivation (lack of adequate access) to key resources needed for full participation in an economic and social life. Wealthier people can also be vulnerable when they live in unstable and uncertain environments, such as, for example, those who bear the extreme fire risk to thatched cottages on the fynbos coast of the South-Western Cape (DEAT, 2006).

Even though financial resources (or the lack thereof) do not necessarily determine level of vulnerability, it is important to consider aspects of poverty in determining vulnerability. According to the DEAT (2006), the Eastern Cape Province has 18% of the poverty gap in South Africa. The figure below provides an overview of poverty indicators in South Africa.

Province	Number of poor person (millions)	% of population in poverty	Poverty gap* (R billions)	Share of poverty gap (%)
Eastern Cape	4.6	72	14.8	18
Free State	1.8	68	5.9	7
Gauteng	3.7	42	12.1	15
KwaZulu-Natal	5.7	61	18.3	22
Limpopo	4.1	77	11.5	14
Mpumalanga	1.8	57	7.1	9
North West	1.9	52	6.1	8
Northern Cape	0.5	61	1.5	2
Western Cape	1.4	32	4.1	5
South Africa	**25.5**	**58**	**81.4**	**100**

**** The poverty gap measures the required annual income transfer to all poor households to bring them out of poverty.***

Figure 8-2: Poverty Indicators by Province[11]

Keeping the above mentioned aspects in mind, the specific vulnerability profile of the ADM can be influenced by various aspects. The National Disaster Management Framework defines *Vulnerability* as *"The degree to which an individual, a household, a community, an area or a development may be adversely affected by the impact of a hazard. Conditions of vulnerability and susceptibility to the impact of hazards are determined by* ***physical, social, economic and environmental factors*** *or processes."*

[11] *DEAT 2006*

A lot of the aspects that can contribute to the vulnerability in the ADM were discussed as part of the Status Quo assessment in Section 6; key aspects of the characteristics of the ADM are discussed below.

Physical vulnerability of communities can relate to the type of housing, available infrastructure and the quality of infrastructure. According to StatsSA, an informal dwelling is defined as a *"makeshift structure not approved by a local authority and not intended as a permanent dwelling. Typically built of found materials (corrugated iron, cardboard, plastic, etc.). Contrasted with formal dwelling and traditional dwelling."* Informal dwellings, or buildings constructed from low quality material can be considered more susceptible to the effects of some hazards. The percentage of formal and informal dwellings within an area can therefore be used as one indicator of the level of vulnerability of an area.

Due to the import role water plays within communities, including the health of community members, it can be stated that the inadequate quantity or quality of drinking water can increase the vulnerability of communities to the effects of certain hazards. Because of this, access to water can also be used as an indicator of relative vulnerability.

Adequate sanitation is critical to ensure that the appropriate public health conditions are maintained in a community. Inadequate or unsuitable sanitation or disposal of waste can increase the risk of disease, and can facilitate the spread of waterborne diseases such as cholera. The access of community members to proper sanitation, including toilets, can therefore be used as an indicator of relative vulnerability.

The type of energy available for cooking and lighting can also serve as an indicator of the relative vulnerability of communities. In areas without electricity, community members need to make use of alternative energy sources, such as paraffin, gas or wood. This can have a detrimental effect on the health of community members, and also pose an increase in the fire hazard.

The **social characteristics** of a community can also have an impact on the vulnerability of the community. Wisner (2004) identified a number of characteristics that can increase the vulnerability of communities. These characteristics includes, amongst others:

- Limited access to power, structures and resources;
- Lack of local institutions, training and skills; and
- Lack of ethical standards in public life.

Economic characteristics influencing the vulnerability of communities can include aspects such as the levels of unemployment, levels of income and the percentage of economically active individuals.

Additional **environmental characteristics** that can influence the vulnerability of an area are deforestation, rapid urbanization and a decline in soil productivity (Wisner 2004).

The following steps can be taken to decrease the vulnerability and reduce disaster risk by increasing resilience in the ADM (Wisner 2004):

- Increase the access of vulnerable groups to power structures and resources;
- Challenge any ideology, political system or economic system where it causes or increases vulnerability;
- Development of local institutions, education, training and appropriate skill development opportunities;
- Develop and secure local investment and local markets;
- Improve ethical standards in public life (including crime prevention, safety and security)
- Manage urbanisation;
- Protect natural and forest environments;
- Diversify rural income opportunities; and
- Strengthen livelihoods and increase low income levels.

The vulnerability profile of the ADM was calculated based on the StatsSA 2011 Census data. The indicators used to compile the vulnerability profile included:

- Access to water;
- Sanitation systems;
- Refuse removal services;
- Income Levels;
- Energy used for cooking;
- Employment levels;
- Dwelling type;
- Age Profile; and
- Educational Profile.

The first profile was used to compare the ADM with other municipalities in the Eastern Cape Province. The result from this assessment is shown in Table 8-1 below.

Table 8-1: Relative Vulnerability levels of municipalities in the Eastern Cape Province

	Water	Refuse	Energy	Education	Employed	Income	Housing	Sanitation	**Vulnerability Rating**
DC10: Cacadu	0.79	0.79	0.81	0.13	0.27	0.15	0.81	0.78	4.53
DC12: Amathole	0.46	0.16	0.55	0.08	0.10	0.06	0.50	0.35	2.26
DC13: Chris Hani	0.57	0.28	0.63	0.09	0.13	0.08	0.59	0.53	2.89
DC14: UKhahlamba	0.52	0.28	0.56	0.08	0.15	0.08	0.57	0.51	2.76
DC15: O.R.Tambo	0.23	0.11	0.45	0.08	0.09	0.06	0.35	0.45	1.82
DC44: Alfred Nzo	0.24	0.06	0.28	0.06	0.09	0.05	0.33	0.40	1.52
BUF: Buffalo City	0.90	0.70	0.74	0.18	0.25	0.17	0.69	0.78	4.42
NMA: Nelson Mandela Bay	0.95	0.83	0.86	0.21	0.25	0.19	0.79	0.90	4.98

Based on the results from the above analysis, the ADM is rated as having the third highest vulnerability rating, in comparison with the other municipalities in the Eastern Cape Province. The same analysis was undertaken in comparing the individual local municipalities in the ADM. The result of this analysis is shown in Table 8-2.

Table 8-2: Relative Vulnerability levels of local municipalities in the ADM

Hazard	EC121: Mbhashe	EC122: Mnquma	EC123: Great Kei	EC124: Amahlathi	EC126: Ngqushwa	EC127: Nkonkobe	EC128: Nxuba	Combined
Transport Hazards - Air Transportation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
Transport Hazards - Rail Transportation	0.03	0.03	0.02	0.02	0.03	0.02	0.02	0.17
Transport Hazards - Road Transportation	0.17	0.17	0.17	0.17	0.18	0.17	0.17	1.19
Transport Hazards - Water Transportation (Incl. Marine Accident)	0.04	0.03	0.03	0.00	0.03	0.00	0.00	0.13
Civil Unrest - Demonstrations / Riots	0.49	0.36	0.26	0.22	0.29	0.14	0.10	1.86
Civil Unrest - Refugees / Displaced People	0.17	0.17	0.17	0.17	0.18	0.17	0.17	1.19
Civil Unrest - Xenophobic Violence	0.17	0.17	0.17	0.17	0.18	0.17	0.17	1.19
Civil Unrest - Terrorism	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Civil Unrest - Armed Conflict (Civil/Political War)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Civil Unrest - Crime	0.24	0.23	0.38	0.41	0.32	0.40	0.40	2.38
Hydro-meteorological - Drought	0.49	0.47	0.42	0.44	0.41	0.41	0.40	3.03
Environmental Degradation - Deforestation	0.30	0.30	0.25	0.20	0.20	0.15	0.13	1.53
Environmental Degradation - Erosion	0.09	0.06	0.04	0.04	0.03	0.03	0.01	0.30
Environmental Degradation - Land Degradation	0.16	0.15	0.13	0.13	0.13	0.14	0.10	0.94
Environmental Degradation - Loss of Biodiversity	0.16	0.10	0.06	0.06	0.07	0.04	0.03	0.51
Disease / Health - Disease: Animal	0.40	0.27	0.25	0.20	0.15	0.25	0.20	1.72
Disease / Health - Disease: Human	0.47	0.45	0.12	0.14	0.21	0.15	0.11	1.65
Disease / Health - Disease: Plants	0.25	0.26	0.03	0.25	0.22	0.19	0.18	1.38
Fire Hazards - Veld/Forest Fires	0.47	0.43	0.15	0.48	0.26	0.44	0.15	2.38
Fire Hazards - Formal & Informal Settlements / Urban Area	0.45	0.40	0.19	0.35	0.21	0.31	0.11	2.02
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)	0.34	0.29	0.26	0.30	0.25	0.22	0.19	1.84
Geological Hazards - Earthquake	0.21	0.21	0.20	0.21	0.21	0.20	0.20	1.46
Geological Hazards - Landslides/Mud flows	0.20	0.18	0.18	0.17	0.17	0.17	0.14	1.21
Geological Hazards - Rock-fall	0.14	0.13	0.18	0.12	0.11	0.11	0.09	0.88
Geological Hazards - Subsidence	0.20	0.18	0.18	0.17	0.17	0.17	0.14	1.21
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	0.32	0.26	0.22	0.20	0.20	0.18	0.15	1.54
Hydro-meteorological Hazards - Desertification	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.10
Hydro-meteorological Hazards - Extreme Temperatures	0.15	0.12	0.12	0.08	0.08	0.06	0.03	0.63
Hazardous Material - Spill/Release (Storage & Transportation)	0.14	0.10	0.07	0.09	0.12	0.07	0.05	0.64
Hazardous Material - Fire/Explosion (Storage & Transportation)	0.14	0.10	0.07	0.09	0.12	0.07	0.05	0.64
Infestations - Plant Infestations (Intruder Plants)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	2.10
Infestations - Animal Infestation / Over Population	0.15	0.17	0.12	0.10	0.14	0.07	0.05	0.80
Infestations - Insect Infestation	0.22	0.20	0.18	0.17	0.18	0.16	0.15	1.26
Infestations - Algal Bloom (Red Tide)	0.21	0.21	0.20	0.00	0.21	0.00	0.00	0.83
Infrastructure Failure / Service Delivery Failure - Electrical	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.09
Infrastructure Failure / Service Delivery Failure - Information Technology	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Infrastructure Failure / Service Delivery Failure - Sanitation	0.14	0.19	0.20	0.21	0.20	0.22	0.26	1.42
Infrastructure Failure / Service Delivery Failure - Transport	0.14	0.14	0.13	0.14	0.14	0.14	0.13	0.95
Infrastructure Failure / Service Delivery Failure - Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Infrastructure Failure / Service Delivery Failure - Water	0.15	0.19	0.20	0.23	0.24	0.24	0.22	1.48
Major Event Hazards - Cultural / Religious	0.24	0.23	0.14	0.20	0.13	0.15	0.10	1.19
Major Event Hazards - Political	0.24	0.23	0.14	0.20	0.13	0.15	0.10	1.19
Major Event Hazards - Recreational / Commercial	0.24	0.23	0.14	0.20	0.13	0.15	0.10	1.19

Hazard	EC121: Mbhashe	EC122: Mnquma	EC123: Great Kei	EC124: Amahlathi	EC126: Ngqushwa	EC127: Nkonkobe	EC128: Nxuba	Combined
Major Event Hazards - Sport	0.24	0.23	0.14	0.20	0.13	0.15	0.10	1.19
Pollution - Air Pollution	0.20	0.18	0.17	0.21	0.17	0.16	0.10	1.19
Pollution - Land Pollution	0.31	0.27	0.24	0.26	0.30	0.24	0.11	1.73
Pollution - Water Pollution (Fresh and Sea)	0.38	0.31	0.25	0.21	0.22	0.18	0.19	1.74
Structural Failure - Bridge Failure	0.18	0.22	0.18	0.28	0.11	0.24	0.20	1.41
Structural Failure - Building Failure	0.14	0.14	0.13	0.14	0.14	0.14	0.13	0.95
Structural Failure - Dam failure	0.04	0.04	0.15	0.32	0.12	0.20	0.17	0.00
Oceanographic - Tsunami	0.22	0.20	0.20	0.00	0.18	0.00	0.00	0.81
Oceanographic - Sea Level Rise (Climate Change)	0.05	0.03	0.03	0.00	0.01	0.00	0.00	0.12
Oceanographic - Storm Surge	0.05	0.03	0.03	0.00	0.01	0.00	0.00	0.12
Other - Space Objects	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Combined	10.29	9.39	7.60	8.24	7.74	7.34	5.96	

Based on the results from the analysis, the Mbhashe Local Municipality was calculated as being the most vulnerable in terms of the used vulnerability indicators, while the Nxuba Local Municipality was calculated as being least vulnerable.

8.2 Vulnerability Mapping

The Vulnerability modelling for the district was conducted based on relative vulnerability levels associated with social, structural, economic and environmental vulnerability levels in the ADM. Land cover data was used to indicate relative vulnerability ratings for economic and structural vulnerability. Social vulnerability mapping is based on the level of service available to communities, while the environmental vulnerability map is based on a combination of the vegetation protection status map and the conversation status map. The vulnerability maps for the ADM are shown below

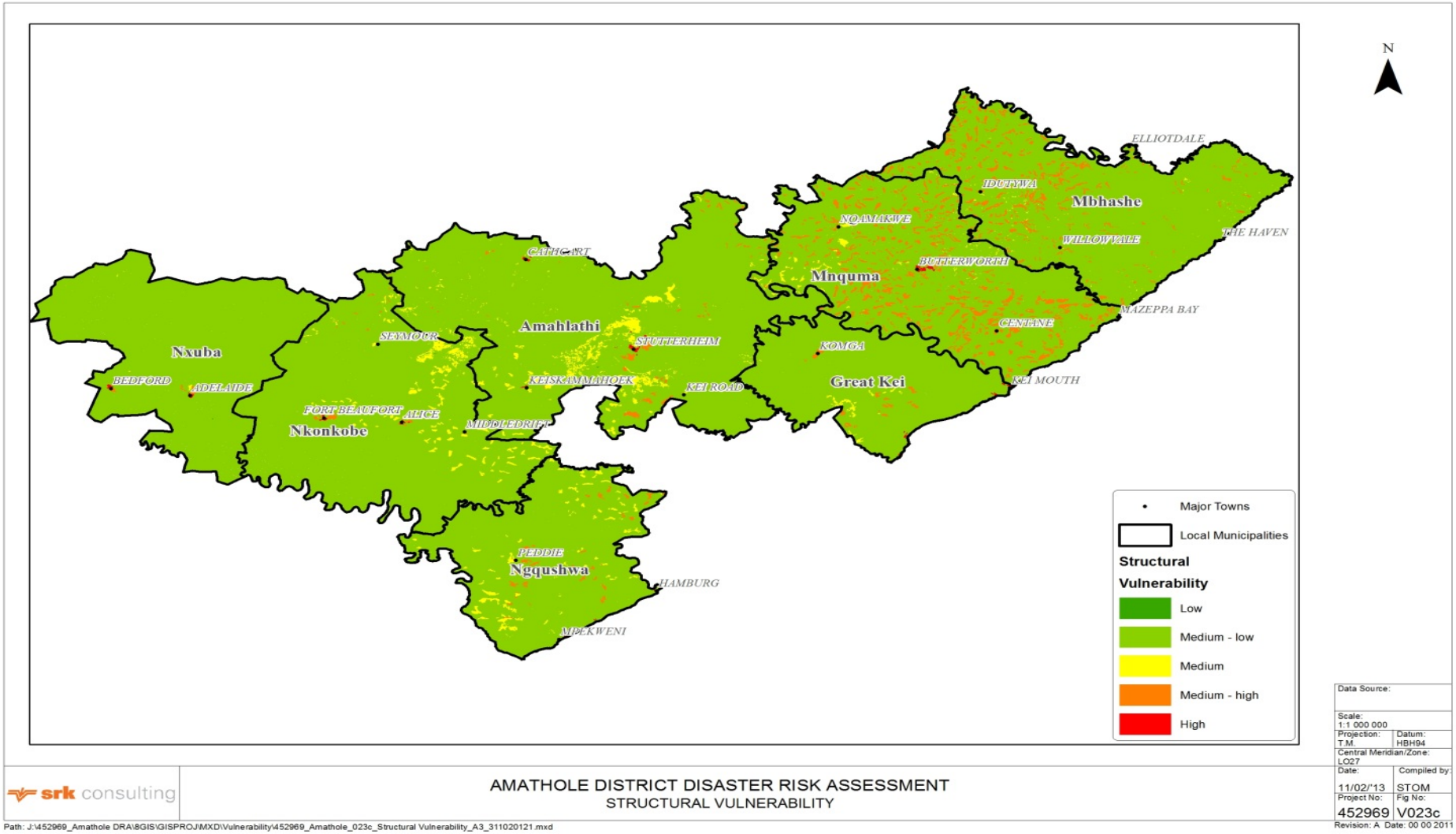


Figure 8-3: Structural Vulnerability of the ADM

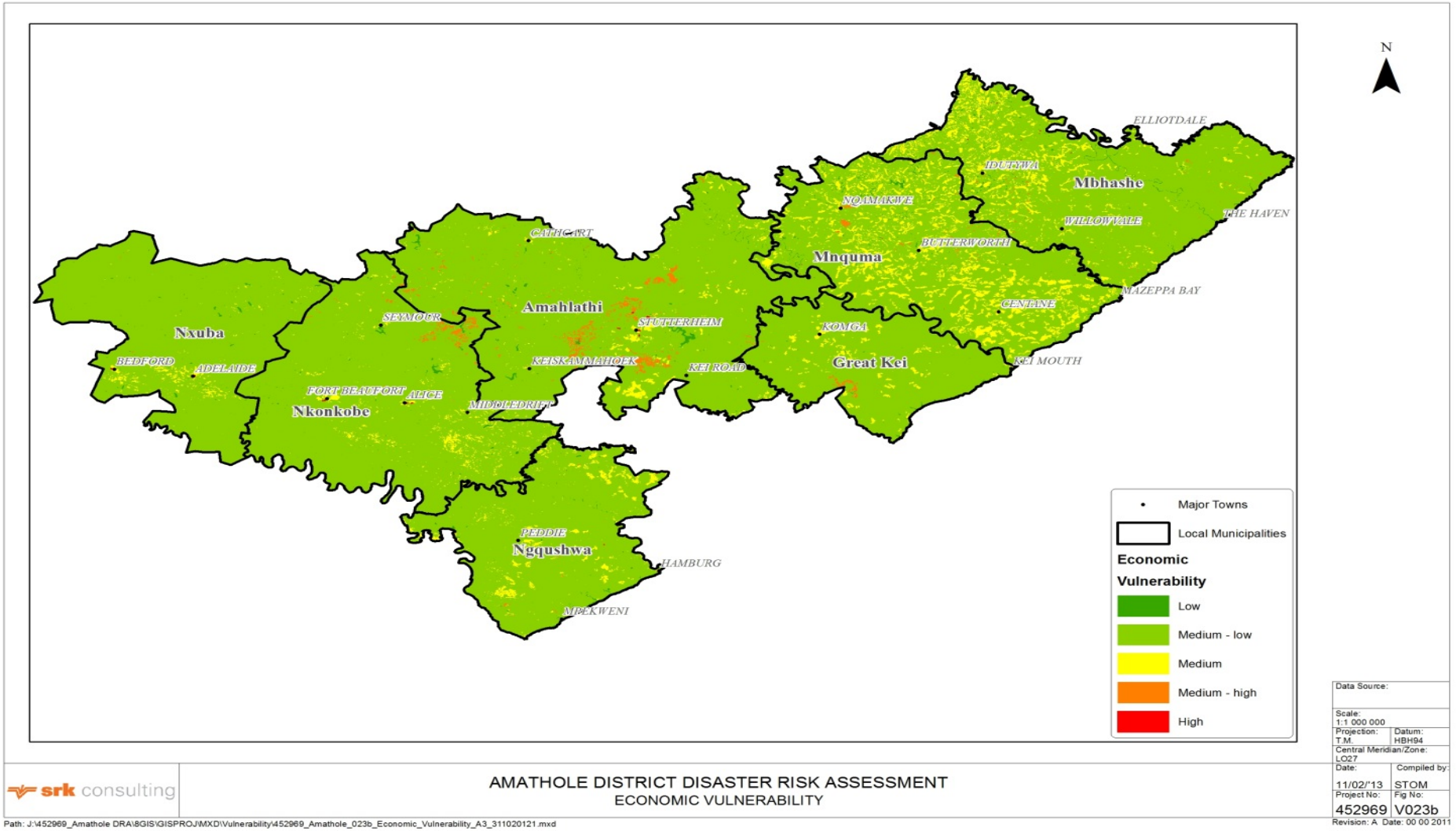


Figure 8-4: Economic Vulnerability of the ADM

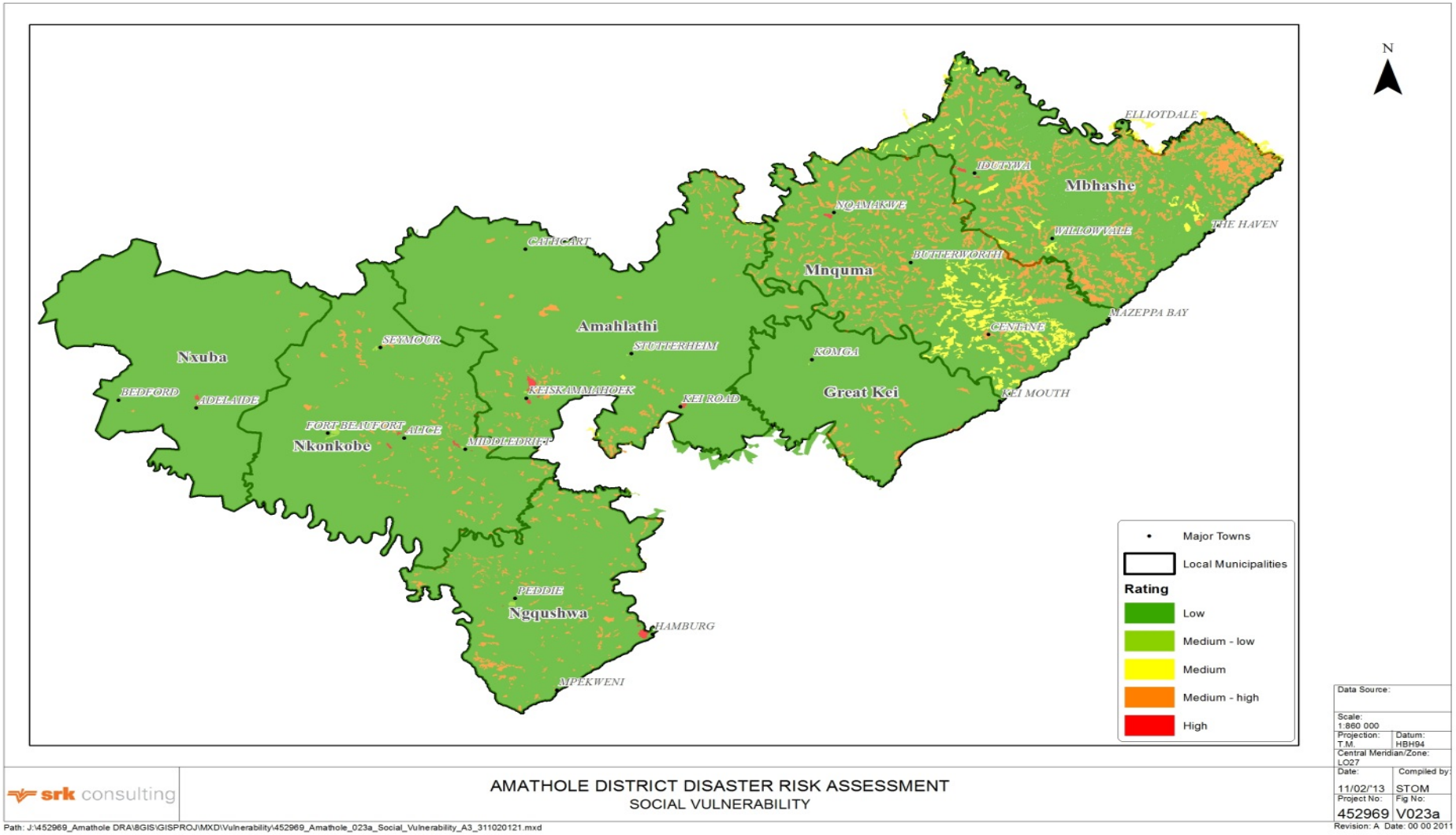


Figure 8-5: Social Vulnerability of the ADM

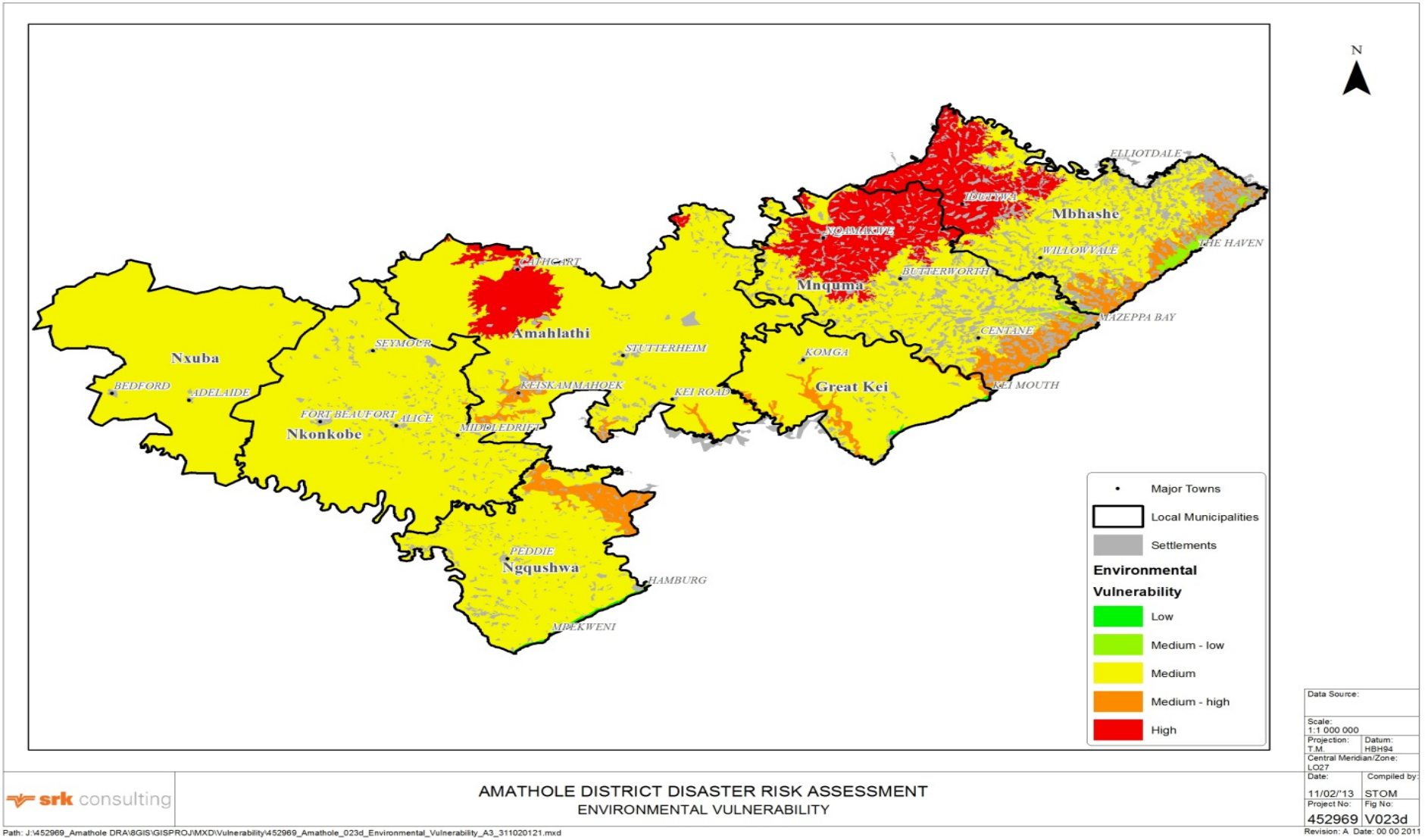


Figure 8-6: Environmental Vulnerability of the ADM

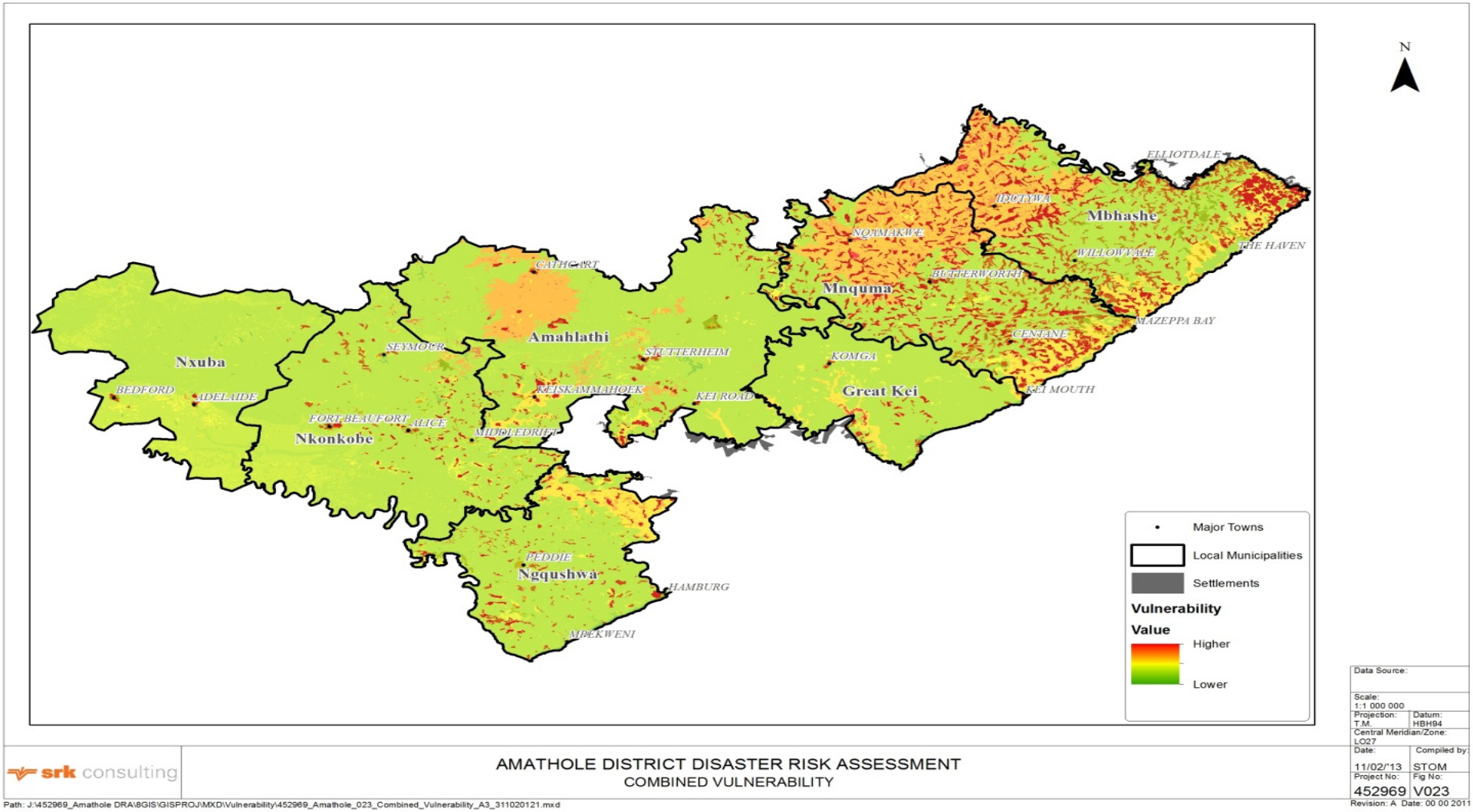


Figure 8-7: Combined Vulnerability of the ADM

The results from the resilience mapping indicate that areas of high vulnerability can be found throughout the district. Varying levels of vulnerability can be identified between the different local municipalities.

9 Resilience Profile of the ADM

The resilience characteristics relate to the capacity within the ADM area to counter the effects of hazards and vulnerabilities. Resilience levels consist of Manageability and Capacity values, and are defined as follows:

Manageability – For the purpose of this assessment Manageability was defined as the combination of all the strengths and resources available within the government departments and line-functions that can be used to reduce the level of risk or the effects of a disaster. This includes the level of staff or human resources, available expertise, suitable experience, available vehicles, equipment, funding or budget allocations, facilities and risk reduction and response plans.

Capacity – For the purpose of this assessment Capacity was defined as the combination of all the strengths and resources available within the community or society that can be used to reduce the level of risk or the effects of a disaster. Capacity was rated by making use of the same classification as Manageability.

Resilience – The Resilience value defines the total 'resilience' level in a specific area or community based on the *Capacity* levels of the community, as well as the *Manageability* levels of the authorities, government department and line-functions to deal with disaster risk or the effects of disasters. The Resilience value is calculated by combining the Manageability and Capacity values.

During analysis of the resilience data, it was found that key representatives for each line-function or organization, did not attend the workshop sessions, or did not to participate in the study. Due to this, a comprehensive discussion on the resilience characteristics of different role-players is not possible. Data collected from participation stakeholders are discussed below.

9.1 Description of Resilience Role Players

A description of the responding role-players as well as the results of the self-evaluation is provided below.

9.1.1 Business, Industry and the Chamber of Commerce

The private sector plays an important role with regard to disaster management. According to the GPODM (1998) "*the commercial and private sector can also play an essential role in disaster mitigation. Usually the role of such players has been in the field of relief and recovery. While the value of such contributions is great, the commercial sector should play a greater role in the mitigation of disasters through training, education and capacity building. Involvement by this sector can also be expanded from that of relief to proactive mitigation."*

It is important that cooperation and coordination between the private sector and the ADM, including disaster management, is encouraged. The private sector, however, does not only play a role in supporting the municipality's disaster management activities, but should also ensure that internal risk management activities, especially related to enterprise risk and business continuity management are in place. This will lead to a more resilient economy in the ADM.

9.1.2 Community Representatives

According to the GPODM (1998) *"community groups have played and continue to play a major role in disaster management. They are quick in response, have local knowledge and expertise to their*

advantage and can also act as important channels for awareness raising and education. Disaster management therefore needs to be a coordinated effort between government, various institutions, non-governmental organisations, community-based organisations and the commercial sector. Where communities are not directly involved and are passive recipients of relief, the result may be the aggravation of a "dependency" syndrome. Existing community networks and agencies can therefore play a major role in disaster management, but the pressing need is for such groups to expand their roles in disaster reduction and mitigation activities and not merely to focus on relief activities."

Based on the above, it is important to consider the community in the ADM not only as helpless victims of disaster events, but as empowered role-players who can play a valuable role in support of both pre- and post-disaster activities. Table 9-1 provides an overview of the roles various groups within the community can play in disaster management activities.

Table 9-1: Function of Community members and Authorities

Community Role Player	Function
The Disaster Management Volunteers	The formal, trained volunteer unit assist Disaster Management in their functions.
The Residents and affected communities	Assist with disaster risk reduction and co-operation.
The Ward Councillors	The Ward Councillors assist with community liaison.
The Community Leaders	The Community Leaders assist with community liaison.
Community Development Workers (CDWs)	CDWs assist with liaison and needs identification.

9.1.3 Healthcare Representatives

Healthcare representatives play a critical role in disaster management. This is not only true for post-disaster response activities, but more so for pre-disaster risk reduction. Health related role players can play a valuable role in improving the health of community members, thereby decreasing vulnerability to some types of hazards, but can also play a role in surveillance and early warning to identify the outbreak of diseases.

The location of health related facilities within the ADM was identified based on GIS data received from the ADM as well as the NDMC. The location of all the facilities included in the GIS modelling process is shown in Figure 9-1 with a distance buffer around each of the facilities.

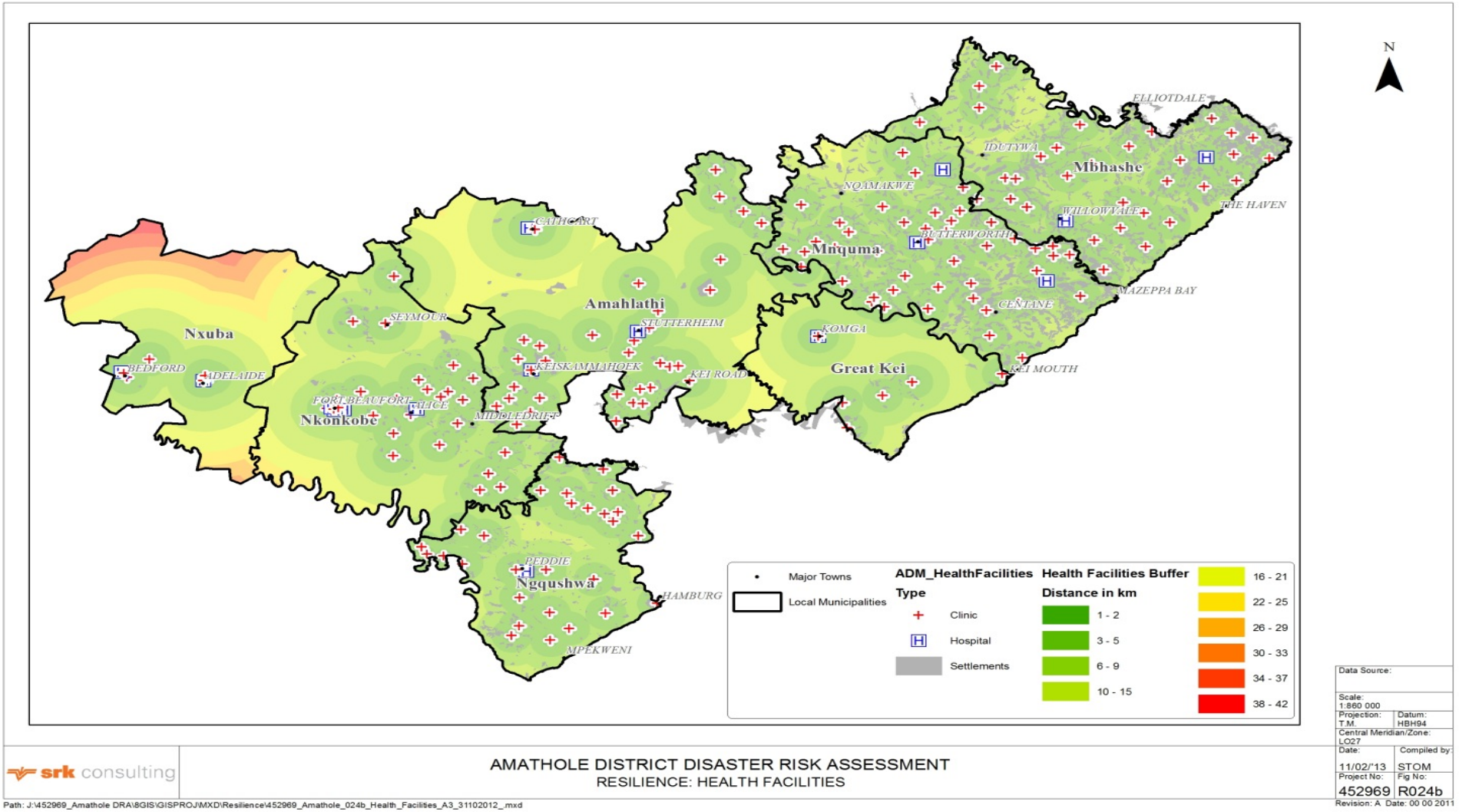


Figure 9-1: Location resilience based on Healthcare related facilities in the ADM

9.1.4 Education

Role-players in the education sector not only play an important role in terms of capacity building and raising awareness, but can also assist with risk reduction and response initiatives. Schools often also have infrastructure that can be used during the response to disasters. Please refer to Figure 6-23: Schools in ADM.

9.1.5 Department of Social Development / Social Security

The Department of Social Development has the following primary core functions:

- Management and oversight over social security, encompassing social assistance and social insurance policies that aim to prevent and alleviate poverty in the event of life cycle risks such as loss of income due to unemployment, disability, old age or death occurring.
- Developmental social welfare services that provide support to reduce poverty, vulnerability and the impact of HIV and AIDS through sustainable development programmes in partnership with implementing agents such as State-funded institutions, Non-Governmental Organisations (NGOs), Community-Based Organisations (CBOs) and Faith-Based Organisations (FBOs).

9.1.6 Department of Home Affairs

The mandates of the Department of Home Affairs are embedded in legislation, as well as other policy documents. In order to fulfil its mission the Department executes or participates in the execution of Civic, Immigration and other mandates. Some of the core functions include the following key services, such as Civic Services. This entails:

- Maintaining the National Population Register;
- Management of records;
- Citizenship;
- Travel documents and passports; and
- Identity documents (DHA 2009).

Immigration services provided by the Department include:

- Admissions;
- Inspectorate;
- Refugee affairs;
- Information co-ordination;
- Policy directives; and
- Counter-xenophobia (DHA 2009).

From this overview, it is evident that the Department of Home Affairs can play an important role in Disaster Management. This role is especially important when complex disasters or events such as xenophobic violence occur.

9.1.7 Department of Water Affairs

According to DWAF (2009) *"the Department of Water Affairs and Forestry is the custodian of South Africa's water and forestry resources. It is primarily responsible for the formulation and implementation of policy governing these two sectors and has override responsibility for water services provided by local government. While striving to ensure that all South Africans gain access to clean water and safe sanitation, the water sector also promotes effective and efficient water resources management to ensure sustainable economic and social development. The forestry programme promotes the sustainable management of the country's natural forest resources and commercial forestry for the lasting benefit of the nation."*

Due to the important role that water plays in affecting the vulnerability, resilience and hazard profile of an area, it is clear that the Department of Water Affairs (DWA) plays an important role in Disaster Management. Even though the DWA will play a critical role in terms of setting policies and strategic management of water resources on national level, the local capacity of DWA representatives will affect the ADM more directly. Continued cooperation between disaster management and local representatives of DWA is encouraged.

9.1.8 Disaster Management

The role of the Disaster Management centre is described in the Act and related framework documents. The Disaster Management functions are overall disaster risk management and co-ordination, as per section 44 of the Disaster Management Act. This includes a range of activities both during pre- and post-disaster stages. The results of the self-evaluation of the representatives tasked with disaster management are shown in Table 9-2.

Table 9-2: Results of Self-evaluation: Disaster Management

Capacity and Manageability	Disaster Management
Q5 - Staff/Human Resources	1.3
Q6 - Expertise, Experience & Specialist Knowledge	1.7
Q7 - Vehicles	1.7
Q8 - Equipment	1.7
Q9 - Funding/Budget	1.7
Q10 - Facilities/Buildings	1.5
Q11 - Prevention, Mitigation & Risk Reduction Plans, Policies & Programmes	1.8
Q12 - Response & Recovery Plans, Policies & Programmes	2.0

In this context a value of 3 has the highest capacity and manageability levels, or displayed high levels, and 1 was the lowest, displaying inadequate or lacking levels of capacity and manageability.

It should be stated that the specific needs identified should be given urgent attention. In order to effectively implement Disaster Management within a municipality such as the ADM, an appropriate investment should be made in human resources, disaster management systems, plans and procedures. This can only be done with the commitment and co-operation from senior and top management in the ADM. Secondly, it should be stated that, according to the act and framework, disaster management should, to a large extent, play a coordinating function in the municipality. Due to this, adequate provision and support should be provided to the disaster management function in order to ensure that the required co-operation and coordination can take place between disaster management, other departments and the relevant line functions. This, again, can only be done with adequate support and resources from the relevant council and top management.

9.1.9 Electricity Department

Electricity provision plays an important role with regard to disaster management. Not only can the failure of electricity supply cause wide spread disruption to communities, but extended periods of disruption can reduce the resilience of community and municipal role players especially in disaster situations.

9.1.10 Fire Service

The Fire Service plays a critical role in disaster management. This is not only related to emergency response for incidents such as fires and accidents, but also relates to fire risk reduction with inspections and training throughout the municipality.

The location of fire stations within the ADM was identified based on GIS data received from the ADM as well as the NDMC. The location of fire stations in the ADM is shown in Figure 9-2.

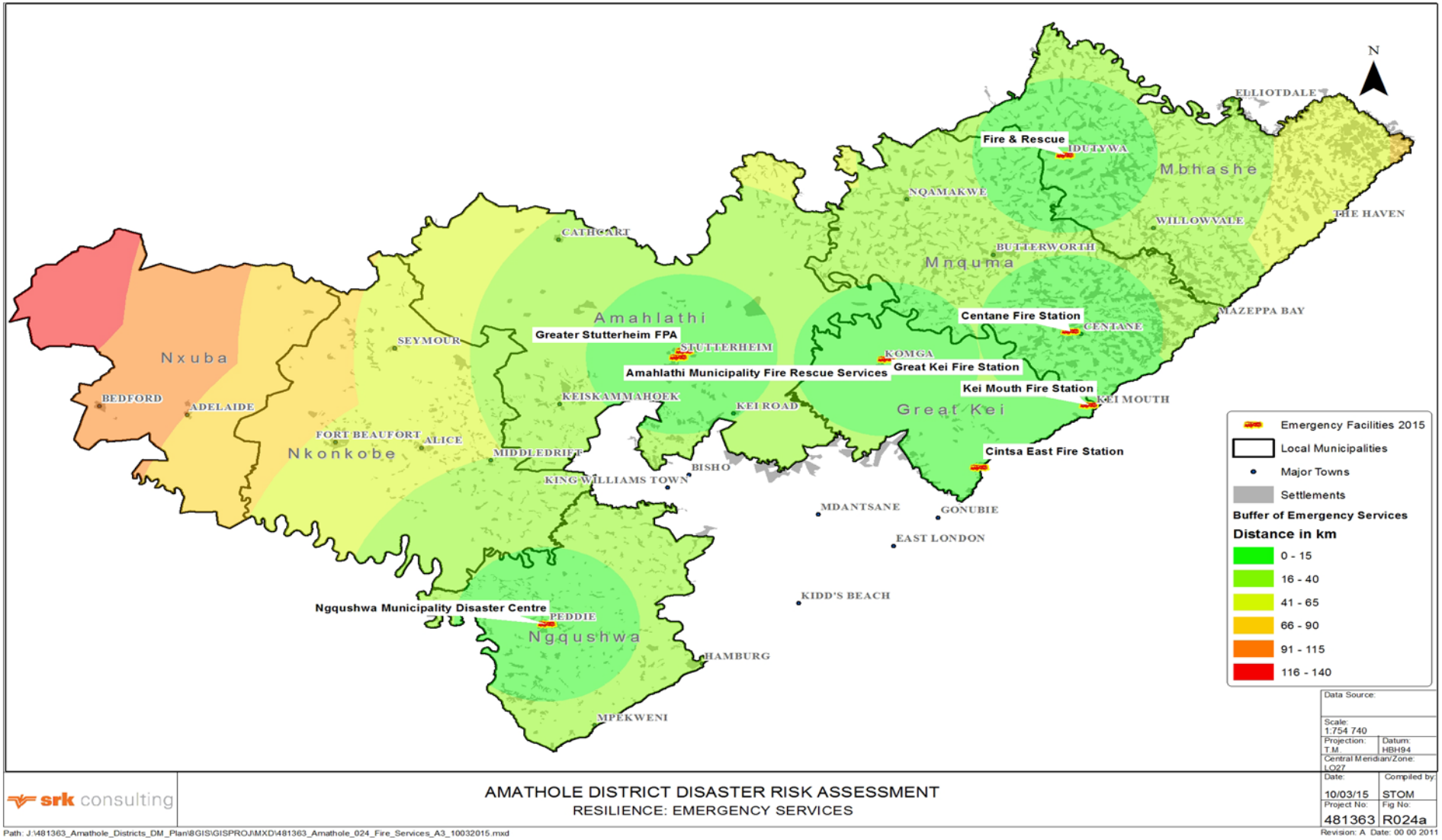


Figure 9-2: Location of Fire Stations in the ADM

Table 9-3: Results of Self-evaluation: Fire Brigade Services

Capacity and Manageability	Fire Brigade
Q5 - Staff/Human Resources	1.0
Q6 - Expertise, Experience & Specialist Knowledge	2.3
Q7 - Vehicles	1.0
Q8 - Equipment	1.0
Q9 - Funding/Budget	1.0
Q10 - Facilities/Buildings	1.3
Q11 - Prevention, Mitigation & Risk Reduction Plans, Policies & Programmes	1.3
Q12 - Response & Recovery Plans, Policies & Programmes	1.3

In this context a value of 3 has the highest capacity and manageability levels, or displayed high levels, and 1 was the lowest, displaying inadequate or lacking levels of capacity and manageability.

9.1.11 Traffic Department

The traffic department can play an important role in both pre- as well as post-disaster situations. Not only does the traffic department assist with managing aspects related to transportation during emergencies and disasters, but the traffic department has an important responsibility with regards to risk reduction and law enforcement which can reduce the risk of transportation related disasters.

Table 9-4: Results of Self-evaluation: Traffic Services

Capacity and Manageability	Traffic Department
Q5 - Staff/Human Resources	1
Q6 - Expertise, Experience & Specialist Knowledge	1.25
Q7 - Vehicles	1
Q8 - Equipment	1
Q9 - Funding/Budget	1
Q10 - Facilities/Buildings	1.5
Q11 - Prevention, Mitigation & Risk Reduction Plans, Policies & Programmes	1.25
Q12 - Response & Recovery Plans, Policies & Programmes	1.25

In this context a value of 3 has the highest capacity and manageability levels, or displayed high levels, and 1 was the lowest, displaying inadequate or lacking levels of capacity and manageability.

9.1.12 Non-Governmental Organizations

Non-Governmental, Religious and Faith Based Organizations can play an important role in disaster management. According to the GPODM (1998) *"non-governmental organisations have often played an important relief role in disasters. Some evaluations of past involvement of non-governmental organisations and during disasters have shown that non-governmental involvement has generally been positive. This is not to say that all community committees worked well. Some have been more successful than others. Conflicts between government and non-governmental organisations, and between community groups, can arise, delaying and hampering disaster management activities. Because non-governmental organisations can often provide relief more quickly, and in the case of small disasters, more appropriately, it is important that the government ensure that non-governmental organisations receive information promptly. At the same time, non-governmental organisations have much useful information to offer to the local early-warning system. Non-*

governmental organisations should therefore be a formal part of the local early-warning system. Even when disasters are so large that they are beyond the resources of the non-governmental organisations, these organisations are often able to provide assistance that is complementary to government. Good links with non-governmental organisations should therefore be promoted at all levels." The above section highlights the importance of the role of NGOs in disaster management.

9.1.13 South African National Defence Force

According to the GPODM[12] (1998), *"the primary role of the SANDF is defence. The SANDF may, however, be employed for service in the preservation of life, health, or property and for service in the provision or maintenance of essential services. The SANDF can also be requested to provide support by other government departments. In the past, the SANDF has provided valuable support and services to national departments and local government where capacity has been lacking. The SANDF's role therefore is cross-cutting and can be used to enhance existing attempts by other government departments to deal with disaster situations more effectively. The SANDF has resources, though limited, to carry out search and rescue operations at land, sea and air, to provide medical support, to transport relief provisions such as food and water, and to undertake the building of bridges, earth removal and road-building. The SANDF can also have access to military assistance in disaster relief operations from the other members of the Southern African Development Community. The SA Air Force can also assist with Search and Rescue Operations. The SANDF has the capability of communicating with the whole defence force and can rapidly distribute information. The SANDF works closely with provinces and at the local level, and cooperates with the SAPS through a system of security committees at all levels.* "It is clear that the SANDF can play a critical role in disaster situations. One such example was the role the SANDF played during the xenophobic violence in South Africa during May 2008.

9.1.14 South African Police Service

According to the GPODM[13] (1998) *"the primary role of the SAPS is crime prevention, crime investigation, and the security of citizens. However, the SAPS may be employed for service in the preservation of life, health, or property and for service in the provision or maintenance of essential services and can be requested to provide support by other government departments. In the past, the SAPS have provided valuable support and services to national departments and local government where capacity has been lacking. The role therefore is cross-cutting and can be used to enhance existing attempts by other government departments to deal with disaster situations more effectively.*

The SAPS has been involved in cases of disaster in crime prevention, control of traffic, maintaining public order and cordoning off and patrolling disaster areas. The SAPS also has a more specialised role in security-related disasters such as civil unrest, bomb explosions and acts of terror. In general, the SAPS are involved in most disasters where negligence is suspected and where people are killed. The SAPS has well-established nodal points which can serve as an early warning system and can be used to enhance preparedness in cases of crisis. The SAPS also has units at the provincial and local levels. It is strengthening its networks and can reach all sectors of our society through the existing Community Policing Forums. These networks are important in mobilizing voluntary support and disseminating information about disasters to communities. In this way, community preparedness can be rapidly activated."

[12] *Sections of quote related to SAPS removed to shorten paragraph.*

[13] *Sections of quote related to SANDF removed to shorten paragraph.*

The role that the SAPS play in terms of specialist as well as supporting function with regard to disaster management is critical. The location of police stations within the ADM was identified based on GIS data received from the ADM as well as the NDMC. The location of the stations included in the GIS modelling process is shown in Figure 9-3.

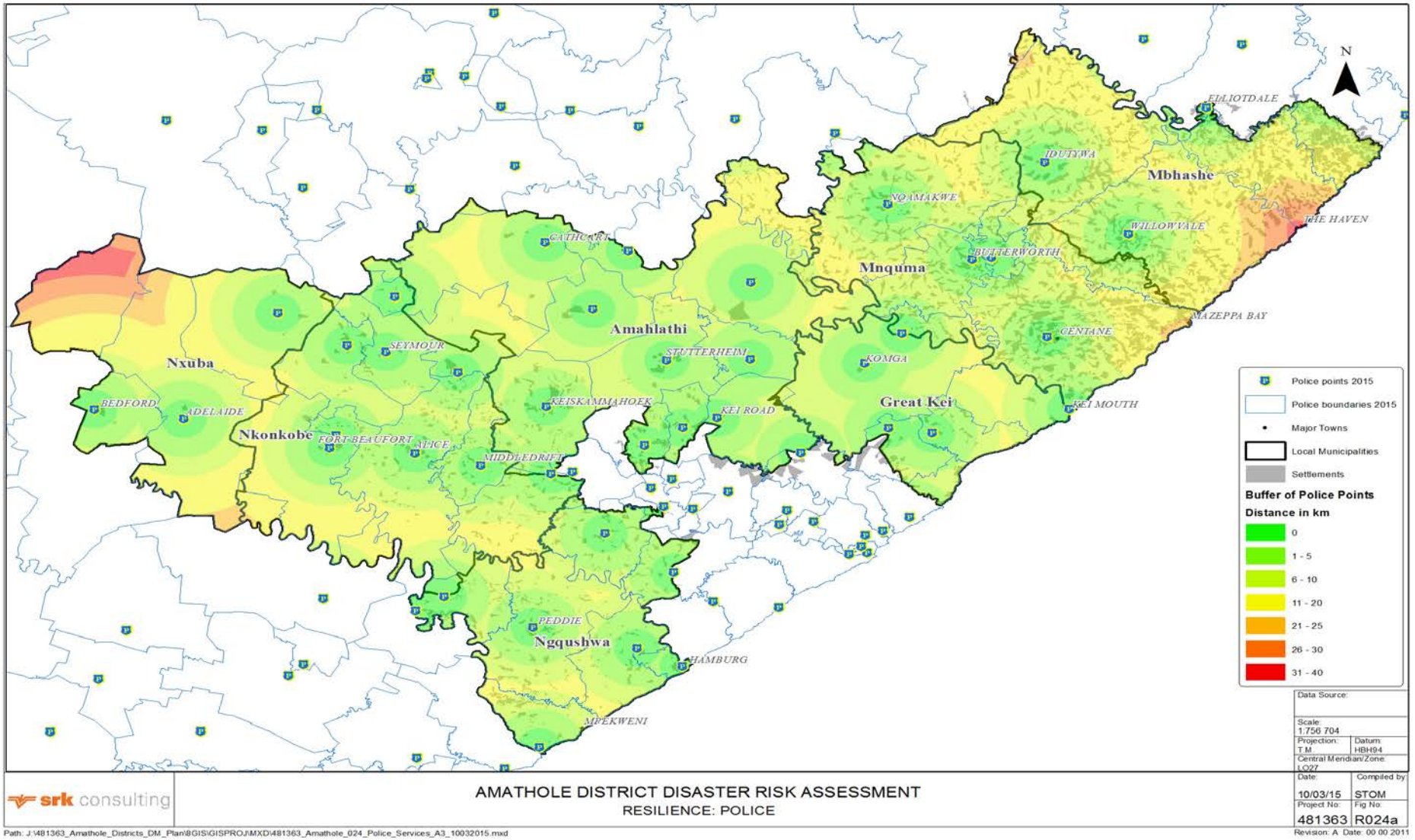


Figure 9-3: Location of Police Stations in the ADM

The SAPS was also included in the self-evaluation exercise. The result is shown in Table 9-5. In this context a value of 3 has the highest capacity and manageability levels, or displayed high levels, and 1 was the lowest, displaying inadequate or lacking levels of capacity and manageability.

Table 9-5: Results of Self-evaluation: South African Police Service

Capacity and Manageability	SAPS
Q5 - Staff/Human Resources	1.3
Q6 - Expertise, Experience & Specialist Knowledge	1.0
Q7 - Vehicles	1.0
Q8 - Equipment	1.0
Q9 - Funding/Budget	1.3
Q10 - Facilities/Buildings	1.0
Q11 - Prevention, Mitigation & Risk Reduction Plans, Policies & Programmes	1.7
Q12 - Response & Recovery Plans, Policies & Programmes	1.7

9.1.15 Weather Services

The South African Weather Service (SAWS) became a public entity on 15 July 2001 in terms of the South African Weather Service Act, Act No. 8 of 2001. In terms of the Act, the company provides two distinct services, namely public good services which are funded by government, and commercial services, where the user-pays principle applies. The South African Weather Service is an authoritative voice for weather and climate forecasting in South Africa and, as a member of the World Meteorological Organization (WMO), complies with international meteorological standards. As an Aviation Meteorological Authority, SAWS is designated by the state to provide weather services to the aviation industry and to fulfil the international obligations of the government under the Convention of the International Civil Aviation Organization (ICAO). The company also provides maritime weather forecasting services for the vast oceans around Southern Africa extending to Antarctica. The SAWS can play a very import role especially in the field of early warning and risk reduction in disaster management.

9.2 GIS based Resilience mapping for the ADM

The risk assessment approach also required the spatial mapping of resilience levels in the ADM. This was done as described in Section 5.6. The result of the resilience mapping based on the location of key facilities is shown in Figure 9-4.

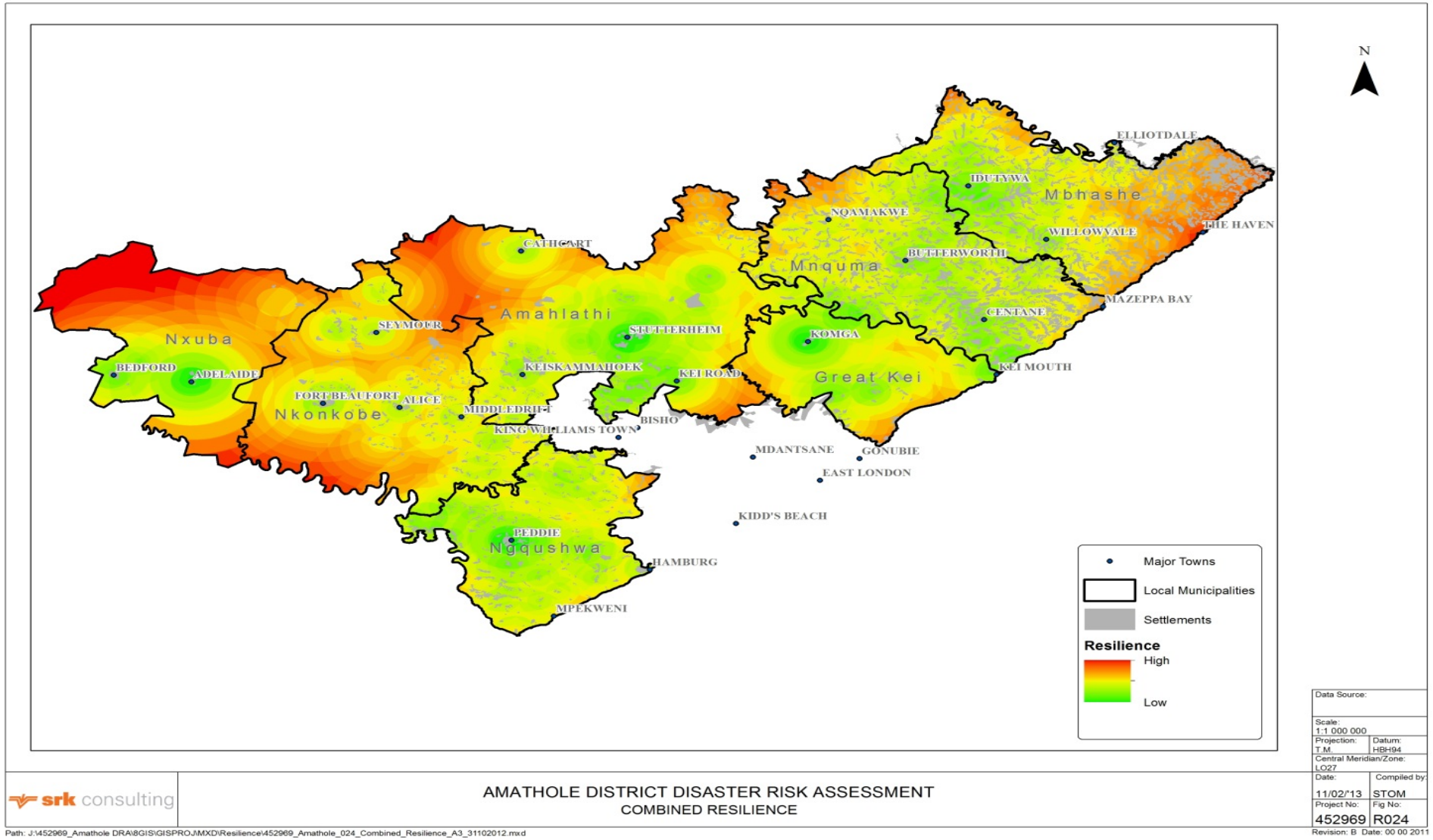


Figure 9-4: Resilience mapping based on location of key facilities in the ADM.

The results from the resilience mapping indicates that settlements located in the eastern part of Mbhashe, northern parts of Nxuba, southern parts of Nkonkobe and northern parts of Amahlathi generally has a lower level of access to facilities that some of the other settlements in the district. This analysis is only based on the location of settlements in related to key facilities.

10 Risk Assessment and Modelling Results

The Risk modelling process was completed by using the hazard, vulnerability and capacity data, and calculating the risk levels as described in Section 5. The risk assessment results for the ADM, based on the different risk assessment approached undertaken, are presented below.

10.1 Prioritised Risk Profile

The prioritised risk profile for the ADM is based on the data received from the workshop consultations, as well as the base data collected during the study. The stakeholder perception data and local resilience data were also compared with the desktop hazard assessment results, and the prioritised risk profile was developed. The Risk Prioritization for the ADM is shown in Table 10-1.

Table 10-1: Prioritized Risks for the Amathole District Municipality

No	Hazard Name	Risk
1	Hydro-meteorological – Drought	Higher Priority
2	Disease / Health - Disease: Human	
3	Transport Hazards - Road Transportation	
4	Civil Unrest – Crime	
5	Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)	
6	Fire Hazards - Formal & Informal Settlements / Urban Area	
7	Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)	
8	Fire Hazards - Veld/Forest Fires	
9	Disease / Health - Disease: Animal	
10	Pollution - Water Pollution (Fresh and Sea)	
11	Pollution - Land Pollution	
12	Environmental Degradation – Deforestation	
13	Infestations - Plant Infestations (Intruder Plants)	
14	Pollution - Air Pollution	
15	Infrastructure Failure / Service Delivery Failure – Electrical	
16	Civil Unrest - Demonstrations / Riots	
17	Hydro-meteorological Hazards - Extreme Temperatures	
18	Infrastructure Failure / Service Delivery Failure - Sanitation	
19	Disease / Health - Disease: Plants	
20	Structural Failure - Bridge Failure	
21	Environmental Degradation – Erosion	
22	Transport Hazards - Rail Transportation	
23	Structural Failure - Building Failure	
24	Geological Hazards - Rock-fall	
25	Major Event Hazards – Sport	
26	Environmental Degradation - Land Degradation	
27	Major Event Hazards – Political	
28	Infrastructure Failure / Service Delivery Failure - Water	
29	Transport Hazards - Water Transportation (Incl. Marine Accident)	
30	Major Event Hazards - Cultural / Religious	
31	Major Event Hazards - Recreational / Commercial	
32	Transport Hazards - Air Transportation	
33	Hazardous Material - Spill/Release (Storage & Transportation)	
34	Civil Unrest - Refugees / Displaced People	
35	Civil Unrest - Xenophobic Violence	
36	Infestations - Insect Infestation	
37	Geological Hazards - Earthquake	
38	Geological Hazards - Landslides/Mud flows	
39	Infestations - Animal Infestation / Over Population	
40	Geological Hazards - Subsidence	
41	Structural Failure - Dam failure	
42	Infrastructure Failure / Service Delivery Failure - Transport	
43	Oceanographic - Tsunami	
44	Infestations - Algal Bloom (Red Tide)	
45	Oceanographic - Storm Surge	
46	Hazardous Material - Fire/Explosion (Storage & Transportation)	
47	Environmental Degradation - Loss of Biodiversity	
48	Other - Space Objects	
49	Infrastructure Failure / Service Delivery Failure - Information Technology	
50	Oceanographic - Sea Level Rise (Climate Change)	
51	Hydro-meteorological Hazards - Desertification	
52	Civil Unrest - Armed Conflict (Civil/Political War)	
53	Infrastructure Failure / Service Delivery Failure - Gas	
54	Civil Unrest - Terrorism	Lower Priority

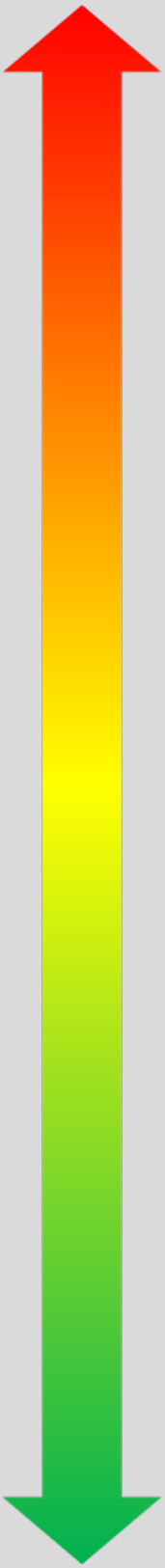


Table 10-2: Prioritized Risks for the ADM Local Municipalities

EC121: Mbhashe
Hydro-meteorological - Drought
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Formal & Informal Settlements / Urban Area
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Fire Hazards - Veld/Forest Fires
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)
Environmental Degradation - Deforestation

EC122: Mnquma
Hydro-meteorological - Drought
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Formal & Informal Settlements / Urban Area
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Fire Hazards - Veld/Forest Fires
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)
Environmental Degradation - Deforestation

EC123: Great Kei
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Fire Hazards - Formal & Informal Settlements / Urban Area
Disease / Health - Disease: Animal
Fire Hazards - Veld/Forest Fires
Pollution - Water Pollution (Fresh and Sea)

EC124: Amahlathi
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Formal & Informal Settlements / Urban Area
Fire Hazards - Veld/Forest Fires
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

EC126: Ngqushwa
Hydro-meteorological - Drought
Disease / Health - Disease: Human
Civil Unrest - Crime
Transport Hazards - Road Transportation
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Fire Hazards - Formal & Informal Settlements / Urban Area
Fire Hazards - Veld/Forest Fires
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

EC127: Nkonkobe
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Fire Hazards - Veld/Forest Fires
Fire Hazards - Formal & Informal Settlements / Urban Area
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

EC128: Nxuba
Hydro-meteorological - Drought
Civil Unrest - Crime
Disease / Health - Disease: Human
Transport Hazards - Road Transportation
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
Fire Hazards - Veld/Forest Fires
Fire Hazards - Formal & Informal Settlements / Urban Area
Disease / Health - Disease: Animal
Pollution - Water Pollution (Fresh and Sea)

11 Results of ward level indigenous knowledge survey

A comprehensive ward level ground truthing survey was conducted by ADM appointed volunteers. The volunteers were trained and organised by the project team. The volunteers conducted a survey on ward level with community representatives to gather indigenous knowledge on disaster related information in ADM. This portion of the DRA was spearheaded by ACETE Development Consultants.

The following table contains the summarised results of this survey. The full results are available electronically under Annexure J.

Table 11-1: Results of indigenous knowledge survey

Municipality		**Great Kei**	**Mbhashe**	**Mnquma**	**Amahlathi**	**Ngqushwa**	**Nkonkobe**	**Nxuba**	**Amathole**
		Average	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**
Q1 - Which of the following Hazards are a problem in your Ward?		**3: Very Severe - 0: Not a concern**							
Air Transportation Hazards (Aircraft or Helicopter Crashes)	3: Very Severe - 0: Not a concern	0.00	0.00	0.05	0.11	0.17	0.00	0.00	0.05
Rail Transportation Hazards (Train & Rail Accidents)		0.00	0.20	0.06	0.07	0.17	0.20	0.00	0.10
Road Transportation Hazards (Car, Taxi & Bus Accidents)		1.60	2.07	1.60	1.33	1.33	2.43	1.50	1.69
Water Transportation Hazards (Boat accidents)		0.00	0.23	0.17	0.04	0.00	0.00	0.00	0.06

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Civil Unrest (Demonstrations / Riots)		0.33	0.87	0.18	0.30	0.33	0.20	0.50	0.39
Civil Unrest (Refugees / Displaced People)		0.00	0.46	0.25	0.27	0.33	0.33	0.00	0.24
Civil Unrest (Xenophobic Violence)		0.75	0.33	0.32	0.16	0.17	0.83	0.00	0.37
Civil Unrest (Terrorism)		0.00	0.40	0.17	0.08	0.17	0.33	0.00	0.16
Civil Unrest - Armed Conflict (Civil/Political War)		0.00	1.00	0.44	0.50	0.17	0.50	0.25	0.41
Civil Unrest - Crime (Theft, Assault, Burglary, Rape)		2.80	2.33	2.48	2.16	2.33	2.86	2.50	2.49
Hydro-meteorological (Drought)		1.60	1.87	1.05	1.57	1.33	2.14	2.25	1.69
Environmental Degradation - Deforestation (Cutting down of a lot of Trees)		1.33	2.14	0.95	1.41	1.67	1.57	0.50	1.37
Environmental Degradation (Erosion)		1.60	2.00	0.74	1.07	1.50	1.43	0.25	1.23
Environmental Degradation - Land Degradation (Reduction in quality of the Soil)		0.67	1.80	0.67	0.97	0.83	1.50	0.25	0.96
Environmental Degradation - Loss of Biodiversity (Disappearance of types of Plants and Animal Species)		0.67	1.47	0.63	0.65	0.83	1.17	0.50	0.84
Animal Disease (Foot and Mouth Disease, Swine Fever, etc.)		1.67	2.20	1.45	1.96	1.33	2.43	1.00	1.72
Human Disease (HIV/AIDS)		2.60	2.47	2.13	2.14	1.83	2.71	2.50	2.34
Human Disease (Tuberculosis - TB)		2.80	2.60	1.95	1.94	2.00	2.43	2.25	2.28
Human Disease (Cholera)		1.25	1.67	1.05	1.08	0.67	0.83	0.75	1.04
Human Disease (Other Diseases - Diarrhoea, etc.)		2.50	2.07	1.30	1.56	0.83	2.00	1.25	1.64

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Plant Disease (Diseases to Crops and other Plants)		1.50	2.40	1.11	1.73	1.17	1.67	0.33	1.42
Fire Hazards (Veld and Forest Fires)		2.20	1.93	1.41	1.49	0.83	1.43	0.50	1.40
Fire Hazards (Building Fires & Fires in Informal Settlements)		0.33	1.27	0.76	0.69	0.50	1.33	0.75	0.81
Hydro-meteorological Hazards (Floods in Rivers, Streams)		0.00	2.15	1.22	1.39	0.83	1.83	1.50	1.28
Hydro-meteorological Hazards (Floods in Streets, Roads, Houses)		1.50	2.00	1.28	1.70	1.67	2.43	1.25	1.69
Geological Hazards (Earthquake or Tremors)		0.00	0.47	0.00	0.44	0.00	0.60	0.00	0.22
Geological Hazards (Landslides/Mud flows)		0.00	0.73	0.00	0.12	0.00	0.00	0.25	0.16
Geological Hazards (Rock-fall)		0.75	0.79	0.25	0.24	0.00	1.00	0.00	0.43
Geological Hazards - Subsidence (Sink Holes)		0.00	0.87	0.50	0.83	0.67	0.25	0.00	0.44
Hydro-meteorological Hazards - Severe Storms (Strong Wind, Hail, Snow, Lightning, Fog)		1.67	2.27	1.52	1.75	1.33	2.57	1.00	1.73
Hydro-meteorological Hazards - Desertification (Plants disappearing and area becoming like Desert)		0.00	1.54	0.41	0.22	0.17	1.40	0.00	0.53
Hydro-meteorological Hazards - Extreme Temperatures (Very Hot or Cold Temperatures)		1.75	1.71	0.45	1.55	1.17	2.14	2.00	1.54
Hazardous Material - Spill/Release (Spillage of petrol, poisons, pesticides, etc.)		0.00	0.33	0.06	0.30	0.00	0.00	0.00	0.10

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Hazardous Material - Hazmat: Fire/Explosion (Burning or explosion of Petrol, Gas, Chemicals, etc.)		0.00	0.33	0.00	0.31	0.00	0.00	0.00	0.09
Infestations - Plant Infestations (Nuisance, Invasive or Alien Plants)		0.00	0.93	0.17	0.40	0.83	0.33	0.50	0.45
Infestations - Animal Infestation / Over Population (Overpopulation of Animals such as Elephants, Rats, etc.)		0.00	1.21	0.24	0.38	1.00	0.60	0.00	0.49
Infestations - Insect Infestation (Infestation of Insects such as Locusts, Beetles, Worms, etc.)		0.33	1.50	0.42	0.55	1.50	1.00	0.75	0.87
Infestations - Algal Bloom (Red Tide)		0.00	1.73	0.29	0.37	0.40	0.60	0.25	0.52
Infrastructure Failure / Service Delivery Failure - Electrical (Power failure or Power Lines collapsing)		1.80	1.60	1.43	1.52	1.50	1.33	1.00	1.46
Infrastructure Failure / Service Delivery Failure - Information Technology (Break in Telephone, Radio, Television or Cell phone Services)		2.00	2.00	1.14	1.28	1.67	1.00	0.50	1.37
Infrastructure Failure / Service Delivery Failure - Sanitation (Breakage or blockage of Sanitation pipes, and failure of Water Treatment works)		1.50	0.80	0.86	1.36	0.67	1.80	0.50	1.07
Infrastructure Failure / Service Delivery Failure - Transport (Forming of Potholes and ditches in Roads)		2.00	2.53	2.10	1.83	2.00	2.67	2.25	2.20
Infrastructure Failure / Service Delivery Failure - Gas (Break of Gas		0.75	0.46	0.22	0.04	0.17	0.20	0.00	0.26

Municipality		**Great Kei**	**Mbhashe**	**Mnquma**	**Amahlathi**	**Ngqushwa**	**Nkonkobe**	**Nxuba**	**Amathole**
		Average	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**
Pipes, or no gas available at refill stations)									
Infrastructure Failure / Service Delivery Failure - Water (Water shortages, or breakage of pumps or pipes)		2.00	2.40	1.70	1.58	2.00	1.86	1.75	1.90
Major Event Hazards - Sport, Religious, Cultural, Recreational (Injuries and damages caused by large groups of people)		0.75	1.47	0.44	0.66	0.67	1.14	0.25	0.77
Pollution - Air Pollution (Smoke, Gas)		0.50	1.27	0.40	1.07	0.00	0.60	0.50	0.62
Pollution - Land Pollution (Waste & Trash)		1.50	1.73	1.21	1.36	0.83	1.43	1.25	1.33
Pollution - Water Pollution (Pollution of Rivers, Streams and Dams)		0.67	2.20	1.10	1.39	1.17	2.00	1.25	1.40
Structural Failure - Bridge Failure (Collapsing of Bridges)		1.00	1.67	0.35	1.05	0.17	1.80	0.50	0.93
Structural Failure - Building Failure (Collapsing of Buildings)		1.50	1.67	0.75	0.97	0.83	2.17	0.25	1.16
Structural Failure - Dam failure (Collapsing of breakage of Dams)		0.00	0.80	0.27	0.53	0.50	1.20	0.25	0.51
Oceanographic (Flooding and damage due to a Tsunami)		0.00	0.40	0.20	0.00	0.17	0.40	0.00	0.17
Oceanographic - Sea Level Rise & Storm Surge (Flooding and damage due to the Sea)		0.67	0.07	0.00	0.00	0.00	0.40	0.00	0.16
Q2 - Which hazards are the biggest problem in the Ward?		Crime	Infrastructure / Service Delivery Failure	Crime	Crime	Crime	Crime	Human Disease	Crime

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
		Human Disease	Human Disease	Human Disease	Infrastructure Failure / Service Delivery Failure	Infrastructure Failure / Service Delivery Failure	Human Disease	Drought	Human Disease
		Service Delivery Failure	Drought & Severe Storms	Infrastructure Failure / Service Delivery Failure	Human Disease	Human Disease	Road Transportation	Road Transportation	Infrastructure / Service Delivery Failure
		Plant and Animal Disease							
		Drought							
		Env. Degradation / pollution							
Q3 - How many people in this ward are healthy?	3: Everybody is healthy 0: No one is healthy	1.20	1.57	1.50	1.70	1.60	1.50	2.00	1.58
Q4 - In which parts of the ward is Crime a problem?	3: Entire Ward 0: No problem	2.57	2.60	2.44	2.49	3.00	2.86	2.50	2.64
Q5 - What crimes are the biggest problem in this ward?		Rape	Theft	Theft / Burglary	Theft	Rape	Theft & Stock Theft	House Breaking	Theft
		Theft	Burglary / House Breaking	Rape	Rape	Theft	Burglary	Domestic Violence	Rape
		Assault	Rape	Assault & Stock Theft	Robberies & Stock Theft		Rape	Rape	Burglary
Q6 - How many people in the ward can read?	3: Everybody 0: No one	1.71	1.60	1.80	1.88	2.17	1.71	2.00	1.84
Q7 - How many of the Children in the ward go to school?	3: Everybody 0: No one	1.67	2.00	1.92	1.97	2.33	2.14	2.00	2.00
Q8 - What communication services are available in the Ward?									
Fixed Line Telephone in dwelling	3: Everywhere in the	0.33	0.07	0.29	0.48	0.67	0.80	1.25	0.56

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Cell phone	Ward 0: Not available	2.29	2.57	2.64	2.61	2.67	2.86	2.25	2.55
Public telephone (in ward)		2.00	0.43	0.39	0.35	0.67	1.20	1.00	0.86
Post Office		0.33	0.20	0.32	0.41	0.33	0.60	0.50	0.39
Post Box		0.00	0.50	0.56	0.72	0.00	0.50	0.25	0.36
No access		0.00	0.70	0.08	0.00	0.00	1.00	0.33	0.30
Q9 - What access do people living in the ward have to the Media or Magazines?									
Newspaper	3: Everywhere in the Ward 0: Not available	1.00	0.20	0.40	0.45	0.67	0.67	1.00	0.63
Radio		2.57	2.60	2.50	2.61	2.40	2.86	3.00	2.65
Television		2.33	1.80	2.20	2.61	2.40	2.29	3.00	2.38
Internet		0.50	0.27	0.28	0.75	0.00	0.83	1.00	0.52
Q10 - How do most people living in the ward travel to work or school?									
Bicycle	3: Everybody uses this mode of transport 0: No one uses this mode	0.00	0.60	0.44	0.51	1.33	0.67	1.00	0.65
Bus		0.67	0.60	0.78	0.81	0.67	0.83	0.00	0.62
Car (driver)		0.33	0.93	1.15	1.21	1.33	1.67	1.00	1.09
Car (passenger)		1.00	1.50	1.70	1.33	2.00	1.86	1.75	1.59
Minibus/Taxi		2.00	0.80	1.32	1.73	1.50	1.50	2.00	1.55
Motorcycle		0.00	0.07	0.19	0.18	0.00	0.00	0.50	0.13
Train		0.00	0.07	0.06	0.03	0.00	0.00	0.00	0.02
Foot		1.60	2.07	2.18	2.02	2.20	2.14	2.25	2.07
Other		0.00	0.13	0.46	0.38	0.50	0.25	0.50	0.32
Q11 - Is domestic violence a problem in the Ward?	3: More Prevalent 0: Less prevalent	1.71	1.33	1.13	1.25	1.00	1.57	1.25	1.32
Q12 - Is alcohol / drug abuse a problem in the Ward?		2.00	2.07	1.96	2.14	2.00	2.29	1.75	2.03
Q13 - Are there churches/religious organization in the Ward?	3: Many Facilities 0: Few Facilities	1.57	1.93	2.21	2.08	2.20	2.57	1.25	1.97
Q14 - Are there Community Based Organizations / Non-Governmental Organizations in the Ward?		0.71	1.08	1.13	1.33	0.20	1.00	1.50	0.99
Q15 - Are there regular arguments between community members within the ward?	3: Yes 0: No	0.86	1.13	1.22	1.61	1.20	1.43	2.00	1.35

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Q16 - Are all groups/people in the community represented when decisions are made?	3: Yes 0: No	2.14	1.93	1.92	2.00	2.17	2.14	2.25	2.08
Q17 - Are there strong family relationships in the Ward?	3: Yes 0: No	1.71	2.00	2.13	1.84	2.00	1.71	2.25	1.95
Q18 - Who use, own, control or manage the resources in the families in the ward?	3: Men 2: Women 1: Both 0: Uncertain	2.14	1.93	1.57	1.35	2.17	0.86	1.50	1.64
Q19 - Who use, own, control or manage the resources in the community?	3: Men 2: Women 1: Both 0: Uncertain	1.57	2.00	1.41	1.37	1.00	1.43	1.00	1.40
Q20 - How many Disabled people live in the Ward?	3: Many 0: Few	1.86	2.13	1.46	1.55	1.50	2.00	1.50	1.71
Q21 - How many Elderly people live in the Ward?	3: Many 0: Few	1.86	2.33	2.00	2.12	2.50	2.71	2.75	2.33
Q22 - How many Child headed households are there in the Ward?	3: Many 0: Few	1.33	1.47	1.30	1.60	1.67	1.71	1.75	1.55
Q23 - Who is responsible to change the current situation within the Community in order to create a safer community?	3: Government 2: NGO's 1: Community 0: Someone else	1.17	1.53	1.75	1.48	2.67	1.57	2.50	1.81
Q25 - Can the community create a safer environment without help and assistance from outside?		No	No	No	Tied	No	No	2 x no & 2 x yes	No
Q26 - Why did you select the answer in the previous question? Explain you answer.			Lack of resources	Need Assistance	Community need to work together	Varying	Lack of skills and resources		Lack of resources
Q27 - What type of Houses are mostly found in the Ward?									
Formal	3: All the houses are this type 0: None of the houses	1.50	0.87	1.45	1.35	2.00	1.67	2.25	1.58
Informal		1.75	1.20	1.16	1.56	1.25	1.33	1.00	1.32
Traditional		2.50	2.13	1.83	1.52	2.00	1.57	0.25	1.69

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Other	are this type		0.25	0.09	0.67	1.00	0.00	0.00	0.33
Q28 - What type of Energy is mostly used in the Ward?									
Electricity	3: Only this type 0: This type is not being used	1.86	1.67	2.00	2.40	2.33	2.14	2.50	2.13
Gas		0.80	0.93	1.00	0.98	1.25	1.00	0.67	0.95
Paraffin		1.67	2.13	2.00	1.53	1.75	1.86	1.00	1.71
Wood		2.17	2.27	1.86	1.57	1.75	1.86	1.00	1.78
Coal		0.00	0.21	0.06	0.19	0.00	0.40	0.00	0.12
Animal dung		1.00	1.80	1.44	0.74	1.25	1.00	0.25	1.07
Solar			0.29	0.20	0.32	0.33	0.20	0.25	0.26
Other			0.00	0.00	0.20	0.00	0.00	0.00	0.03
Q28 - What is the quality of this type of energy in the ward?									
Electricity	3: High 1: Low 0: Not used	1.33	1.17	2.10	2.07	1.83	2.33	2.25	1.87
Gas		2.00	1.33	1.32	1.28	0.75	1.75	2.00	1.49
Paraffin		1.57	1.92	1.72	1.86	1.75	1.67	2.33	1.83
Wood		2.00	2.23	1.74	1.81	1.75	1.60	2.00	1.88
Coal		0.00	0.25	0.38	0.45	0.33	0.80	0.00	0.32
Animal dung		1.33	1.77	1.31	1.06	0.50	0.80	0.33	1.02
Solar		0.67	0.50	0.13	0.53	0.33	0.60	0.33	0.44
Other		0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.04
Q29 - What type of Water Supply is mostly used in the Ward?									
Water is available from the Municipality inside the house	3: Only this type 0: This type is not being used	0.00	0.07	0.53	0.72	0.00	0.33	1.50	0.45
Water is available from the municipality from a tap inside the yard		1.00	0.27	0.58	0.81	0.75	0.50	2.00	0.84
Water is available from a communal stand closer than 200m from the houses		1.33	0.64	0.82	1.81	1.25	2.00	1.00	1.27
Water is available from a communal stand further than 200m from the houses		2.00	0.71	0.65	1.50	1.50	1.00	0.25	1.09
Water is available from a borehole		0.00	0.33	0.13	0.46	0.33	0.00	0.00	0.18

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Water is available from spring		0.33	1.00	0.56	0.35	0.33	0.00	0.00	0.37
Water is available from rain tanks		1.20	1.67	1.35	1.22	1.00	0.83	1.00	1.18
Water is available from a dam or pool		0.80	0.86	0.80	0.92	0.33	0.33	0.50	0.65
Water is available from a river or stream		0.25	2.13	1.47	1.08	0.33	0.71	0.50	0.93
Water is bought from a vendor or other sources		0.75	0.07	0.13	0.17	0.00	0.00	0.00	0.16
Q29 - What quality of this water type in the ward?									
Water is available from the Municipality inside the house	3: High 1: Low 0: Not used	0.00	0.31	0.27	0.80	0.00	0.80	2.50	0.67
Water is available from the municipality from a tap inside the yard		0.33	0.38	0.41	1.00	0.75	1.00	2.25	0.88
Water is available from a communal stand closer than 200m from the houses		1.00	0.75	0.69	1.88	1.00	2.00	1.25	1.22
Water is available from a communal stand further than 200m from the houses		1.00	0.83	0.56	1.44	0.75	1.57	0.33	0.93
Water is available from a borehole		0.00	0.50	0.13	0.53	0.33	0.00	0.00	0.21
Water is available from spring		0.33	1.00	0.56	0.50	0.33	0.00	0.00	0.39
Water is available from rain tanks		2.40	1.54	1.24	1.47	0.67	0.80	1.33	1.35
Water is available from a dam or pool		0.40	0.92	0.60	1.00	0.67	0.50	0.67	0.68
Water is available from a river or stream		0.25	1.46	0.94	1.05	0.67	0.57	0.33	0.75
Water is bought from a vendor or other sources		0.50	0.08	0.13	0.24	0.00	0.00	0.00	0.14
Q30 - What type of Sanitation is mostly used in the Ward?									
Flush toilet with a sewer system	3: Only this type 0: This type is not being used	0.00	0.07	0.61	0.63	0.00	0.50	1.75	0.51
Flush toilet with a septic tank		0.00	0.07	0.24	0.18	0.33	0.17	0.50	0.21

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Chemical toilets are available		0.00	0.33	0.24	0.68	0.00	0.00	0.00	0.18
Pit latrines with ventilation		0.75	0.47	0.47	0.73	1.00	0.67	0.00	0.58
Pit latrine without ventilation		2.00	1.00	0.71	1.05	1.00	0.86	0.00	0.95
Bucket latrine		0.00	0.00	0.07	0.09	0.00	0.17	1.25	0.22
No Toilets		1.75	1.57	1.39	0.91	1.80	0.67	0.00	1.16
Q31 - What type of Waste Removal is mostly provided in the Ward?									
Waste removed once per week	3: Only this type 0: This type is not being used	0.75	0.07	0.63	0.57	0.00	0.50	1.75	0.61
Removed less than once per week		0.00	0.00	0.13	0.18	0.00	0.00	1.00	0.19
People living in the ward use a communal dump		0.00	0.40	0.27	0.16	0.00	0.00	0.75	0.23
People living in the ward use their own refuse dump		2.33	1.33	1.29	2.02	2.20	1.57	0.50	1.61
There is no disposal of waste		2.67	1.36	1.10	0.48	1.00	1.17	1.00	1.25
Q32 - What type of Roads are mostly found in the Ward?									
Concrete	3: Only this type 0: This type is not being used	0.00	0.20	0.63	0.48	0.00	0.17	0.33	0.26
Asphalt		0.00	0.13	0.14	0.11	0.00	0.17	0.33	0.13
Gravel / Limestone		2.00	2.20	1.95	2.54	2.67	2.43	1.75	2.22
Unpaved / Dirt		2.33	1.00	1.40	0.58	1.00	1.00	2.00	1.33
No Roads		2.00	1.14	1.00	0.87	1.50	1.00	0.00	1.07
Q33 - What form of Public Transportation is mostly available in the Ward?									
Bus Transportation	3: Only this type 0: This type is not being used	0.00	0.53	0.94	0.69	0.67	1.00	0.00	0.55
Taxi or Mini bus taxis		2.57	1.93	2.09	2.13	2.50	1.86	2.00	2.15
Train Transportation		0.00	0.07	0.00	0.08	0.00	0.00	0.00	0.02
Q34 - What type of Health & Security Services are available in the Ward?									
Public Emergency Health & Ambulances	3: Service available in the ward	1.00	0.40	0.20	1.00	0.75	1.17	1.75	0.90

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Private Emergency Health & Ambulances	2: Within 3km of ward 1: Within 40 km of ward 0: Further than 40km from ward	0.86	0.07	0.05	0.10	0.60	0.00	0.00	0.24
Clinics		1.00	1.80	1.30	1.57	1.83	1.71	2.75	1.71
Public Hospital		1.00	0.87	0.37	0.57	1.00	1.00	2.50	1.04
Private Hospital		0.67	0.07	0.00	0.03	0.25	0.00	0.00	0.14
Pharmacy		0.75	0.47	0.29	0.26	1.00	0.83	1.25	0.69
Doctor		0.80	0.60	0.35	0.61	0.50	0.60	2.25	0.82
Traditional Healer		1.80	2.07	1.53	1.70	1.80	2.50	2.75	2.02
Police Station		1.20	0.60	0.68	0.73	0.60	1.50	2.50	1.12
Fire Station		1.00	0.33	0.35	0.38	0.75	0.40	0.50	0.53
Military Base		0.33	0.00	0.20	0.06	0.00	0.17	0.00	0.11
Q35 - Which of the following Education Services are available in the Ward?									
Crèches	3: Service available in the ward 2: Within 3km of ward 1: Within 40 km of ward 0: Further than 40km from ward	2.80	1.60	2.33	2.18	2.17	2.00	3.00	2.30
Primary School		2.67	2.00	2.50	2.36	2.33	2.86	3.00	2.53
Secondary School		1.60	2.20	2.05	1.80	1.60	2.00	2.00	1.89
Tertiary Education Facilities		0.25	0.40	0.44	0.08	0.25	0.60	0.00	0.29
Q36 - Where do the people normally buy goods / food?									
Large Retailers	3: Service available in the ward 2: Within 3km of ward 1: Within 40 km of ward 0: Further than 40km from ward	0.80	0.47	0.65	0.31	0.75	0.17	0.25	0.48
Medium Shops		0.75	0.93	0.47	0.72	0.80	1.00	2.25	0.99
Small Shops		1.43	2.07	2.26	2.10	2.50	2.57	3.00	2.28
Informal Traders		2.25	2.07	1.71	1.81	1.40	1.86	2.25	1.91
Q37 - Are there Markets or Stalls available for community members to sell local products, goods or agricultural produce?									
Informal Market Area	3: Service available in the ward 2: Within 3km of	0.75	0.29	0.58	0.82	0.40	0.86	1.25	0.71

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Formal Market Area	ward 1: Within 40 km of ward 0: Further than 40km from ward	0.25	0.21	0.28	0.43	0.75	0.43	0.00	0.34
Q38 - How many of the houses in the Ward are located on steep slopes?	3: Many 0: None	1.80	2.07	1.41	1.47	2.00	2.14	0.50	1.63
Q39 - How many of the houses in the Ward are located in flood areas?	3: Many 0: None	2.00	1.33	1.23	1.38	2.20	1.57	0.25	1.42
Q40 - In what industry do the people living in the ward generally work?									
Agriculture Related - Subsistence Farming (Members produce their own food)	3: Everybody 2: Most 1: Some 0: No one	1.00	1.20	0.83	1.18	1.00	1.29	0.50	1.00
Agriculture Related - Commercial Farming (As workers on a Farm)		1.33	0.33	0.40	0.91	1.00	1.14	1.25	0.91
Construction (As builders, Technicians or Machine Operators)		0.86	0.86	0.85	1.09	1.00	1.17	0.75	0.94
Electricity/Gas/Water (As Technicians in Water Treatment, Plumbing, Electricity, etc.)		0.33	0.53	0.56	0.88	0.40	0.83	0.75	0.61
Business Services (For Private Businesses, including Administration, Marketing, etc.)		0.20	0.47	0.50	0.88	0.40	0.33	0.25	0.43
Manufacturing (In Factories)		0.33	0.43	0.50	0.62	0.25	0.17	0.25	0.36
Mining/ Quarrying (As workers in a mine of a quarry)		0.20	0.47	0.35	0.43	0.20	0.00	0.00	0.24
Private Households (As housekeepers or care takers)		0.50	1.07	0.95	0.86	0.60	1.17	1.25	0.91

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Transport/Communication (As drivers or support services to the Transportation Industry)		1.00	1.07	1.05	0.88	0.40	1.00	0.75	0.88
Wholesale/ Retail (In Shops or Shopping Centres)		1.33	0.80	0.72	0.98	0.60	0.83	1.00	0.90
Government (In Government Positions, including Police, Fire, Waste Removal, Sanitation, etc.)		1.00	0.80	1.00	1.08	0.80	1.00	1.25	0.99
Education (As teachers.)		1.17	1.33	1.35	1.17	0.80	1.00	1.00	1.12
NGOs & CBO (As Community workers, Administration assistants, etc.)		0.67	1.00	0.79	1.04	0.60	0.67	1.00	0.82
Other (Please Specify)		0.00	0.17	0.20	0.71	0.00	0.20	0.67	0.28
Q41 - How many Ward members are Employed?					1.00				
Unemployed	3: Everybody 2: Most 1: Some 0: No one	1.50	1.47	1.70	1.93	1.67	1.67	1.75	1.67
Self Employed (Such as Informal Traders or Private Farmers)		0.67	1.00	1.19	1.17	1.00	1.00	1.00	1.00
Seasonal Employment (like Farm Workers during harvesting seasons)		0.86	0.53	0.50	0.77	0.33	1.00	1.25	0.75
Employed (Such as workers in a formal industry)		0.71	0.73	0.89	0.91	0.33	0.50	0.50	0.65
Q42 - How many Ward members borrow or save money?									
Save Money		1.17	1.13	0.81	0.98	1.20	1.14	1.00	1.06
Borrow Money		1.86	1.40	1.30	1.58	2.00	1.57	1.75	1.64
Q43 - How many People living in the ward own the house they live in?									
Own the house - No repayment		2.14	2.27	2.26	2.45	2.67	2.14	1.75	2.24
Own the house - Loan		0.75	0.13	0.47	0.48	0.33	0.50	1.00	0.52

Municipality		Great Kei	Mbhashe	Mnquma	Amahlathi	Ngqushwa	Nkonkobe	Nxuba	Amathole
		Average	Average	Average	Average	Average	Average	Average	Average
Renting the house		1.50	0.47	0.83	0.79	0.00	0.67	1.50	0.82
Q44 - What are the major source of income in this ward?		Social Grants	Social Grants	Social Grants	Social Grants	Social Grants	Social Grants	Pension	Social Grants
		Wages	Self Employed	Wages & Self Employed	Wages & Self Employed	Self Employed	Self Employed	Wages	Self employed
								Grants	
Q45 - What are the major sources of food in this ward?		Commercial	Subsistence	Subsistence	Subsistence	Subsistence	Commercial	Commercial	Subsistence
		Subsistence	Commercial	Commercial	Commercial	Commercial	Subsistence	Subsistence	Commercial
Q46 - Does the community ever experience a seasonal food shortage?		Yes	Yes	No	Yes	Yes	No	No	Yes
Q47 - To what extent is overgrazing a problem in the ward?	3: Big concern 0: No concern	1.80	1.71	1.09	1.38	2.00	1.43	1.00	1.49
Q48 - To what extent is water pollution a problem in the ward?	3: Big concern 0: No concern	1.57	2.47	1.54	1.26	1.67	1.00	1.50	1.57
Q49 - What is the cause of water pollution in this ward?		No Clear Reason	Animals & Lack of sanitation	Animals & Lack of sanitation	Lack of Infrastructure	Human	Waste disposal	Littering / waste disposal	Lack of infrastructure & Waste disposal
Q50 - To what extent is water shortage a problem in the ward?	3: Big concern 0: No concern	1.71	2.40	1.78	1.52	2.00	1.40	1.67	1.78
Q51 - What is the causes of water shortages in the Ward?		Lack of Infrastructure	Lack of Infrastructure	Lack of Infrastructure	Infrastructure and Service delivery failure	Infrastructure and Service delivery failure	Infrastructure and Service delivery failure	Drought	Lack of infrastructure & Service delivery failure
				Drought	Drought	Drought			Drought
Q52 - To what extent is erosion a problem in the ward?	3: Big concern 0: No concern	1.83	1.93	1.45	1.69	1.83	1.33	1.00	1.58

Municipality		**Great Kei**	**Mbhashe**	**Mnquma**	**Amahlathi**	**Ngqushwa**	**Nkonkobe**	**Nxuba**	**Amathole**
		Average	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**
Q53 - Why are the people in this ward vulnerable to disasters? (Poverty, lack of resources, lack of services, etc.)		Poverty	Poverty & Unemployment	Poverty & Unemployment	Poverty & Unemployment	Poverty & Unemployment	Poverty & Unemployment	Poverty & Unemployment	Poverty & Unemployment
					Education and awareness		Unsafe living structures	Lack of resources	

12 Conclusions

The top 10 disaster risks for ADM were identified as:

- Hydro-meteorological - Drought
- Disease / Health - Disease: Human
- Transport Hazards - Road Transportation
- Civil Unrest - Crime
- Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
- Fire Hazards - Formal & Informal Settlements / Urban Area
- Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
- Fire Hazards - Veld/Forest Fires
- Disease / Health - Disease: Animal
- Pollution - Water Pollution (Fresh and Sea)

It was evident from the results of the community survey that there is a strong correlation between the desktop identified hazard, vulnerability and resilience factors and what the perceived causes of potential disasters could be in the community's opinions.

These priority risks should also be reflected in the future budgets and the IDP of ADM. There should be specific focused actions to reduce vulnerability, minimise hazards and to increase resilience with relation to these risks.

It is becoming more and more apparent that we have to consider risk from all angles in South Africa. Strengths such as strong traditional structures should be targeted and utilised in focused community awareness programs aimed at reducing risk. A lot of risks are closely related and directly or indirectly influence the each other. Plant Infestation will for example exasperate drought due to the fact that alien plants affect ground water. This means that if you address plant infestation you are indirectly reducing the risk of drought

13 Recommendations

It is recommended that ADM should constructively build to a level 3 Disaster Management Plan, as required by the National Disaster Management Framework by engaging in the following actions:

- A level 2 Disaster Management plan should be drafted, as the next step to following a phased approach to drafting a level 3 plan as contemplated in the National Disaster Management Framework; and
- Detailed studies should be conducted into the high priority risks to initiate focused risk reduction strategies and risk monitoring.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Appendix A - Hazard Categories and Listing

No	Hazard category
1	Civil Unrest - Armed Conflict (Civil/Political War)
2	Civil Unrest - Crime
3	Civil Unrest - Demonstrations / Riots
4	Civil Unrest - Refugees / Displaced People
5	Civil Unrest - Terrorism
6	Civil Unrest - Xenophobic Violence
7	Disease / Health - Disease: Animal
8	Disease / Health - Disease: Human
9	Disease / Health - Disease: Plants
10	Environmental Degradation - Deforestation
11	Environmental Degradation - Erosion
12	Environmental Degradation - Land Degradation
13	Environmental Degradation - Loss of Biodiversity
14	Fire Hazards - Formal & Informal Settlements / Urban Area
15	Fire Hazards - Veld/Forest Fires
16	Geological Hazards - Earthquake
17	Geological Hazards - Landslides/Mud flows
18	Geological Hazards - Rock-fall
19	Geological Hazards - Subsidence
20	Hazardous Material - Fire/Explosion (Storage & Transportation)
21	Hazardous Material - Spill/Release (Storage & Transportation)
22	Hydro-meteorological - Drought
23	Hydro-meteorological Hazards - Desertification
24	Hydro-meteorological Hazards - Extreme Temperatures
25	Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)
26	Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)
27	Infestations - Algal Bloom (Red Tide)
28	Infestations - Animal Infestation / Over Population
29	Infestations - Insect Infestation
30	Infestations - Plant Infestations (Intruder Plants)
31	Infrastructure Failure / Service Delivery Failure - Electrical
32	Infrastructure Failure / Service Delivery Failure - Gas
33	Infrastructure Failure / Service Delivery Failure - Information Technology
34	Infrastructure Failure / Service Delivery Failure - Sanitation
35	Infrastructure Failure / Service Delivery Failure - Transport
36	Infrastructure Failure / Service Delivery Failure - Water
37	Major Event Hazards - Cultural / Religious
38	Major Event Hazards - Political
39	Major Event Hazards - Recreational / Commercial
40	Major Event Hazards - Sport

No	Hazard category
41	Oceanographic - Sea Level Rise (Climate Change)
42	Oceanographic - Storm Surge
43	Oceanographic - Tsunami
44	Other - Space Objects
45	Pollution - Air Pollution
46	Pollution - Land Pollution
47	Pollution - Water Pollution (Fresh and Sea)
48	Structural Failure - Bridge Failure
49	Structural Failure - Building Failure
50	Structural Failure - Dam failure
51	Transport Hazards - Air Transportation
52	Transport Hazards - Rail Transportation
53	Transport Hazards - Road Transportation
54	Transport Hazards - Water Transportation (Incl. Marine Accident)

Appendix B – GIS RHVMC Modelling & Buffer Guidelines

NMMDM Draft Hazard Modeling Guidelines

ID	Main Category	Sub Category	Hazard Sub Category	Identified Hazard Information				
				Method	Applicable Land Cover / Base data (Core)	Buffer_1 (Distance from core)	Buffer_2 (Distance from Buffer1)	Rating
001	Technological	Transport Hazards	Air Transportation	Desktop identification of routes and landing strips	Main landing/departure routes including a 1000m buffer (see specific guidelines) in identified area. See sheet 2	2 000m	None	As from Workshops Sheet / Calculations
001	Technological	Transport Hazards	Air Transportation	Desktop identification of routes and landing strips	3000m Buffer of airfields			
002	Technological	Transport Hazards	Rail Transportation	Desktop identification of routes and stations	All rail in identified area including a 50m buffer (with same Hr as core value)	20m	None	As from Workshops Sheet / Calculations
002	Technological	Transport Hazards	Road Transportation	Desktop identification of roads and hazard classification based on road type	See Sheet: Road Accidents		None	As from Workshops Sheet / Calculations
003	Technological	Transport Hazards	Water Transportation	Desktop buffer of coastline	20m buffer on land and sea			
004	Human	Civil Unrest	Demonstrations / Riots	Desktop identification of land use data	Main Routes, Government, Educational and Major Industry buildings in identified area	500m	500m	As from Workshops Sheet / Calculations
004	Human	Civil Unrest	Refugees / Displaced People	Stakeholder input (Polygon)/ Naming of ward number or settlement	Settlements / identified areas			As from Workshops Sheet / Calculations
004	Human	Civil Unrest	Xenophobic Violence	Stakeholder input (Polygon)/ Naming of ward number or settlement	Settlements / identified areas			As from Workshops Sheet / Calculations
004	Human	Civil Unrest	Terrorism	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable buildings (National Key Points, Government offices, Mass Event Venues/Businesses, Military Bases, Diplomatic Buildings, etc) in identified areas			As from Workshops Sheet / Calculations
004	Human	Civil Unrest	Crime	Stakeholder input (Polygon)/ Naming of ward number or settlement	Settlements / identified areas	None	None	As from Workshops Sheet / Calculations
005	Natural	Hydro-meteorological	Drought	Desktop study, combination of rainfall history and land cover data	Use land cover to identify vulnerable land use types	None	None	As from Workshops Sheet / Calculations
006	Environmental	Environmental Degradation	Deforestation	Desktop study, land cover data and stakeholder input (Polygons)	Settlements in identified area including a 500m Buffer	500m	None	As from Workshops Sheet / Calculations
006	Environmental	Environmental Degradation	Erosion	Desktop study, land cover data and stakeholder input (Polygons)	Eroded areas as per land cover data and 1:50 000 shapefiles	100m	None	As from Workshops Sheet / Calculations
006	Environmental	Environmental Degradation	Land Degradation	Desktop study, land cover data and stakeholder input (Polygons)	Urban and degraded areas as per land cover	100m	None	As from Workshops Sheet / Calculations
006	Environmental	Environmental Degradation	Loss of Biodiversity	Desktop study, land cover data and stakeholder input (Polygons)	Classify NMMDM Biodiversity Data	None	None	As from Workshops Sheet / Calculations
``	Natural	Disease / Health	Epidemic Disease: Animal	Desktop study, land cover data and stakeholder input (Polygons)	Farms, Nature Reserves and identified areas, 5km buffer of International border	5000m	3000m	As from Workshops Sheet / Calculations
008	Natural	Disease / Health	Epidemic Disease: Human	Stakeholder input (Polygon)/ Naming of ward number or settlement	Urbanized areas based on ratings ins human epidemics sheets			As from Workshops Sheet / Calculations
009	Natural	Disease / Health	Epidemic Disease: Plant	Stakeholder input (Polygon)/ Naming of ward number or settlement				
010	Natural	Fire Hazards	Veld Fires	Desktop study, land cover data and stakeholder input (Polygons)	Based on Landcover, calculated factors	None	None	As from Workshops Sheet / Calculations
010	Technological	Fire Hazards	Settlements / Urban Area	Desktop study, land cover data and stakeholder input (Polygons)	Developed/Settlement areas as identified	300m	100m	As from Workshops Sheet / Calculations
011	Natural	Hydro-meteorological Hazards	Floods	Desktop study: Use available floodlines / create buffers of rivers and streams	Identified Rivers and Waterways	100 year floodplain width or 100m buffer	None	As from Workshops Sheet / Calculations
012	Natural	Geological Hazards	Earthquake	Stakeholder input (Polygon)/ Naming of ward number or settlement	Fault line / other identified areas including a 5km hazard buffer (with same Hr as core value) .	5 000m	5 000m	As from Workshops Sheet / Calculations
012	Natural	Geological Hazards	Landslides	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable slopes in identified area	200m	200m	As from Workshops Sheet / Calculations
012	Natural	Geological Hazards	Rock-fall	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable slopes in identified area	200m	200m	As from Workshops Sheet / Calculations
012	Natural	Geological Hazards	Subsidence	Desktop study, geological data and stakeholder input (Polygons)	Areas with applicable geological characteristics (including undermined and dolomite) in identified areas	250m	250m	As from Workshops Sheet / Calculations
013	Natural	Hydro-meteorological Hazards	Severe Storms	Stakeholder input (Polygon)/ Naming of ward number or settlement	Area identified	6 000m	5 000m	As from Workshops Sheet / Calculations
013	Natural	Hydro-meteorological Hazards	Desertification	Desktop study, land cover data and stakeholder input (Polygons)	Based on desertification base data	2 000m	1 000m	As from Workshops Sheet / Calculations
013	Natural	Hydro-meteorological Hazards	Extreme Temperatures	Stakeholder input (Polygon)/ Naming of ward number or settlement	Area identified	4 000m	4 000m	As from Workshops Sheet / Calculations
014	Technological	Hazardous Materials	Hazmat: Spill/Release	Desktop study, transportaion and land use data and stakeholder input (Polygons)	Industrial area/Hazardous Facility (including petrol/gas transport routes) in identified area	400m	None	As from Workshops Sheet / Calculations
014	Technological	Hazardous Materials	Hazmat: Fire/Explosion	Desktop study, transportaion and land use data and stakeholder input (Polygons)	Industrial area/Hazardous Facility (including petrol/gas transport routes) in identified area	400m	None	As from Workshops Sheet / Calculations
015	Natural	Infestations	Plant Infestations	Stakeholder input (Polygon)/ Naming of ward number or settlement / Available vegetation data	Identified areas	500m except for water bodies	300m except for water bodies	As from Workshops Sheet / Calculations
015	Natural	Infestations	Algal Bloom (Red Tide)	Stakeholder input (Polygon)/ Naming of ward number or settlement				
015	Natural	Infestations	Animal Infestation / Over Population	Stakeholder input (Polygon)/ Naming of ward number or settlement	Farms & Natural Environments in identified area	500m	300m	As from Workshops Sheet / Calculations
015	Natural	Infestations	Insect Infestation	Stakeholder input (Polygon)/ Naming of ward number or settlement	Farms & Natural Environments in identified area	500m	300m	As from Workshops Sheet / Calculations
016	Technological	Infrastructure Failure / Service Delivery Failure	Electrical	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable infrastructure (power and sub stations, etc) in identified area (Rated importance of Infrastructure)	None	None	As from Workshops Sheet / Calculations
016	Technological	Infrastructure Failure / Service Delivery Failure	Information Technology	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable infrastructure (telecoms towers) in identified area (Rated importance of Infrastructure)	None	None	As from Workshops Sheet / Calculations
016	Technological	Infrastructure Failure / Service Delivery Failure	Sanitation	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable infrastructure (Sewage works and network) in identified area (Rated importance of Infrastructure)	None	None	As from Workshops Sheet / Calculations
016	Technological	Infrastructure Failure / Service Delivery Failure	Transport	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable infrastructure (Roads and bridges) in identified area (Rated importance of Infrastructure)	None	None	As from Workshops Sheet / Calculations
016	Technological	Infrastructure Failure / Service Delivery Failure	Water	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable infrastructure (Water Treatment works) in identified area (Rated importance of Infrastructure)	None	None	As from Workshops Sheet / Calculations
016	Technological	Infrastructure Failure / Service Delivery Failure	Gas	Stakeholder input (Polygon)/ Naming of ward number or settlement	Applicable infrastructure (Gas pipelines) in identified area (Rated importance of Infrastructure)			
017	Human	Major Event Hazards	Cultural / Religious	Desktop study, buffer churches	All applicable Religious/mass event venues in identified area	100m	100m	As from Workshops Sheet / Calculations
017	Human	Major Event Hazards	Political	Stakeholder input (Polygon)/ Naming of ward number or settlement	All applicable political/mass event venues in identified area	100m	100m	As from Workshops Sheet / Calculations
017	Human	Major Event Hazards	Recreational / Commercial	Stakeholder input (Polygon)/ Naming of ward number or settlement	All applicable recreational/commercial or mass event venues in identified area	100m	100m	As from Workshops Sheet / Calculations
017	Human	Major Event Hazards	Sport	Stakeholder input (Polygon)/ Naming of ward number or settlement	All applicable sporting or mass event venues in identified area	100m	100m	As from Workshops Sheet / Calculations
018	Technological	Pollution	Air Pollution	Desktop study, land use data and stakeholder input (Polygons)	Industrial areas, mines and identified sources buffered with 1000m in identified areas	2000m	None	As from Workshops Sheet / Calculations
018	Technological	Pollution	Land Pollution	Desktop study, land use data and stakeholder input (Polygons)	Applicable sources in identified area, buffered with 100m	300m	None	As from Workshops Sheet / Calculations
018	Technological	Pollution	Water Pollution	Desktop study, land use data and stakeholder input (Polygons)	Applicable sources in identified area, buffered with 100m	300m	2km	As from Workshops Sheet / Calculations
019	Technological	Structural Failure	Bridge Failure	Desktop study, bridge data and stakeholder input (Polygons)	Bridges witf 50m buffer	None	None	As from Workshops Sheet / Calculations
019	Technological	Structural Failure	Building Failure	Desktop study, socio economic and stakeholder input (Polygons)	Large buildings identified	None	None	As from Workshops Sheet / Calculations
019	Technological	Structural Failure	Dam failure	Desktop study, dam data	Based on length of dam wall	None	None	As from Workshops Sheet / Calculations
020	Natural	Oceanographic	Tsunami	Desktop study, Buffer coast, Use contour data	0-10 M High, 11-20m Medium, 21-30m Low hazard	None	None	As from Workshops Sheet / Calculations
021	Natural	Oceanographic	Sea Level Rise (Climate Change)	Desktop study, Buffer coast, Use contour data	0-2 m elevation High	None	None	As from Workshops Sheet / Calculations
021	Natural	Oceanographic	Storm Surge	Desktop study, Buffer coast, Use contour data	0-5m High, 6-10m Medium, 11-15m Low	None	None	As from Workshops Sheet / Calculations

Desktop
Desktop with stakeholder input
Stakeholder input alone

Road Accidents

FEAT_TYPE	Cnt_FEAT_T	Max_Hazard
ARTERIAL ROUTE	31	0.70
HIKING TRAIL	27	0.00
MAIN ROAD	42	0.70
NATIONAL ROUTE	25	0.80
OTHER ACCESS	5338	0.10
SECONDARY ROAD	359	0.50
STREET	14084	0.20
TRACK FOOTPATH	20190	0.00
UNDER CONSTRUCTION	7	0.80

Human Epidemics	
Sum_type	Max_hazard
Formal Residential	0.5
Formal Town	0.5
Former Township	0.6
Industrial / Commercial	0.3
Informal	0.9
Mixed Use	0.3
Rural Settlement	0.7

Urban Fire Ratings				
DESCR	Max_Fuel	Max_Igniti	Max_Manage	Max_Hazard
Urban / Built-up (residential)	0.70	0.60	0.80	1.63
Urban / Built-up (residential, formal suburbs)	0.70	0.60	0.80	1.63
Urban / Built-up (residential, formal township)	0.70	0.60	0.60	2.17
Urban / Built-up (residential, informal squatter camp)	0.70	0.90	0.30	5.33
Urban / Built-up (residential, informal township)	0.70	0.90	0.30	5.33
Urban / Built-up (rural cluster)	0.60	0.70	0.50	2.60
Urban / Built-up, (commercial, education, health, IT)	0.70	0.60	0.80	1.63
Urban / Built-up, (commercial, mercantile)	0.80	0.80	0.80	2.00
Urban / Built-up, (industrial / transport : heavy)	0.80	0.80	0.70	2.29
Urban / Built-up, (industrial / transport : light)	0.80	0.80	0.70	2.29

Appendix C – Risk Reduction Measures

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Hydro-meteorological Hazards - Floods (River, Urban & Dam Failure)	Natural flash floods due to high intensity rainfall, or flooding due to seasonal weather patterns or human manipulation of water catchment or drainage areas, flood plains or dams	• Flash Floods • Rapid run-off • Dam breakage	• Physical Damage – structural damage • Soil movement • Injuries and public health risks • Fatalities • Drowning • Epidemics • Water supply – Contamination of surface and groundwater • Loss of food supplies or agriculture crops • Loss of animals, agricultural implements, seed	• Flood prediction – Seasonal patterns, capacity of drainage region or dam • Mapping of flood plains, aerial or physical surveys • Early warning	• Evacuation • Search and Rescue • Medical support • Disaster Assessment • Water supply / Purification • Food Aid (Short term) • Epidemiology supervision • Temporary housing / shelter
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
	• Depth of water • Duration of flow • Velocity of water • Speed of rise in water level • Frequency • Seasonality	• Location of Settlements in Flood plains • Lack of awareness on flood risk • Reduction in permeability of soil • Lack of buildings and foundations • Unprotected food material, crops and animals	• Mapping of floodplains and land-use planning / control • Awareness raising • Flood controls, dams, erosion protection	• Early warning • Warning • Awareness • Contingency Planning • Flood Master planning	• Forms to determine damage • Land or air surveys.
	KPIs: Measurable performance targets		**Means**		**Main responsible department / stakeholder responsible**
	• Assessment of dambreak impacts on existing developments. • Dam break flood impacts		• Documentation indicating impacts and consequences		• City Engineering & Maintenance
	• Develop indicative flood mapping, giving an indication of the 100-year and RMF floodlines along the major watercourses. • High frequency and risk of flood events, based on past events		• Major impacts on especially informal and low-income settlements		• Disaster Management Centre
	• High water markers and beacons to indicate depth of rivers. • Maintenance of beacons, and installation of additional high water markers		• Maintaining of beacons; identification of positions for high water level markers; installation of high water markers		• City Engineering & Maintenance
	• Flood hazard assessments for selected watercourses. • Hazard assessment studies, reports and associated maps		• Budget allocation for the various projects		• Disaster Management Centre
	• Ensuring no development and building in floodline areas. • Awareness programmes and law enforcement.		• Awareness communication materials (pamphlets/calendars), Media campaigns		• Integrated Development Planning
	• Stormwater maintenance. • Ongoing stormwater maintenance		• Stormwater asset management register and maintenance scheduled and budgeted for.		• City Engineering & Maintenance

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Hydro-meteorological - Drought	Immediate cause – Shortage of Rainfall	• Reducing water and moisture availability • Reduced rainfall • Reduced water resources • Agricultural drought / no moisture in the soil	• Reduction of income • Reduce expenditure in agriculture • Increase in prices of stable foods • High inflation rate • Deterioration of food value • Starvation / diseases / deaths • Reduced sources for drinking water • Migration • Breaking up of communities • Loss of livestock and crops • Unemployment	• Periods of unusual dryness are normal in all weather systems. • Rainfall and hydrological data should be carefully analyzed and if there are factors that influence droughts so prior warning is usually possible.	• Measures to maintain food security • Price stability • Food aid • Job creation programs • Distribution of food • Extra food programs • Special programs for livestock and livestock farmers • Complimentary water and health programs • Rehabilitation
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
	Possible underlying causes: • EL Nino • High temperatures due to heat waves • Man-made changes in ground surface	• Location in arid areas where dry conditions are influenced by drought • Farming in marginal areas – subsistence farming • Lack of agricultural contributions to help improve crops • Areas dependent on other weather systems for water supply • Areas where the soil moisture retention is low • Lack of recognition and allocation of resources for drought obstacles	• Early warning system for drought and famine	• Development of an inter-society contingency plan	• Nutrition surveys • Socio-economic surveys • Monitoring of rainfall and hydrological data • Satellite images

Hazard Name	KPIs: Measurable performance targets	Means	Main responsible department / stakeholder responsible
Hydro-meteorological - Drought	• Alternative dams and/or cross-border water supply negotiations	• Budget and programme action plans for specific water supply schemes	• City Engineering & Maintenance
	• Installation of water collection and storage containers in strategic locations	• Budget and location identification for containers	• City Engineering & Maintenance
	• Installation of collection and storage containers at industries and organisations	• Awareness communication materials (pamphlets/calendars), Media campaigns, Notice boards; Warnings via television, radio, newspapers, verbal.	• City Engineering & Maintenance
	• Installation of collection and storage containers at private homes	• Awareness communication materials (pamphlets/calendars), Media campaigns, Notice boards; Warnings via television, radio, newspapers, verbal.	• City Engineering & Maintenance
	• Linkages of data to monitor long term weather patterns vs water demand. • Change monitored and predictions made	• Scenarios indicated and planned for	• Disaster Management Centre
	• Ground water resources usability known	• Ground water quality survey and impact assessment	
Hydro-meteorological Hazards - Extreme Temperatures	• Early temperature risk predictions based on weather	• Early warning system, linked with Weather Services; Warnings via television, radio, newspapers, verbal.	• Disaster Management Centre
Hydro-meteorological Hazards - Desertification	• Link with Weather Services: Monitoring and studies. Draft medium-longer term contingency plans for areas at risk	• Mainly monitoring	• Parks, Sport & Recreation

<table>
<tr><th>Hazard Name</th><th>Causes</th><th>Characteristics</th><th>General Impact</th><th>Predictability</th><th>Disaster Needs</th></tr>
<tr><td rowspan="6">Hydro-meteorological Hazards - Severe Storms (Wind, Hail, Snow, Lightning, Fog)</td><td>A combination of heat and moisture that forms a low pressure core over the tropical oceans latitudes where the water temperatures are higher than 26 degrees C
Wind currents tolls and collect around the increasing low pressure, it increase in speed to the centre and moves in a circuit driven by trade winds
The low pressure area changes to a tropical cyclone when gale force winds reaches 117 miles per hour</td><td>When the cyclone hit the country, causing strong winds and exceptional rainfall and approaching storms with secondary flooding and landslides</td><td>Physical damage: structures damaged by wind, floods, approaching storms and landslides
Accidents and poor public health can be caused by debris that is blown around or flood contamination of water sources that can lead to virus epidemics
Water supply: groundwater can be contaminated by flood water
Crops and food supplies: strong winds and rain may damage crops on the land as well as food supplies
Communications and logistics: widespread disruption is possible as wind blows telephone lines, power lines, antennas and satellite dishes over. Transport to and repairs can be restricted</td><td>Tropical cyclones / severe winds can be followed from their origin
Accurate predictions about when the country hit, usually an hour ahead of time
Unpredictable direction changes can occur</td><td>Evacuation, emergency housing, food supply, search and rescue
Medical assistance
Water purification
Relocation of logistical support and communication
Disaster rating
Spiritual help and support</td></tr>
<tr><td>Factors increasing risk</td><td>Factors increasing vulnerability</td><td>Risk Reduction guidelines</td><td>Preparedness Measures</td><td>Tools for Impact assessment</td></tr>
<tr><td></td><td>Settlements situated in low lying areas
Settlements in adjacent areas (heavy rainfall with floods)
Poor communication and warning systems
Light structures, old and poor quality construction
Elementary infrastructural roads and bridges</td><td>Risk rating and mapping of obstacles
Control of land use and management of floodplains
Reduction of structural vulnerability
Improvement of vegetation cover</td><td>Public warning systems
Evacuation plans
Education and community participation</td><td>Forms to determine damage
Land and air surveys</td></tr>
<tr><td colspan="2">KPIs: Measurable performance targets</td><td colspan="2">Means</td><td>Main responsible department / stakeholder responsible</td></tr>
<tr><td colspan="2">Early storm risk predictions based on weather</td><td colspan="2">Early warning system, linked with Weather Services; Warnings via Television, radio, newspapers, verbal.</td><td>Disaster Management Centre</td></tr>
</table>

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Geological Hazards - Earthquake & Subsidence	Shifting crust of rock formations all along the degradation or pressure areas and checking back for new direction lines	Earthquakes are caused by waves under the earth's surface that cause: • Surface degradation • After-shocks • Tremors and vibrations • Fusing • Landslides	• Physical damage – damage to structures, infrastructure, fire, dam failures, landslides and flooding • Accidents – often high, especially in densely populated areas, where buildings cannot withstand landslides. • Public health – fracture injuries are the most common problem; pollution of water sources or the collapse of sanitary conditions, the storage of dead bodies and animal carcasses • Water supply – big problems, especially with damage to water systems, pollution from open wells, boreholes and changes in ground levels	• The probability of occurrence can be determined, but not exact timing • Predictions are based on the monitoring seismic activity and appearance and historical observations	• Search and rescue • Emergency medical treatment • Damage needs and valuations programme • Assistance • Emergency housing and food supply • Mortuaries and funerals • Repair en reconstruction • Economic recovery
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
		• Location of settlements in seismic areas • Structures that do not withstand ground movement • Residential buildings with a high occupancy • Lack of information about earthquake risks	• Mapping of barriers and public awareness of training, rating and reducing of structural vulnerability • Control over land use or zoning and the application of construction standards and good construction methods • Insurance	• Earthquakes warning and preparedness programs • Media and radio communication	• Earthquake scale

Hazard Name	KPIs: Measurable performance targets	Means	Main responsible department / stakeholder responsible
Geological Hazards - Earthquake & Subsidence	• Detailed Geological Risk Study in areas at possible risk. Monitoring of types and severity of incidents that may lead to disasters. • Yearly reports and inclusion of data into DMC database	• Contingency Plans for possible occurrences. • Reports submitted to DMC on yearly basis	• Parks, Sport & Recreation

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Fire Hazards - Veld/Forest Fires	• Abundant seasonal rainfall during growing season • Excessive grasslands and vegetation • Heavy weather activities with static electricity and strong winds	• Veld fires cause the destruction of valuable pastures • Disturbing the ecological environment • Can cause drought	Physical damage: • Destruction of valuable grazing • Damage to infrastructure (power lines, telephone lines and camp wires) • Destruction of animal life, the wildlife and the destruction of valuable vegetation has an economic impact on the field • Contribute to drought conditions	• The probability of the appearance and activities can be determined but not with precise timing • Forecast is based on the density of vegetation due to development	• Fire-fighting equipment and water pumps • Establishment of a fire contingency plan • Medical emergency plan • Adequate fire training • Manpower and transportation • Assistance • Economic recovery
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
		• Excessive and lush growth of grass fields, as well as severe weather activities • The inaccessibility of large areas	• Public awareness, training and the establishment of a fire protection unit • Creating firebreaks	• Regular liaison with rural residents and providing ongoing guidance • Use of communication channels to reduce risk	• Mapping of damage by air or land surveys • Evaluation of contingency
	KPIs: Measurable performance targets		**Means**		**Main responsible department / stakeholder responsible**
	• Residential related fires. Awareness programmes		• Awareness communication materials (pamphlets/calendars) • Media campaigns		• Disaster Management Centre & Fire Services
	• Veld fires. Awareness programme in and around open spaces, fire breaks administered		• Awareness communication materials (pamphlets/calendars) • Media campaigns, Notice boards • Fire breaks		• Disaster Management Centre & Fire Services
	• Early fire risk predictions. Early warning of high fire risk places & times, based on weather and vegetation/field condition		• Early warning system, linked with Weather Services; • Warnings via television, radio, newspapers, verbal.		• Disaster Management Centre & Fire Services

<table>
<tr><th>Hazard Name</th><th>Causes</th><th>Characteristics</th><th>General Impact</th><th>Predictability</th><th>Disaster Needs</th></tr>
<tr><td rowspan="11">Disease / Health - Disease: Human</td><td>• Unhygienic conditions due to over-population and poverty
• Ecological changes that favour breeding of transmitters
• People who are not immune and migrate to epidemic disease areas
• Deterioration of food status
• Contamination of water and food sources</td><td>• The risk that disease may be imported or distributed
• Possibility of major patient case loads
• Severe disease leading to disability or death
• Risk of social or economic disruption
• Lack of adequate professional staff and necessary supplies
• Danger of international transfer</td><td>• Illness and death
• Social and political disruption and economic losses
• Increased trauma in residential areas, villages and emergency camps</td><td>• Epidemics can spread due to an increase in travel or migration of people
• Long term – latent symptoms of sexually transmitted diseases
• Reporting of epidemics may increase due to better medical coverage
• Forecast is supported by epidemiological status, but can be impacted by newly formed settlements and emergency camps</td><td>• Emergency medical assistance
• National and International help if epidemic cannot be controlled</td></tr>
<tr><td>Factors increasing risk</td><td>Factors increasing vulnerability</td><td>Risk Reduction guidelines</td><td>Preparedness Measures</td><td>Tools for Impact assessment</td></tr>
<tr><td></td><td>• Poverty
• Lack of immunity (or immunization) to diseases
• Little or no sex education, unsafe sex
• Poor sanitation, poor nutrition, poor water quality and overcrowding
• Disorganized delivery of health services
• Medication existing disease (AIDS/HIV)</td><td>• Structuring of emergency health services
• Prepare a contingency plan for inventory of needed resources
• Establishment of early warning systems through routine investigation
• Training of National, Provincial and Local staff and volunteers in emergency operations</td><td>Intervention:
• Check and confirm diagnoses
• Identify cases
• Discover the source of the epidemic
• Treat cases and control distribution
• Community education regarding personal hygiene</td><td>• Epidemiological surveys
• Evaluation of health care and emergency response systems</td></tr>
<tr><td colspan="3">KPIs: Measurable performance targets</td><td colspan="2">Means</td><td>Main responsible department / stakeholder responsible</td></tr>
<tr><td colspan="3">• Epidemic statistic tracking and warnings. Early warning of possible epidemics in specific areas</td><td colspan="2">• Awareness communication materials (pamphlets/calendars),
• Media campaigns, Notice boards; Warnings via television, radio, newspapers, verbal.</td><td>• Disaster Management Centre</td></tr>
<tr><td colspan="3">• Ensure potable water supply delivery to all settlements, even informal settlements if possible. Water supply delivery programmes in areas where population density is high but water supply not available</td><td colspan="2">• Budget allocation for water piping & supply projects</td><td>• City Engineering & Maintenance</td></tr>
<tr><td colspan="3">• Immunisation programmes.</td><td colspan="2">• List of areas and places immunised</td><td>• Public Health</td></tr>
<tr><td colspan="3">• Logging system and monitoring of communicable diseases on a daily basis at clinics and hospitals, on a central database. Communicable diseases report including graphs</td><td colspan="2">• Database of communicable diseases updated weekly/monthly; monthly digital reports presented to DMC</td><td>• Public Health</td></tr>
</table>

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Hazardous Material - Hazmat: Spill/Release (Storage & Transportation) Hazardous Material - Hazmat: Fire/Explosion (Storage & Transportation)	• Disaster / Explosion in factories or stores that handle toxic substances • Accidents during the transportation of chemicals and toxic substances • In proper waste management of chemicals and toxic substances • Technological system failures • Shortcomings regarding the safety design of factories and stores or safety components • Natural barriers 5005 fires, earthquakes, floods and other factors • Arson or sabotage		Physical damage: • Damage to or destruction of structures and infrastructure • Transport accident damage vehicles and other objects with impact • Industrial fires can reach exceptional high temperatures and large areas are destroyed Accident: • Many people could be killed or injured and may require medical treatment Region-wide: • Pollution of air and water resources, land and wildlife could suffer • Areas uninhabitable for humans and animals • Ecological systems can be disrupted on large scale	• The presence of chemical or industrial accidents is expected to increase as industrialization in developing countries and regions increases as well as railway and road transport increases	• Evacuation from the field • Search and rescue • Alternative water sources • Harvesting and cleaning • Monitoring of impact on environment • Emergency housing • Medical support
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
		• Water pollution (surface and underground) • Persons involved and the community • Structures • Living beings • Ecological damage to wildlife • Crops and environmental damage • Closest to the accident are the most vulnerable • Large scale release of air pollution can spread for miles • Lack of safety measures and evacuation plans • Unconsciousness possible disaster conditions in communities	• Create a contingency plan for technical staff to assist • Community awareness of hazardous installations in their areas • Establishment of disaster response plans	• Mapping of barriers • Identification of hazardous substances • Inspection of chemical factories and storage areas • Monitoring of disposal of toxic waste procedures • Improving fire fighting capabilities • Create evacuation plans • Test alarms warning	• Forms for the evaluation of emergency response plan • Liaison with HAZMED • Rate information system
	KPIs: Measurable performance targets		**Means**		**Main responsible department / stakeholder responsible**
	• Survey of industries (for fire and hazardous materials risks); associated updating of hazard severity map; • Compilation of hazardous materials register/database, indicating the location and contents of facilities spatially and in database format; • Stakeholder meetings to confirm and refine the findings. • Integrated register/database		• Database design, development and population; • Exact information, locality and hazardous materials known. • Ensure industries have emergency and evacuation plans in place		• Disaster Management Centre

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Pollution - Water, Land and Air Pollution	Air pollution - Pollution agents such as: • Sulphur dioxide • Nitric compounds • Carbon dioxide • Lead from industries and transport Water pollution: • Deposit of human waste and domestic waste water • Barrels, ditches and ponds • Runoff of nitrogen from fertilizer Possible heating of the globe: • Accumulation of carbon dioxide from the burning of fossil fuels • Deforestation and methane from livestock Depletion of Ozone: • Chlorine fluoride carbons that are released in the atmosphere thin out the Ozone cover against ultra violet rays		Air pollution: • Damaged agricultural crops (Lucerne / maize) • Structural materials and human health Water pollution: • Distribution of chemicals to the environment • That affects the health of humans and animals Heating of the globe: • Rise in seal level • Climate change • Higher temperatures Thinning of Ozone layer: • Increase in skin cancer • Cataracts of the eyes • Deterioration in function of the immune system	• Pollution is related to the per capita consumption, pollution tends to be increasing as countries develop	
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
		• High levels of industrialization and per capita use • Lack of regulation of pollution agents • Insufficient resources to use against the impact of pollution	• Lay down ambient air standards • Lay down limits for each contamination agent • Set protection measures for water supplies • Reduce the rate of deforestation and increase tree planting • Promote energy efficiency • Regulate the use of aerosols and the disposal of refrigeration units • Prohibit the manufacture and use of chlorine fluoride carbons	• Establish a Local, Provincial and National environmental and safety protection plan • Create educational programs for environmental awareness • Training of Local, Provincial and National staff as part of the development process	• Air, distance and ground surveys • Air, water and ground equipment • Comparison of climatologically data • Socio-economic surveys

Hazard Name	KPIs: Measurable performance targets	Means	Main responsible department / stakeholder responsible
Pollution – Water and Land Pollution	• Specific incidences quickly and effectively reported and information distributed for possible evacuation / response. • Immediate warnings once incidents take place	• Awareness communication materials (pamphlets/calendars) • Media campaigns, Notice boards; Warnings via television, radio, newspapers, verbal.	• Disaster Management Centre
	• Industry, Mining and Private Individuals compliance to pollution control requirements. • Quarterly/yearly reports • Possible polluter-pays measures, • Environmental education of public	• List of pollution-control required industries/mines, waste sites etc, • Specific license requirements; • Database of industries/mines checked for reporting and compliance quarterly/annually • List of public education initiatives	• Parks, Sport & Recreation
	• Agricultural awareness. Awareness programmes with farmers with regard to pesticides, herbicides etc. control	• Awareness communication materials (pamphlets/calendars) • Media campaigns, Notice boards; Warnings via television, radio, newspapers, verbal.	• Disaster Management Centre

Risk Reduction Measures

Hazard Name	KPIs: Measurable performance targets	Means	Main responsible department / stakeholder responsible
Pollution – Air Pollution	• Monitor industrial related air pollution, in areas where applicable. • Quarterly/yearly reports; Bylaws; license requirements; • Possible polluter-pays measures	• Industries providing proof of prevention/minitation • measures	• Disaster Management Centre
	• Awareness and subsequent minimisation of air pollution in communities that utilise fuel for heat and cooking, instead of electricity. • Awareness programmes in informal settlements	• Pamphlets and public meetings where community leaders urge community to utilise electricity rather than fires, where possible	• Disaster Management Centre
Environmental degradation	• Waste site location and management. Integrated waste management plans	• Drafting and acceptance of the waste management plans, and spatial data indicating location of all existing and future waste sites	• Parks, Sport & Recreation
	• Erosion protection, especially where sand and gravel mining is taking place. • Stricter environmental controls	• Decreased erosion and extraction	• Parks, Sport & Recreation

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Civil Unrest - Demonstrations / Riots / Xenophobic Violence	• Expatriates from other regions • Unemployment and mainly because of conflict and collapse of law and order • Lead to further population displacement and great misery for millions of people	• Risk of urbanization • Possibility of outbreak of conflict • Lack of housing and food • Unemployment increases • Crime is increasing • Poor health conditions • Rapid population growth	• Loss of necessary livelihoods • Loss of adequate food sources • Sexual transmitted diseases and overcrowding • Large numbers of children without supervision • No security for tension and military activities	• Urbanization taking place • Poor housing and no structures • Unemployment increases • Increase of tariffs for essential services • Lack of emergency medical services	
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
		• Poverty • Unemployment • Uprooted people • Refugees from neighbouring provinces and countries • Political conflict • Taxi violence and conflict • Cultural differences	• Providing permanent housing • Provision of essential services • Create job creation programs • Moral and spiritual support • Counselling regarding contraception • Provision of emergency medical services	• Ground and air surveys • Setting up security and protection measures • Job creation programs and projects • Moral and spiritual support	• Spiritual and social welfare workers to defuse situation • Monitoring the situation • National, Provincial and Local support • Guidance and training regarding the risk • Land and air based aid
	KPIs: Measurable performance targets		**Means**		**Main responsible department / stakeholder responsible**
	• Monitoring system implemented. Database with incidents indicated		• Graphs and probability evaluations updated		• Traffic Services And Saps
	• Incident database to be set up and maintained. Incident database updated and maintained		• Incident database designed, developed and • implemented; updated		• Traffic Services And Saps

Hazard Name	Causes	Characteristics	General Impact	Predictability	Disaster Needs
Transport Hazards - Road / Rail Transportation	• Increased road traffic and the privatization of freight • Overloading of buses and “taxi” transport • Deterioration of roads and main roads	• The incidence of road accidents is expected to increase as road traffic increases • The impatience and careless behaviour of drivers • Uncontrolled walking of animals on roads • Ignoring Law and Order by failing to reduce speed to stop • The driving under the influence of alcohol and drugs	• Loss of life and injuries • Economic impact • Loss of manpower • Place burden on the government of the day • Unemployment due to disability	• Road accidents are predictable during holidays, festivals and peak times due to circumstances	• Emergency medical services and ambulance assistance • Rescue and fire crews • Traffic and police services • National, Provincial and Local Government services • Ground and air support • Moral, spiritual and welfare support services
	Factors increasing risk	**Factors increasing vulnerability**	**Risk Reduction guidelines**	**Preparedness Measures**	**Tools for Impact assessment**
		• Impatience, careless behaviour and poor discipline • Speed and driving under the influence • Poor road surface • Non-sufficient rest and fatigue • Straying animals	• Incident management • Aims to improve roads • Stricter enforcement • Awareness programs and training • Regular media coverage • Visible policing		• Traffic and police services • Department of Transport • Ground and air support • Evaluation of impact
	KPIs: Measurable performance targets		**Means**		**Main responsible department / stakeholder responsible**
	• Road maintenance. Road maintenance projects		• Budget allocation for road maintenance and upgrade projects		• City Engineering & Maintenance
	• Railway maintenance. Railway maintenance projects		• Budget allocation for railway maintenance and upgrade projects		• Spoornet & Transnet
	• Specific incidences quickly and effectively reported and information distributed for possible evacuation. Immediate warnings once incidents take place		• Warnings via television, radio, newspapers, verbal.		• Disaster Management Centre
	• Hazmat transport inspections on road. Inspections		• List of hazmat transporters and spot-checks to ensure they have what they are listed to carry, forwarded bi-monthly to DMC		• Public Health & Traffic Services
	• Transport and container inspections by rail. Inspections		• List of hazmat transporters and spot-checks to ensure they have what they are listed to carry, forwarded bi-monthly to DMC		• Public Health & Traffic Services
Transport Hazards Air Transportation	• Monitoring of types and severity of incidents that may lead to disasters. • Yearly reports and inclusion of data into DMC database		• Reports submitted to DMC on yearly basis		• Disaster Management Centre

Hazard Name	KPIs: Measurable performance targets	Means	Main responsible department / stakeholder responsible
Infrastructure Failure / Service Delivery Failure	• Co-ordination between water, electricity and sanitation services to identify cross-impacts and severity of impacts. • Quarterly task group meetings	• Co-ordination and integrated planning	• City Engineering & Maintenance
Major Events Hazard	• Preparation and planning, and informing communities of events and disaster plans relating to it. • Event plans and pamphlets	• Plans designed and distributed well beforehand	• Disaster Management Centre
	• Database indicating all possible venues and available evacuation and other plans for that venue	• Lists of all venues that could house 250+ persons and associated risks for each, submitted to the DMC and/or Districts/Towns	• Disaster Management Centre
Oceanographic-Tsunami, Sea Level Rise, Storms	• Specific incidences quickly and effectively reported and information distributed for possible evacuation. • Immediate warnings once incidents take place	• Warnings via television, radio, newspapers, verbal.	• Disaster Management Centre
	• Early storm risk predictions based on weather	• Early warning system, linked with Weather Services; • Warnings via television, radio, newspapers, verbal.	• Disaster Management Centre
	• Ensuring sufficient breakwater and related protection	• Planning, implementation, inspections	• City Engineering & Maintenance
Plant infestation /overpopulation	• Monitoring of types and severity of incidents that may lead to disasters. • Yearly reports and inclusion of data into DMC database	• Reports submitted to DMC on yearly basis	• Parks, Sport & Recreation
Animal/Insect infestation /overpopulation	• Monitoring of types and severity of incidents that may lead to disasters. • Yearly reports and inclusion of data into DMC database	• Reports submitted to DMC on yearly basis	• Parks, Sport & Recreation
Deforestation	• Monitoring of types and severity of incidents that may lead to disasters. • Yearly reports and inclusion of data into DMC database	• Reports submitted to DMC on yearly basis	• Parks, Sport & Recreation
Loss of biodiversity	• Monitoring of types and severity of incidents that may lead to disasters. • Yearly reports and inclusion of data into DMC database	• Reports submitted to DMC on yearly basis	• Parks, Sport & Recreation

Appendix D – Electronic Copy of Report and Project Data

SRK Report Distribution Record

Report No.	481363/1 (Final)
Copy No.	2

Name/Title	Company	Copy	Date	Authorised by
Thembile Twala	Amathole Municipality	1	May 2015	
Nomsa Mkaza	Acete Development Consultants	2	May 2015	
Andries Fourie	SRK	3	May 2015	
Matt Braune	SRK	4	May 2015	
Library	SRK	5	May 2015	

Approval Signature: