AMAJUBA DISTRICT MUNICIPALITY ENVIRONMENTAL MANAGEMENT FRAMEWORK

Status Quo Report

ENVIRONMENTAL MANAGEMENT FRAMEWORK FOR THE AMAJUBA DISTRICT MUNICIPALITY

Status Quo Report

Prepared for

AMAJUBA DISTRICT MUNICIPALITY

edtea
Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

Prepared by

Institute of Natural Resources

67 St Patricks Road, Scottsville, 3209
Tel: 033 346 0796, Fax: 033 346 0895, E-Mail: dcox@inr.org.za

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Client:
Ms Nothile Mthimkhulu, DD: Environmental Management
Amajuba District Municipality.
nothilem@amajuba.gov.za;
Tel: 034 3297325
Mobile: 3297200

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Report Compiled by:
Mr Leo Quayle MPhil (Environmental Management - UCT)
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Report reviewed and approved by:
Mr David Cox (M EnvDev)

Technical Team and Contributors:
Mr Leo Quayle (INR)
Ms Simone Chetty (INR)
Ms Samiksha Singh (INR)
Mr Perushan Rajah (INR)
Mr Ian Bredin (INR)
Ms Nosipho Makaya (INR)
Mr Andrew Simpson(IMA Traders)
Mr Paul Hansmeyer (EngeoLab)
Mr Jaques Du Preez (EngeoLab)
Mr Len van Schalkwyk (Thembeni Heritage Resources)

EXECUTIVE SUMMARY

Introduction

The Amajuba District Municipality (ADM) has embarked on the development of Environmental Management Framework (EMF). The need for the EMF was driven by authority concerns in the District regarding the following environmental issues:

- The decline in air quality,
- The extent of water pollution,
- Land degradation and other environmental issues that may negatively affect local people and the growing economy, as well as
- The lack of adequate information to make more informed decisions.

The Institute of Natural Resources NPC (INR) has been appointed to conduct the EMF process on behalf of and in collaboration with the ADM, EDTEA and other key roleplayers in the District.

The purpose of this, the Status Quo phase, is to lay a foundation for sustainable development by generating an understanding of the current situation in the District with respect to environmental attributes and their management.

National, Provincial and Regional Planning Framework

National policy

The primary development policies at a national level that have been considered are the National Development Plan, The New Growth Path, The Comprehensive Rural Development Programme, the Comprehensive Plan For The Development Of Sustainable Human Settlements, the Accelerated and Shared Growth Initiative of South Africa (ASGI-SA) and the National Spatial Development Framework (NSDF).

Provincial policy

The key provincial level policies considered are the KwaZulu-Natal Provincial and Growth Development Strategy and the Provincial Spatial Economic Development Strategy (PSEDP).

The KZN Provincial Spatial Economic Development Strategy (PSEDS), guides planning in the province and serves to give effect to ASGI-SA and the NSDF. The PSEDS identified the following sectors as responsible for driving the growth of the province and addressing unemployment and poverty:

- Agriculture: including agri-industry;
- Industry: including heavy and light industry and manufacturing;
- Tourism: including domestic and foreign tourism; and
- Service sector: including financial.

The PSEDS also summarises the high level cluster priorities and objectives for the Amajuba District. The following priorities relate directly to Amajuba District Municipality given the existing importance of the agricultural sector, the tourism opportunities, and the strategic importance of the water resources located within the municipality.

- Agriculture and Land Reform - The protection of high potential agricultural land for commercial production.

- Tourism - Increase arts and crafts resources and improve benefit to previously disadvantaged areas and land reform
- Industry - Securing of water resources

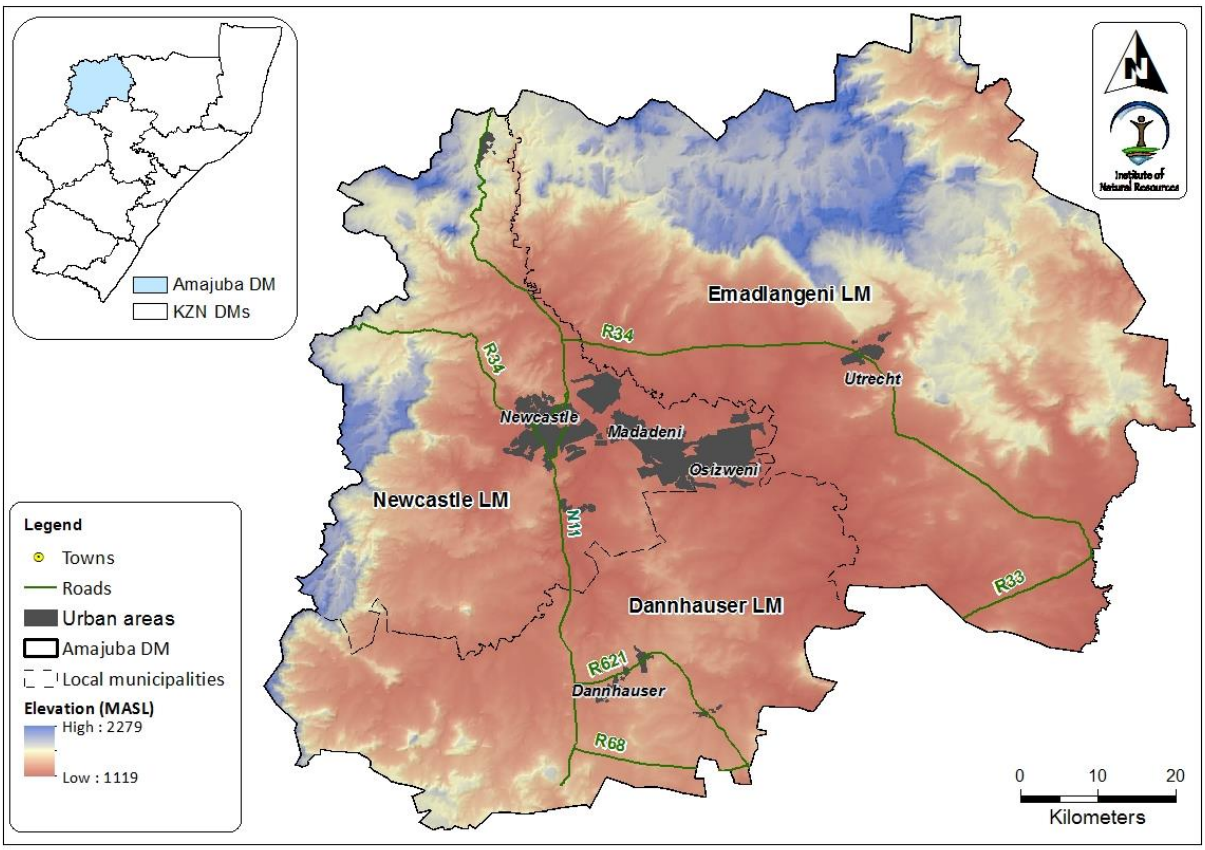
An important part of the PSEDS overall strategic thrust is a focus on development corridors and nodes. To give effect to the PSEDS at a district level, a hierarchy of nodes and corridors is required. From the KZN PSEDS perspective, there are a number of priority nodes in Amajuba District Municipality. Newcastle is listed as multi-sectoral node and is located in the centre of the study area.

Local policy

The most important local planning instruments considered in this study are the ADM Spatial Development Framework (SDF) and the District's Integrated Development Plan (IDP). In addition, planning policy with respect to the District's mountainous regions is relevant and important.

Project area

The ADM comprises three local municipalities (LMs) i.e. Newcastle LM, Dannhauser LM, and Emadlangeni LM. The project area is shown in the figure below. The Newcastle LM is considered the economic hub of the ADM. The key economic activities of the ADM include commercial agriculture, coal mining and industrial manufacturing. There are transport and nodal links to Johannesburg, Durban and Richards Bay ports.



Land use in the ADM consists of an assortment of agriculture (commercial and subsistence), afforestation, industrial uses, mining and high density urban settlements and sparse rural settlements. The vast majority (74%) of the District's land cover consists of natural untransformed vegetation. In almost all areas, this is grassland which is utilised as grazing land for livestock. The more densely populated settlements include Newcastle (central economic hub), Dannhauser, Madadeni, Osizweni and Utrecht.

Socio-economic context

Population

Amajuba District Municipality (ADM) has an estimated population of 531 327 people who are accommodated in 110 963 households (Stats SA 2016 Community survey). This is a youth dominated population distributed as follows:

- Age 0-14 = 35.4%.
- Age 15-65 = 60.9%
- Age > 65 = 3.7%

Although all LMs show an overall growth in population, census data show distinctly that more people are moving to the large Newcastle / Madadeni / Osizweni urban centre. The smaller urban centres of Utrecht and Dannhauser show a net reduction in population. Importantly, there is a trend towards smaller average households meaning many more homes are being built to accommodate this change.

A key aspect of the socio-economic profile of the ADM is the low level of education. The 2011 census (Stats SA) shows that 60% of the people living in this area do not have a matric level qualification and only 5% have any form of tertiary education. Unemployment is consequently high across the district. According to the official definition, employment stands at above 33% of the District's working age population. Using the expanded definition, this figure stands at 71%.

Infrastructure and services

Responsibility for different services infrastructure within ADM varies across different sectors. In addition, responsibility for bulk supply and distribution are separated in several cases.

<u>Water</u>

uThukela water is the primary bulk water service provider to Amajuba District. Responsibility for distribution then rests with the two water services authorities in the District – The Amajuba District Municipality WSA services Emadlangeni and Dannhauser LMs and Newcastle LM WSA is responsible for servicing its own municipal area.

Based on the 2016 Stats SA Community Survey:

- 111 632 people have piped water supply either to inside the home or on site,
- 17% of households rely on communal stand pipes
- 7.9% of households are reliant on boreholes or springs.

Sanitation

There are currently twelve waste water treatment facilities registered on the DWS Integrated Regulatory Information System (IRIS). These are split equally between the two water service authorities in the study area. About 46% of the households in the Amajuba DM have flushed toilets that are connected to a sewerage system, 30% of households utilise unventilated pit latrines and 4% of the households in the Amajuba DM do not have any form of sanitation (Census, 2011).

According to uThukela Water (2012), all of the facilities in the Newcastle LM fleet struggle with aging sewer infrastructure, storm water ingress and resultant hydraulic overloading during summer storm events. This results in the discharge of large volumes of partially treated or untreated effluent.

Electricity

Eskom is the bulk supplier of electricity to Amajuba DM. Newcastle and Emadlangeni LMs possess licenses to supply electricity in certain areas within their LM boundaries. Typically, the CBD and suburbs are supplied by the LM, while outlying townships and rural areas are supplied directly by Eskom. The capacity of Eskom electrification networks within Amajuba DM is considered the key state indicator with respect to the provision of electricity to the municipality.

The majority of networks within the district municipality are not constrained, with certain areas being exceptions. Urbanised areas in Madadeni, Dannhauser and Emadlangeni LMs show some constrained networks, with areas on the outskirts of urban regions indicating slightly constrained networks. The only concern is situated in the northern regions of Emadlangeni and the south-western regions of Dannhauser LMs, as electricity networks in these areas are constrained.

Solid Waste

Individual LMs are responsible for waste management in their municipal areas and are solely responsible for the collection and disposal of waste and the management of their waste disposal sites.

Ten registered landfill sites are located within the NLM of which nine are classified as H:H – that is hazardous facilities. These H:H sites are managed by private sector entities. A registered general waste disposal site is located in Newcastle adjacent to the Newcastle airport. This facility is the largest in the District and is managed by Newcastle LM. In 2004, this site was reported as having sufficient airspace for another two years of operation (Sivest 2004). This site is still however being used today. A new site has been identified and the Newcastle LM is in the process of seeking environmental authorisation for this facility. A key environmental concern with the siting of a landfill site is the potential for such a facility to contaminate groundwater, particularly given the shallow groundwater table across much of the Buffalo River basin. Unregistered waste disposal sites are located in Charlestown, Dannhauser and Waterval Prison whilst a general waste landfill site is located in Utrecht.

Roads

Road hierarchy is a significant determinant in road infrastructure governance as national roads are the sole responsibility of National Department of Transport (DOT) and are maintained through the South African Roads Agency Ltd (SANRAL). Provincial roads (both Provincial main roads and Provincial district roads) are the responsibility of the KwaZulu-Natal Provincial DOT.

The majority of road surfaces within ADM are gravel, with the majority of these gravel roads classed as district distributors. Blacktop (tar) roads cover a significant portion of ADM and are classified as primary and regional distributors. The Draft ADM IDP 2018/19 identified the poor state of several regional roads as a weakness. This is corroborated by the 2012 Amajuba spatial economic overview (Isikhungusethu 2012) which identifies the poor condition of roads as a major challenge in economic development in the region. The majority of community access roads are unsurfaced gravel roads and according to the ADM IDP, they are not constructed according to geometric design standards. The high level of usage by public transport vehicles results in high vehicle maintenance costs and unsafe traveling conditions for passengers. During wet periods, these surfaces become slippery or impassable resulting in unreliable transport options for the communities dependent on these roads.

Water resources

Surface Hydrology

The Amajuba District Municipality (ADM) falls entirely into two primary catchments namely the Thukela and Pongola catchments. The Ngogo, Ncandu, Horn and Ngagane Rivers are important tributaries of the Buffalo River draining from the western highlands while the Slangspruit, Doringspruit and Dorpspruit form the main tributaries in the north. The headwaters of the Pongola River (including the Bivane River) are found in the high lying north eastern areas of the ADM and drain eastwards out of the District.

The Ntshingwayo Dam is fed by the Ngagane River and is situated at the boarder of the Newcastle and Dannhauser Municipalities. This dam is the most important water supply point for Newcastle – the most densely populated area and economic hub of the District. The Zaaihoek Dam is situated in the Emadlangeni Municipality and is used to primarily supply water to Majuba Power Station, but also Volksrust town and to supplement the Vaal catchment.

Surface Water Yield

The ADM intersects two nationally important Strategic Water Source Areas (SWSAs). These mirror the distribution of locally important water source areas which are found in the higher lying sections of the District as is illustrated in the map of runoff categories below.

Because of the District's topographic situation, all of the water used in the Amajuba District comes from the catchments contained within the District's boundaries. There are no transfers of water into the District and no catchments feeding into it. This provides a perspective of the importance of the catchment areas for human wellbeing and economic growth in the District.

Water yield from these catchments is directly affected by vegetation types and cover and invasive alien woody species are increasingly present in these catchment areas. This represents a significant threat to water security in the District.

Water yield is also affected by land use changes. The conversion of natural veld to cultivated agriculture, industry, mining and urbanisation affects runoff and infiltration which in turn affects the quantity, quality and the timing of flows in rivers. Vegetation changes resulting from grazing also decrease the surface vegetative cover which affects water yield. These have all been identified as impacts affecting the ADM strategic water source areas.

Water Quality

Based on the DWS monitoring data for dissolved salts and nutrient indicator groups, a clear gradient / shift in water quality can be noticed moving from the high lying mountainous areas to the lower lying Buffalo River Basin as a result of various anthropogenic activities, particularly around Newcastle and Dannhauser. Monitoring data is unfortunately spatially biased towards impoundments and large areas of the District are not monitored.

Water quality within the ADM is mainly affect by anthropogenic pollution resulting from the domestic, industrial, agricultural and mining sectors. The Thukela River reserve study undertaken in 2004 showed the water quality component of the Present Ecological State (PES) in the Buffalo River below the Utrecht / Osizweni road bridge to be heavily impacted, particularly with respect to various sulphate salts and nutrients.

In particular, Acid Mine Drainage (AMD) is a very real threat to the water quality of the District. AMD results from the oxidation of sulphides, typically pyrite, and is characterized by low pH and high concentrations of SO_4^{2-} (sulphate), iron, metalloids, and many metals (Larsen and Mann 2005). Abandoned mines and tailings piles can be sources for AMD and represent risk to the equilibrium of different ecosystems (Moncur et al. 2005, Cravotta 2008).

In the ADM context, one of the key overarching drivers of change in terms of both water quality and quantity is the combination of population growth, urbanisation, poverty and unemployment. Population growth in urban and peri-urban areas, particularly together with poverty and unemployment, results in the development of informal/unserviced settlements, often close to rivers which inevitably results in a deterioration of water quality through unmanaged sewage and solid waste.

Flood Attenuation Zones

Flood attenuation zones are those areas found adjacent to river systems and which are prone to flooding. These areas play a significant role in dissipating the energy of a flood event and can reduce the impact of flooding on downstream people and infrastructure. It is obviously also important to identify flood zones from a development perspective as flooding poses a risk to human life and any development or activities located within these areas are likely to be damaged or destroyed.

Flood zones in ADM are already highly impacted by agricultural activities and the development of formal and informal settlements and urban areas. These zones are being further impacted by population growth as more people settle in these flood zones which in turn increases human vulnerability.

River Health and Biodiversity

River ecosystems provide essential goods and services for human and environmental well-being. In order to effectively manage the environment to ensure the achievement of a balance between use and protection of river ecosystems it is necessary to characterize each system in terms of its present ecological state (PES) and its ecological value.

The National Freshwater Ecosystem Priority Areas (NFEPA) data set identifies areas that are important for meeting biodiversity conservation goals for freshwater ecosystems. Many of the upper river reaches within the ADM are characterised as river FEPAs. The lower lying areas of the catchment have been characterised as fish support areas. These areas are fish sanctuary areas and are important in the migratory routes of fish species.

DWS's Present Ecological State (PES) information indicates that the Buffalo River is a category B. The Ncandu River is a category D and the Ngagane River is a category C. The results indicate that even though the tributaries are in a poor to fair condition, the main Buffalo River within the ADM is in a good condition which is largely natural with a few modifications.

One of the biggest drivers of change in river health is pollution from activities within the domestic, industrial, mining and agriculture sectors. Another key driver of changes in aquatic ecosystems is invasive alien species. The infestation of riparian areas by alien vegetation can cause significant change in the health of river ecosystems. Alien fish species also have a significant impact on the aquatic ecosystem. Largemouth bass (*Micropterus salmoides*) and Common carp (*Cyprinus carpio*) are both common in the rivers of the District.

Wetlands

The Blood River Vlei, Boschoffsvlei, Groenvlei and the Padavlei are four of the most sensitive and important wetlands in the ADM (among approximately 9200 smaller wetland features).

The District has a high density band of wetlands in the higher lying areas in the north west stretching from the important Blood River Vlei and its upper catchment, through the upper Bivane and Pongola River catchments up to the upper catchment of the Slang River which hosts Zaaihoek dam and Groenvlei wetland. The upper catchments of the Ncandu, Horn and Ngagane Rivers are similarly densely populated with wetlands. The low lying Buffalo River flood plain also hosts a number of wetlands, but the density here is lower. The important Boschoffs Vlei is located in this area.

According to the ADM EMP (2003) the Boschoffsvlei is in a fair condition and the Groenvlei is in a good condition. There is however no record of wetland condition for the thousands of smaller wetland systems in the ADM. There are however many factors which impact on their condition. One of the main drivers of change in wetland extent and condition is the draining

wetland areas for agriculture. Developments such as dams and industrial and domestic housing complexes also drive change within wetland ecosystems. In particular, the flat Buffalo River flood plain has been heavily utilised for the development of housing, both formal and informal and other infrastructure.

Wetlands provide many ecosystem services such as water purification, flood control, groundwater replenishment, sediment control and are areas of high biodiversity. In particular, the ADM is geographically located in an important water supply area, and water generated in the catchments of this District is not only critical to the continued economic growth of the District, but it is also vital to users downstream of the District and in other catchments.

Wetlands are also important features in the ADM tourism plan of placing a strong emphasis on birding and avi-tourism. This niche market has potential to improve the district economically as it is known to be a birding region and there are over 400 bird species identified in the region.

Groundwater

In the ADM, large areas of the municipality have very shallow ground water levels. This is particularly relevant in the lower lying peri-urban areas surrounding Osizweni. Here, outside the formalised township areas, the vast majority of households utilize pit latrines, and numerous cases of outbreaks of bacteria related diseases including cholera have been linked to contaminated groundwater (P. Baytopp *pers com*). The Newcastle LM IDP (2018 review) additionally states that the quality of groundwater is moderate to poor and that the most probable causes are:

1. Poor rates of recharge
2. Mining activities – particularly coal mining
3. Industry
4. Farming activities

Information on borehole yields in ADM was obtained from some 800 boreholes scattered throughout the study area and recorded on the National Groundwater Data Base (NGDB). Statistics which define the yield of boreholes in ADM is presented in the table below. These figures reflect that in the main, groundwater is not a significant water resource to alleviate bulk water shortages, but that small scale use for rural domestic and stock watering purposes can be accommodated.

Summarised statistics of depth related borehole yield data

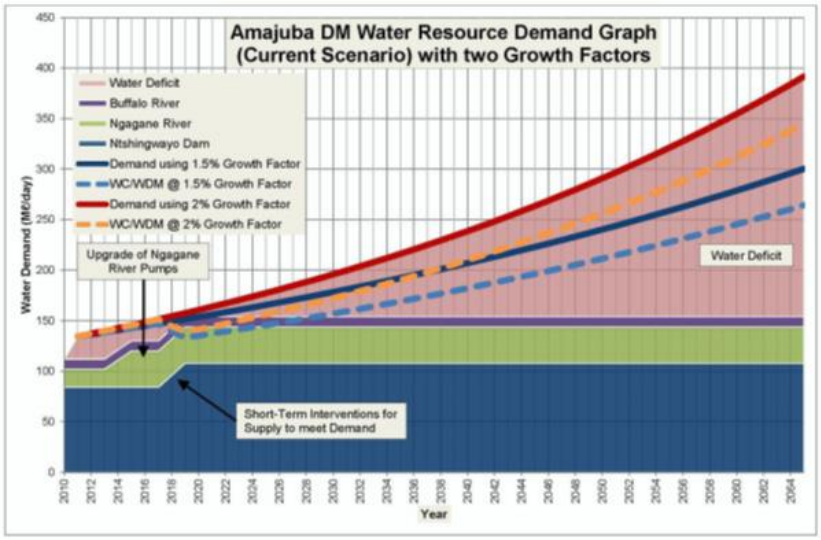
Lithological unit	Mean yield Data (l/s)	Mean yield Range	Maximum Yield Data(l/s)	Maximum Yield Range
Quaternary sediments	**0.9**	Moderate	4.8	High
Dolerite intrusions	**2.7**	Moderate	58	High
Karoo sediments	**1.2**	Moderate	19.8	High
Archaean rocks	**0.9**	Moderate	2.8	Moderate

Where Yield Ranges: - High >3l/s; Moderate >0.5 to 3l/s; Low > 0.1 to 0.5l/s; Very Low ≤0.1l/s

Cross Cutting Water Issues

The key challenge in water resources management is balancing the conservation value of water resources with the growing demand to use them. The DWS's Resource Directed Measures (consisting of Water Resource Classification, Resource Quality Objectives and Ecological Reserve) are designed to identify and implement a balance between the use and the protection of water resources. Neither of the ADM' two primary catchments, the Thukela and the Pongola River Catchments, has a completed classification in place.

The importance and limited supply of ADMs water resources is evident in the ADM water resource demand graph (uThukela Water 2018). Even with short term interventions to meet the water resource demand such as the upgrading of pumping infrastructure there is still likely to be a major water deficit within the ADM in the near future.



Terrestrial resources and land degradation

Terrestrial Biodiversity

There are 4 biomes within the ADM (Forest, Savanna, Grasslands and wetlands) that contain 14 different vegetation types (Scott-Shaw and Escott 2011). The District is dominated by Grasslands and more specifically by Income Sandy Grassland, Wakkerstroom Montane Grassland, Northern KZN Moist Grassland and the KZN Highland Thornveld.

The different grasslands of the ADM are perhaps the most important ecosystems in the District. They play a critical role in providing habitat for a range of biodiversity and perhaps more importantly they provide a range of services that are crucial for the persistence and growth of the local economy. Extensive animal production is directly reliant on grasslands for grazing, while industry, mining and any form of settlement is dependent on the water produced by grassland dominated catchments.

Flora data for the ADM shows that the habitat supports 1 near threatened, 1 rare species and 5 vulnerable species. Faunal data (amphibians, reptiles, birds, mammals, fish and invertebrates) has recorded 3 critically endangered species (all birds), 4 endangered and 5 vulnerable species.

It is widely accepted that globally, habitat loss is the single greatest threat to biodiversity. In the Amajuba District, grasslands such as Income sandy grassland, Paulpietersburg moist

grassland, Northern KZN moist grassland and Amersfoort Highveld Clay grassland have been negatively impacted by land use change showing a decline in spatial coverage of between 20-35% from their original extent.

An analysis of land cover change over the period of 1990 to 2014 (using the national land cover data sets) indicates that roughly 94 000 Ha of grassland has been altered to another land cover type. The table below shows the area of grassland lost to different land cover categories between 1994 and 2014. This represents 18 percent of the grassland that was present in 1990. The majority of this area is altered to woody vegetation, which in the context of ADM largely represents alien wattle species. Alien species thus pose a major threat to indigenous biodiversity.

LC Category	*Area (Ha)*
Woody vegetation	41316.78
Commercial Cultivation	15887.86
Forestry	12172.53
Subs Cultivation	5742.61
Human settlements	4963.65
Other	13612.65
Total	**93696.08**

Agriculture can pose a significant threat to terrestrial biodiversity, particularly the cultivation of virgin land, which transforms large areas of natural vegetation and habitat. In Amajuba District, heavy grazing is a major concern and one of the biggest pressures (Angus Burns WWF. *Pers. comm*). Intense over-grazing of the grassland decreases biodiversity, allows alien invasive infestation and decreases grassland vigour/health. Grasslands are also put at risk by poor burning management, where grasslands are burnt too frequently, in-frequently or burnt in the wrong season (C. Botha – KZN DARD *Pers. comm*).

Unplanned, inappropriate and ill managed development i.e. for tourism, formal and informal, urban and rural developments are extremely destructive to biodiversity. Clearing natural landscapes for informal settlements and / or subsistence agriculture is less destructive than hardened urban environments, but none-the-less eliminates or degrades large areas of habitat and this type of activity is very often unregulated and difficult to control. It is evident from aerial photographs that large portions of grassland in the ADM have been converted to small scale or subsistence agriculture, particularly in the southern low lying areas of the Buffalo River basin.

Mining is in most cases incompatible with biodiversity conservation priorities. The areas of Newcastle, Durnacol, Dundee and Glencoe have a long history of coal and metal ore mining, which have played a big role in the development of the local economy. Conflict between the interests of biodiversity conservation and mining are still prevalent in the ADM.

A large number of coal mines have been abandoned within the Newcastle and Emadlangeni municipalities. From a biodiversity perspective, several old mine sites require rehabilitation and despite their closure, still pose a threat to the environment through water and air pollution. Acid mine drainage from defunct mines has reportedly degraded farmers' water resources in the area and is known to have detrimentally impacted the water quality of important water resources.

Agricultural resources

Given the prioritisation of Agriculture at a National and Provincial level, agriculture is accordingly also a key sector for economic growth in the Amajuba District. Amajuba District Municipality is among the most fertile regions within KwaZulu-Natal. Despite this, the agricultural sector only accounts for roughly 2.2% of total GVA in the Amajuba District (though agri-processing is not fully accounted for in this figure), while the contribution of this sector to total formal employment is also low at 2% (LED review 2011). The contribution of the agricultural sector to the District GVA has declined recently, with an average growth rate of -6.7% (*ibid*).

Annual crop production is focused in three key areas:

1. The area in the South west of the District around Normandien and the Ntshingwayo Dam, the catchments of the Horn River, the Ncandu River and the Ngagane River. This is primarily large scale commercial agriculture with a large area under irrigation.
2. Along the Buffalo River and lower Ncandu River, and Ngagane River in the vicinity of Madadeni and Osizweni. The banks of the Buffalo River are heavily utilised for commercial irrigated agriculture while the area around Madadeni and Osizweni is heavily utilised by small scale farmers, very little of which is irrigated.
3. The far southern area of the District, around Hattingspruit where large scale commercial dryland agriculture dominates production.
4. The south eastern corner of the District, along the Blood River and R34 which includes a mixture of irrigated and dryland commercial agriculture.

The vast majority of the high potential land in the ADM is however primarily important from a grazing perspective (KZN DARD). Grazing resources are however particularly sensitive to different management practices and can easily be degraded by over utilisation and inappropriate burning practices. The ADM area is predominantly highland sourveld with a moderate carrying capacity. Given the importance of grasslands in the agricultural economy of the District, it is important that losses of grazing land be closely analysed.

Further analysis of the areas lost to woody plant encroachment indicates that the vast majority of this area is in fact lost to invasive alien trees, predominantly black (*Acacia mearnsii)* and silver wattle (*Acacia dealbata)*.

Land restitution / redistribution / reform is a highly complex and contentious issue with a vast number of stakeholders. In Amajuba District, numerous documents point to this process as being a key reason for the decline in agricultural production and a major stumbling block to agricultural development in the District. In particular, the delays associated with transfer of land, the lack of support for beneficiaries and the uncertainty created amongst existing

farmers are all cited as key factors. Approximately 70% of agricultural land is under claim in the Emadlangeni municipality.

Water availability is one of the main threats facing agriculture in the District as large scale commercial farmers have limited water available for irrigation while small scale and subsistence farmers face water shortages due to drought. Climate change is likely to aggravate this situation. The availability of water for on-going agricultural development, in particular irrigated agriculture, is a key constraint to the sector.

Geotechnical considerations

Geology, soils and landform

The ADM's Quaternary sediments include fossil subsoils. Limited alluvial deposits generally occur along and in the channels of the larger streams and rivers. In some instances, wetlands have developed locally on the floor of shallow valleys. The extensive dolerite sheets found in the study area represent an important structural element of the geological regime. The greater resistance which these rocks offer to weathering and erosion provides protection for the sedimentary lithologies. This is evident in the steep and often precipitous krantzes which characterize the eastern slopes of the Drakensberg and the upper slopes of the Balelesberg. The Karoo Supergroup is represented almost exclusively by the Ecca and the Beaufort Groups. Of these, the Ecca Group is by far the best represented, in particular by the Vryheid Formation. The sediments of the Beaufort Group, viz, the predominantly sandstone of the **Estcourt Formation** (Adelaide Subgroup) occur at elevations above approximately 1800m amsl and represent the younger lithostratigraphic units of the Karoo Supergroup in the study area.

Generally, the soils in the study area vary from sandy loam over the Vryheid Formation to clayey loam on shale or mudstone. Areas underlain by dolerite are characterised by red to brown or black clayey soils. The typical soil problems that are found in ADM area are the following:

- Higher rainfall areas, highly leached soils occur which usually have a high acid saturation;
- Areas underlain by sandstone – on a macro scale that will include most of the area covered by the Vryheid Formation – leaching of nutrients is prevalent due to its low clay content;
- The soils that have a plinthic origin and are shallow, tend to be susceptible to erosion especially if on a slope and water logging if found on the lower mid-slope and foot slope positions.

In general, the only geological features to pose a constraint to development are alluvial and unconsolidated sediments, particularly where wetlands occur. There are large areas of the District characterized by mountainous terrain and steep slopes. These areas have significant implications for potential land uses. Mining areas have also been mapped as presenting a constraint to development as undermining potentially leads to structural instability.

Air Quality

The Provincial Department of Economic Development, Tourism and Environmental Affairs (EDTEA) sampled and reported monthly dust fallout rates between February 2017 and January 2018 at twelve (12) sites across the Amajuba District Municipality. Overall, the finding of comfortable compliance (on average) with the Residential guideline throughout all sites and all months, with the exception of three sites during October 2017 only, suggests that dust nuisance is not a major issue across the Amajuba District Municipality.

Passive samplers were also deployed at selected sites by EDTEA from February 2017 to January 2018 to measure sulphur dioxide (SO2), nitrogen dioxide (NO2), and the BTEX parameters (benzene, toluene, ethylbenzene and xylene). In addition, some measurements were conducted for hydrogen sulphide (H2S) concentrations. NO2 and SO2 results are shown in the table below.

Site name	SO_2	NO_2
Site 3: Amadada High School	0,8	9,5
Site 6: Madadeni Police Station	3,9	8,8
Site 8: Utrecht Prison	0,3	8,4
Site 9: Emalahleni Secondary School	1,3	4,2
Site 11: Church St and Link St	5,3	11,0
Site 12: Shri Avenue	1,0	12,7

All SO_2 and NO_2 concentrations are well below the National Ambient Air Quality Standards (NAAQS) of 50 µg/m3 and 40 µg/m3 for SO_2 and NO_2 respectively and are thus comfortably compliant. The ratio of SO_2 to NO_2 is typically a good indicator of industrial versus vehicular pollution, since industries produce both SO2 and NO2, whilst road traffic produces much more NO2 than SO2. Since the SO2 ambient measurements are low whilst NO2 concentrations are relatively high compared with SO2 and when expressed as a percentage of the NAAQS for NO2, these results suggest that road traffic rather than industry is the main contributor of gaseous air pollution of the Amajuba District Municipality.

Hydrogen sulphide concentrations were measured at four (4) sites. When compared with the WHO standard of 5 ppb over a 30-minute period, there were no apparent exceedances although it is observed that concentrations of this malodorous gas peak in late winter and early spring, and were highest in the Newcastle area.

The BTEX suite of hydrocarbons was also measured at four (4) sites. The NAAQS for annual concentrations of benzene (5 µg/m3) was not exceeded during the duration of this study. The maximum benzene concentration measured was 2.5 µg/m3. The highest overall BTEX concentrations were measured in Blaauwbosch. VOCs quickly react in the presence of sunlight and moisture, so highest levels are typically measured where samplers are in close

proximity to a source. Since neither Amajuba Park nor Blaauwbosch are close to refineries or tank farms, road traffic emissions are again suspected as the major source of volatiles.

Whilst there is a clear perception from stakeholders that air quality in ADM is under pressure and that residents feel that air quality has been severely compromised, particularly in the Newcastle area, insufficient monitoring data is available to adequately quantify this (available monitoring data is only over a short term period, for passive samplers only and at limited sites). A full dispersion model which accounts for topographic influences has also not yet been developed for this area.

Two key overarching drivers of change in air quality in general are the demand for economic growth which results in the growth of industry, mining and other activities which impact air quality and the growth in urban population which brings an increase in the volume of road traffic and associated air quality impacts. Whilst the highly visible industrial emitters are foremost in the minds of ADM stakeholders, growth in this sector over the last decade has been limited. Road traffic volumes have however increased as the urban population has increased and available monitoring data for the District show that traffic related emissions are a significant contribution to overall air quality impacts.

Heritage Resources

The Amajuba District has played a significant role in the history of South Africa and is rich in heritage resources. Despite this richness, relatively little systematic heritage survey work has taken place in this region, and even less has been systematically documented on SAHRIS. This hampers efforts at determining the heritage character of the area from existing work.

In summary, no area–wide systematic Stone or Iron Age archaeological surveys have been undertaken for the District Municipality. However, recorded sites attest to a great historical depth of human interaction across the landscape from the Early Stone Age (ESA) (1.5m years ago) to the Late Iron Age (LIA) (150 years ago) and latterly, colonial interaction and into the modern era. The Amajuba District was of enormous strategic importance in several phases of South African history, and this is attested to by the presence of several battlefields, military cemeteries, monuments and memorials in the region. The majority of monuments and memorials in the region are related to the history of military action in the area during the Zulu and Anglo-Boer Wars, in the form of commemorative installations at battlefields and cemeteries.

It is self-evident that numerous buildings and structures with historical, aesthetic, architectural and/or social values occur within Amajuba District. However, no systematic, area-wide survey of such heritage resources has been undertaken, hence their locations, condition and management requirements are unknown.

Given the distribution of rural settlements across the District, it is likely that numerous traditional burial places are located outside formal cemeteries. Such burial places are usually located within homestead precincts and are known to and managed by the next-of-kin.

Given the nature of the historical environment and modern land uses it is highly likely that numerous places associated with oral traditions or living heritage are present within Amajuba District.

Palaeontological sensitivity is determined from the underlying geology of an area. The Amajuba District, by virtue of its varied geological makeup, includes deposits that range from having very low to very high fossil sensitivity

Amajuba District's recognised and proclaimed heritage resources are strongly biased towards settler history, and largely pertain to the settlement of Trekkers in the area, the Anglo Zulu War, and the first Anglo-Boer war. There is evidence, however, that a much broader range of heritage sites are located within the region, although knowledge about these sites and their locations is not widely shared.

It must be recognised that the value in heritage resources does not lie in monetary or economic value but rather in their intrinsic worth in terms of social, historical and cultural significance. That being said, certain heritage resources can provide economic stimulus through tourism and job creation. The prime example of this exploitation of heritage resources is to be seen in the tourist-driven industry of battlefield routes, and, indeed, the battlefields are Amajuba's biggest tourism attraction (Urban-Econ 2012). Here potential exists not only for trained guides to traverse the routes with tourists, but also for unskilled maintenance and caretaking staff.

Cross Cutting Issues

Urban population growth is seen to be a key driver of environmental change across a number of the specialist studies. This phenomenon is not unique to ADM, but is evident across the world. Its resulting impacts are critically important for the District from a planning and service delivery perspective and they form the basis for a number of the key environmental issues identified in this study.

The Constitution of South Africa provides for a fundamental right for all of an environment that is not harmful to one's health. Two physical elements that are essential for social health and well-being are clean air and clean water. Both of these are presently threatened in the region. Whilst economic activity and growth is important, the impact of various commercial and public service activities on water resources and air quality is clearly evident in the outcomes of this study. Achieving a balance between such activities and a healthy environment requires that infrastructure such as waste water treatment works be maintained at a high level of functionality and that the management of such facilities is of requisite standard.

Water is an essential requirement for socio-economic and environmental wellbeing. In almost all of the specialist studies undertaken for this project, water has been identified as a critical component.

Closely aligned with the water issue is appropriate management of the ADMs key water producing areas. This is a cross cutting issue because of the importance of these areas for

agriculture, biodiversity, tourism and water provision, and because of the pressure on these areas from a variety of factors.

Municipal capacity has been identified by a number of the specialist studies as being an important factor in driving deterioration or hindering improvements in the state of the environment in the ADM. This includes both capacity with respect to both financial and human resources. It also includes political will, which sits behind both of these elements and additionally drives the determination to deal with non-compliance with regulatory tools and processes.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ADM	Amajuba District Municipality
AMD	Acid Mine Drainage
BTEX	Benzene, Toluene, Ethyl Benzene and Xylene
DEA	Department of Environmental Affairs
DST	Decision Support Tool
DWS	Department of Water and Sanitation
EDTEA	KZN Department of Economic Development, Tourism and Environmental Affairs
EIMS	Environmental Information Management System
EMF	Environmental Management Framework
FDQC	Flow Derived Quinnary Catchments
FDQC	Flow Derived Quinnary Catchments
GIS	Geographic Information System
IDP	Integrated Development Plan
INR	Institute of Natural Resources
IRIS	Integrated Regulatory Information System
NFEPA	National Freshwater Ecosystem Priority Area
NO_2	Nitrate
PES	Present Ecological State
PO4	Phosphate
RIFSA	Road Infrastructure Strategic Framework for South Africa
SAHRIS	South African Heritage Resources Information System
SDF	Spatial Development Framework
SO_4	Sulphate
WWTW	Waste Water Treatment Works

1. INTRODUCTION

1.1 PROJECT MOTIVATION

The Amajuba District Municipality (ADM) has embarked on the development of Environmental Management Framework (EMF). The ADM EMF was initiated through a concurrent agreement between the national and provincial ministers responsible for environmental affairs in terms of Chapter 5 of the National Environmental Management Act (1998). It was prepared as a joint initiative between the National Department of Environmental Affairs (DEA), the KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA) and the ADM. The need for the EMF was driven by authority concerns in the District regarding the following environmental issues:

- The decline in air quality,
- The extent of water pollution,
- Land degradation and other environmental issues that may negatively affect local people and the growing economy, as well as
- The lack of adequate information to make more informed decisions.

The Institute of Natural Resources NPC (INR) has been appointed to conduct the EMF process on behalf of and in collaboration with the ADM, EDTEA and other key roleplayers in the District.

1.2 PURPOSE OF THE EMF

The National Environmental Management Act: EMF regulations 2010 and the EMF guidelines of 2012 outline the purpose of and set the legislated requirements for developing an EMF. The main purpose of an EMF is to streamline and facilitate efficient implementation of the EIA process. This is possible due to the pro-active nature of the EMF which allows for the anticipation and prevention of environmental damage before development proposals are evaluated.

In addition to the benefits associated with the EIA process, the EMF includes a strong spatial output, namely the Environmental Information Management System (EIMS), defined in this process as the Decision Support Tool (DST). The DST facilitates access to the EMF information and outputs by users of the EMF which includes developers, planners, decision makers and broader society.

Aim

In view of the above context, the specific aim of the EMF is to: ***Integrate environmental sustainability into municipal planning and operations, and to inform decision making regarding specific development applications in terms of the EIA and other regulatory processes.***

Objectives

The following objectives need to be met in order to fulfil this aim:

i) Document and provide spatially referenced information indicating the location, sensitivity and value of resources and systems (Present State).
ii) Document the drivers, factors and trends responsible for the Present State and analyse these in determining the key sustainability issues.
iii) Establish the Desired Future State (DFS) and environmental management priorities in the area.
iv) Define opportunities and constraints for different land-uses and development activities.
v) Develop tools that provide for the effective application of the information and outcomes of the process at a planning and project level (EIA), and appropriate responses to address and manage the environmental issues identified.

1.3 EMF PROCESS

This following table (Table 1) summarizes the aims, objectives and deliverables of the project phases. This report contributes to the Status Quo Phase.

Table 1: Project phases, their purpose and outcomes

PHASE	STATUS
1: INCEPTION PHASE ***What do we want to achieve & how are we going to do it?*** ***Purpose:*** Define the aims, objectives and nature of the project deliverables & the proposed approach and methods for achieving these ***Deliverable -*** *Inception Report*	**COMPLETE – NOVEMBER 2017**
2: STATUS QUO ASSESSMENT ***Where are we now? What is the state of our natural systems & environmental quality, the drivers of the state & consequences for socio-economic systems?*** ***Purpose:*** Map, classify and document the Present State of the receiving environment (socio-economic, biophysical, etc.) as well as trends and causes of the present state and environmental issues ***Deliverable*** *- Status quo & supporting specialist reports*	**THIS PHASE**
3: STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA) & DESIRED FUTURE STATE (DFS) ***Define where we want to get to?*** ***Purpose:*** Defines key sustainability issues and the Desired Future State (DFS) in the form of a sustainability framework that defines objectives, criteria, sustainability targets (and permissible limits of change) for the various components of the receiving environment. ***Deliverable –*** *SEA Report, Sustainability Framework and Environmental Management Zones (EMZ's).*	**FEBRUARY 2018**
4: ENVIRONMENTAL MANAGEMENT FRAMEWORK ***How do we get there? Develop the tools to move from SQ to DFS*** ***Purpose***: Develop EMF outputs which include Environmental Assessment guidelines, Decision Support Tool, and Strategic Environmental Management programme. ***Deliverable*** – Final EMF Outputs	**MARCH 2019**

1.4 SCOPE OF WORK

The EMF regulations require that an EMF contain the following:

a) *identify by way of a map or otherwise the geographical area to which it applies;*
b) *specify the attributes of the environment in the area, including the sensitivity, extent, interrelationship and significance of those attributes;*
c) *identify any parts in the area to which those attributes relate;*
d) *state the conservation status of the area and in those parts;*
e) *state the environmental management priorities of the area;*
f) *indicate the kind of developments or land uses that would have a significant impact on those attributes and those that would not;*
g) *indicate the kind of developments or land uses that would be undesirable in the area or in specific parts of the area;*
h) *indicate the parts of the area with specific socio-cultural values and the nature of those values;*
i) *identify information gaps;*
j) *indicate a revision schedule for the environmental management framework; and (k) include any other matters that may be specified.*

Items a) to d) and item h) are to be addressed in this, the Status Quo phase of this EMF. The purpose of the Status Quo phase is to lay a foundation for sustainable development by generating an understanding of the current situation in the District with respect to environmental attributes and their management.

1.5 STUDY APPROACH

The development of the status quo assessment has involved technical work undertaken as specialist studies and has also been informed by input from stakeholders through a consultation process and guidance from the Project Steering Committee (PSC). The specific approach, methods, and timing of the activities for each of these elements are described in this section.

1.5.1 Specialist Investigations

The specialist studies listed in Table 2 has been involved the following activities:

- ***Describe the governance framework***
  Identification of the relevant governance framework (institutional, legal and regulatory arrangements and /requirements) which is applicable to the specialist field. This is largely understood in terms of the national and provincial government structures and legislation but has been enhanced and refined for the local governance structures.

- ***Map the spatial extent of relevant resources or features***
  The EMF has a particularly strong spatial focus. As part of the baseline assessment, the mapping of the location and extent of environmental features and systems is required. Only current and available data has been used for this exercise. As far as reasonably possible, at least high quality provincial data was sourced and incorporated. The data layers used are considered appropriate for informing municipal planning at a district scale and for informing more specific mapping and investigation required in the EIA process.

- ***Classify and define the conservation or social use value/importance/status***

Conservation and/or social use value has been assessed where appropriate according to relevant legal standards and/or environmental thresholds. Again where appropriate, this assessment has been couched in the socio-economic context of the District.

- ***Identify Condition and Environmental Issues and Drivers***
  The data is analysed, identifying the key direct and indirect (secondary) drivers of environmental change. This task also assesses the cross-cutting issues relating to the various resources and features. For example in the case of the biodiversity sector –
  "Transformation and fragmentation of habitats is leading to increased threat status of systems. This is reducing the opportunities for supporting the tourism industry".

Table 2: List of specialist studies and authors

COMPONENT	SPECIALIST & QUALIFICATIONS	ORGANISATION
Air Quality	Andrew Simpson *MSc*	IMA Trader CC
Agriculture	N Makaya *MSc*	Institute of Natural Resources
Aquatic Resources	L Quayle *MPhil* and S Singh *MSc*	Institute of Natural Resources
Catchment Hydrology	S Chetty *MSc*	Institute of Natural Resources
Cultural	L van Schalkwyk,	Thembeni Heritage Resources
Geology	Paul Hansmeyer *BSc. (Hons.)*	EngeoLab
Geohydrology	Jacques Du Preez	EngeoLab
Infrastructure and Services	P Rajah *MSc*	Institute of Natural Resources
Public Participation Process	D Sennoga *MSc*	Institute of Natural Resources
Socio-Economic & Planning	N Makaya *MSc*	Institute of Natural Resources
Terrestrial Biodiversity	S Chetty *MSc* and L Quayle *MPhil*	Institute of Natural Resources
Wetlands	I Bredin *MSc*	Institute of Natural Resources

1.5.2 Policy and Legislative Review

In line with the need for the EMF to facilitate development planning and decision making being 'legally compliant", a legislation and policy review has been undertaken. The review lists relevant Policy and Acts, categorizing them according to National, Provincial and Local levels of governance. The intention is that this baseline is built on by defining what the specific requirements or implications of the policy/act are for the development and/or outcomes of the EMF. In addition to the references provided in the TOR and listed below, Table 3 summarizes the initial policy and legal review.

Relevant Legislation

- The Constitution of the Republic of South Africa Act 108 of 1996 (The Constitution)
- DEAT Guideline: Strategic Environmental Assessment in South Africa, February 2007
- The National Environmental Management Act (Act 107 of 1998, 'NEMA')
- The NEMA EIA and EMF Regulations (2010).
- NEM: Biodiversity Act (Act 10 of 2004)
- NEM: Air Quality Act (Act 39 of 2004)
- NEM Waste Act (Act 59 of 2008)
- Spatial Planning and Land use Management Act, 2013
- Provincial, National and Local air quality intervention strategies

- KwaZulu-Natal Planning and Development Act (2009)
- Municipal Systems Act (Act 32 of 2000)
- National Water Act (Act 36 of 1998)
- The Water Services Act (Act 108 of 1997)
- Conservation of Agricultural Resources Act (Act 43 of 1983)
- Provincial legislations and ordinance
- Infrastructure Development Act, 2014
- The National Environmental Management Act (Act 107 of 1998, 'NEMA'), as amended
- All the Specific Environmental Management Acts (SEMAs) promulgated in terms of NEMA, 1998, as amended
- The Development Facilitation Act (Act 67 of 1995, 'DFA')
- The NEMA EIA Regulations promulgated in terms NEMA, 1998, as amended
- The NEMA EMF Regulations 2010.
- The Guideline Document developed by the National Department of Environmental Affairs and Tourism on Strategic Environmental Assessment in South Africa, February 2007
- Conservation of Agricultural Resources Act (Act 43 of 1983), as amended
- National Water Act (Act 36 of 1998)
- Electricity Regulation Act (Act 4 of 2006)
- The Mineral Resources Petroleum Development Act, Act of 2002 and regulations.
- KwaZulu Natal Planning and Development Act 2008
- The Spatial and Land Use Management Act, Act 16 of 2013 and SPLUMA regulations.
- Provincial legislations and ordinances.
- The Provincial Spatial Economic Development Strategy
- The National Framework for Sustainable Development.
- The World Heritage Convention Act, 1999 (Act 49 of 1999)

Table 3: List of relevant policy and legislation

POLICY LEVEL			
Assessment Issue	International	National	Provincial/Local
Water Yield & Water Quality		▪ National Water Act (NWA) (Act 36 pf 1998) ▪ Mountain Catchment Areas Act (MCAA) (Act 63 of 1970)	▪ KZN Provincial Strategy ▪ DWS Resource Quality Objectives ▪ Information from district and local EMFs, SDFs and SEAs
Wetlands	▪ The Ramsar Convention ▪ Convention on Biological Diversity (CBD) ▪ The United Nations Convention to Combat Desertification (UNCCD) ▪ New Partnership For Africa's ▪ Development (NEPAD) ▪ The World Summit On Sustainable Development (WSSD)	▪ National Environmental Management Act (NEMA), 1998. ▪ EIA regulations (2014) and listing notices (GN 983-985) ▪ National Water Act (NWA), 1998 ▪ Conservation of Agricultural Resources Act (CARA), 1983 (National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003). ▪ National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004). ▪ National Forests Act, 1998. ▪ Draft Offsets Guideline	▪ Wetland information from district and local EMFs, SDFs and SEAs
Agricultural Resources		▪ Strategic Plan for South African Agriculture (SPSAA) – 2012/13-2016/17 ▪ Agricultural Policy Action Plan (APAP) 2015-2019 ▪ The white paper on sustainable forest development in South Africa 1997 (SFDSA) ▪ National Policy on Food and Nutrition Security (NPFNS 2013) ▪ Conservation of Agricultural Resource Act (Act 43 of 1983 - CARA) ▪ Subdivision of agricultural land act 70 of 1970 ▪ Draft policy document on the Preservation and Development of Agricultural Land	▪ KwaZulu-Natal Policy for Agricultural Land Potential, Development Rights and Application Processes, 2015 ▪ KZN DARD Strategic Plan 2015-2022 ▪ KZN 2030 Provincial Growth and Development Plan (2015)
Biodiversity	▪ Convention on Biological Diversity (CBD) (ratified in 1995) ▪ Convention on Conservation of Migratory Species of Wild Animals (Bonn Convention) (1991) ▪ Convention on	▪ National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004) ▪ National Environmental Management: Protected Areas Act (NEMPA) (Act 57 of 2003) ▪ National Veld and Forest Fire Act (NVFFA) (Act 101 of 1998) ▪ National Forests Act (NFA) (Act 84 of 1998)	▪ KwaZulu-Natal Nature Conservation Management Act (KNCMA) (Act 9 of 1997) ▪ KwaZulu-Natal Nature Conservation Act (KNCA) (Act 29 of 1992) ▪ Natal Nature Conservation Ordinance (NNCO) (Act 15 of 1974) ▪ KZN Provincial Growth and

	International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)	▪ Mountain Catchment Areas Act (MCAA) (Act 63 of 1970) ▪ National Environmental Management Act (Act 107 of 1998) ▪ World Heritage Convention Act (No 49 of 1999)	Development Strategy (2011)
Public Participation		▪ NEMA EMF Regulation, 2010 ▪ NEMA EMF Guideline Series 6, 2012 ▪ National Environmental Management Act (107 of 1998) ▪ NEMA Draft Regulations for the Preparation, Evaluation, Adoption And Review of Environmental Management Instruments (2017)	
Development Planning		▪ National Development Plan, Vision 2030 (NDP) ▪ The Constitution of the Republic of South Africa Act 108 of 1996 (The Constitution) ▪ KZN Heritage Act, 1997 ▪ Spatial Planning and Land Use Management Act (Act No 16 of 2013)	▪ KwaZulu-Natal Planning and Development Act, 2008 (Act No. 6 of 2008) ▪ KZN Provincial Growth & Development Plan Vision 2030 ▪ SIP 2 Project Reports
Decision Support Tool (DST)		▪ The Spatial Data Infrastructure Act, 2003 (Act No. 54 of 2003) ▪ Policy on Pricing of Spatial Information Products and Services ▪ Base Data Set Custodianship Policy (Government Gazette No. 38474, 16 February 2015)	

1.5.3 Stakeholder Consultation Process

According to the DEA (2010), the EMF Guidelines place the emphasis of public participation in getting inputs to existing practices and baseline situations, and the determination of the desired state of the environment under consideration. The PPP should therefore have three the following three goals:

i. To inform interested and affected parties (I&APs) of the EMF process and its objectives.
ii. To provide an opportunity for I&APs to engage in the process.
iii. To provide I&APs with an opportunity to review and comment on deliverables.

The way in which these objectives have been addressed in the Status Quo Phase is detailed below.

i. Inform and Register Stakeholder Participation

The requirements of the first bullet were met in the inception phase when the project was publicly advertised and interested and affected parties (I&APs) were provided with a background document and afforded the opportunity to register their wish to formally participate in the EMF development process. This objective has been addressed in this phase

through the maintenance of the stakeholder database, which has been updated as additional interested parties have participated in the process.

ii. Stakeholder Engagement

The stakeholder engagement process during this phase has involved the following activities undertaken to elicit feedback and input from key stakeholders. The EMF is based primarily on the use of existing information. An important aspect of the status quo phase was therefore obtaining inputs from stakeholders to seek confirmation that the information used and the interpretation thereof is accurate.

This was achieved through a focus workshop held in Newcastle in the Abet Room, Department of Public Works, 43 Hardwick Street on the 28th August 2018, involving representatives from various sectors including agriculture, conservation, business, mining and industry, and residents. The record of this engagement is included as Appendix 1.

The draft findings were also presented at the 2nd PSC meeting held at The Amajuba District Municipality offices on the 29th August 2018. The PSC meeting was held immediately after the stakeholder workshop in order that the feedback from the workshop could inform discussions with the PSC.

iii. Comment on Deliverables

This draft Status Quo report was made available to all registered I&APs and the PSC for a 30 day period during which and invitation was extended to make formal written comment that will inform the finalization of the report. The report was made available to the public via the project webpage on the INR's website. All comments have been captured in a comments and response register which confirms that the comments have been noted, and how they have been addressed in finalizing the status quo report.

1.6 DATA GAPS AND LIMITATIONS

A number of data/information gaps and limitations were encountered in the study and importantly, several relate to the key environmental issues facing Amajuba District. The most important of these is a lack of spatially comprehensive monitoring data for various studies including air quality and water quality, both of which have been identified as critical issues.

The non-participation of mining stakeholders in the EMF process also represents a significant limitation given the importance of the mining sector for environmental management in the District.

2. LEGISLATIVE CONTEXTUALISATION

Development planning is undertaken in a hierarchy that encompasses national, provincial and regional level policy. This section documents the influence of this framework and other relevant legislation on Amajuba District Municipality's planning.

2.1 THE CONSTITUTION

The Constitution of the Republic of South Africa Act No. 108 of 1996

According to Section 24, everyone has the right to an environment that is not threatening or harmful. Measures are in place to protect the environment such as promoting conservation, environmentally sustainable development and pollution prevention. Moreover, promoting social and economic development and using renewable resources ensures such an environment. Co-operative governance is also included within the constitution; this cooperation needs to be undertaken between national, provincial and local organs of state especially during the development and preparations of an Environmental Management Framework (EMF). This chapter in terms of the EMF is important as it allows for coordination of environmental policies, plans and programmes between a number of spheres of government which play a significant role in terms of its relationship to the environment.

2.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT

The National Environmental Management Act No. 107 of 1998

The National Environmental Management Act No. 107 of 1998 (NEMA) provides principles and guidelines to be considered in integrated environmental management (IEM). It guides cooperative environmental governance by confirming governments' role in ensuring sustainable development and the role of society in participating in environmental governance. Chapter 1 of the Act aims to ensure that actions and decision making of all officials relating to the legislation which may affect the environment is binding.

Chapter 5 of NEMA provides a guide for environmental planning and management and promotes the use of appropriate environmental management tools in order to ensure the integrated environmental management of activities. These activities can include policies, plans, projects and processes. NEMA is the parent statute under which a set of environmental laws and regulations have been developed. The environmental management framework is a tool whose overall objective is to promote integrated environmental management (IEM). The objectives of integrated environmental management include: evaluating, predicting and identifying potential threats to the environment, including the socio-economic environment and heritage resources together with determining alternatives and mitigation measures to ensure negative impacts to the environment are adequately minimised, while maximising benefits together with promoting compliance with the general principals of environmental management. To ensure that all processes of IEM are adhered too, public participation around decisions that affect the environment must occur, consideration of environmental attributes and the environmental management style best suited for a particular activity in accordance with the legislation must occur.

2.3 NATIONAL, PROVINCIAL AND REGIONAL PLANNING FRAMEWORK

2.3.1 National, provincial and regional planning framework

The primary development policies at a national level are the National Development Plan, The New Growth Path, The Comprehensive Rural Development Programme, the Comprehensive Plan For The Development Of Sustainable Human Settlements, the Accelerated and Shared Growth Initiative of South Africa (ASGI-SA) and the National Spatial Development Framework (NSDF).

Accelerated and Shared Growth Initiative of South Africa (ASGI-SA)[1]

- ASGI-SA is the primary national policy and has a strong focus on poverty reduction,
- ASGI-SA has chosen three priority sectors, specifically: tourism; business process outsourcing and off-shoring (BPO & O); and bio-fuels.

This implies that opportunities within these sectors should be maximized

The National Spatial Development Framework (NSDF)[2]

The NSDP guides government in implementing its programmes in order to achieve the objectives of ASGI-SA of halving poverty and employment by 2014. Of relevance to the EMF is Objective 4: which requires that *"In order to overcome the spatial distortions of apartheid, future settlement and economic development opportunities should be channelled into activity corridors and nodes that are adjacent to or link the main growth centres*".

Spatial Planning and Land Use Management Act No. 16 of 2013 (commonly known as SPLUMA). The intention of this national legislation is to introduce the norms and standards for spatial planning and to specify the relationship between spatial planning and land use management.

2.3.2 Provincial policy

The key policies at a provincial level are the KwaZulu-Natal Provincial and Growth Development Strategy and the Provincial Spatial Economic Development Strategy (PSEDP).

The KZN Provincial Spatial Economic Development Strategy (PSEDS), guides planning in the province and serves to give effect to ASGI-SA and the NSDF. The PSEDS identified the following sectors as responsible for driving the growth of the province and addressing unemployment and poverty:

- *Agriculture***:** including agri-industry;
- *Industry:* including heavy and light industry and manufacturing;
- *Tourism:* including domestic and foreign tourism; and
- *Service sector:* including financial.

The PSEDS also summarises the high level cluster priorities and objectives for the Amajuba District. The following priorities relate directly to Amajuba District Municipality given the existing importance

[1] ASGI-SA - Aims to ensure that the South African economy achieves higher rates of growth and produces larger volumes of the wealth needed to meet the challenges of growth and development.
[2] NSDF - Aims to support the development of sustainable local economies through integrated government action.

of the agricultural sector, the tourism opportunities, and the strategic importance of the water resources located within the municipality.

- *Agriculture and Land Reform* - The protection of high potential agricultural land for commercial production.
- *Tourism* - Increase arts and crafts resources and improve benefit to previously disadvantaged areas and land reform
- *Industry* - Securing of water resources

An important part of the PSEDS overall strategic thrust is a focus on development corridors and nodes. To give effect to the PSEDS at a district level, a hierarchy of nodes and corridors is required. From the KZN PSEDS perspective, there are a number of priority nodes in Amajuba District Municipality. Newcastle is listed as multi-sectoral node and is located in the centre of the study area.

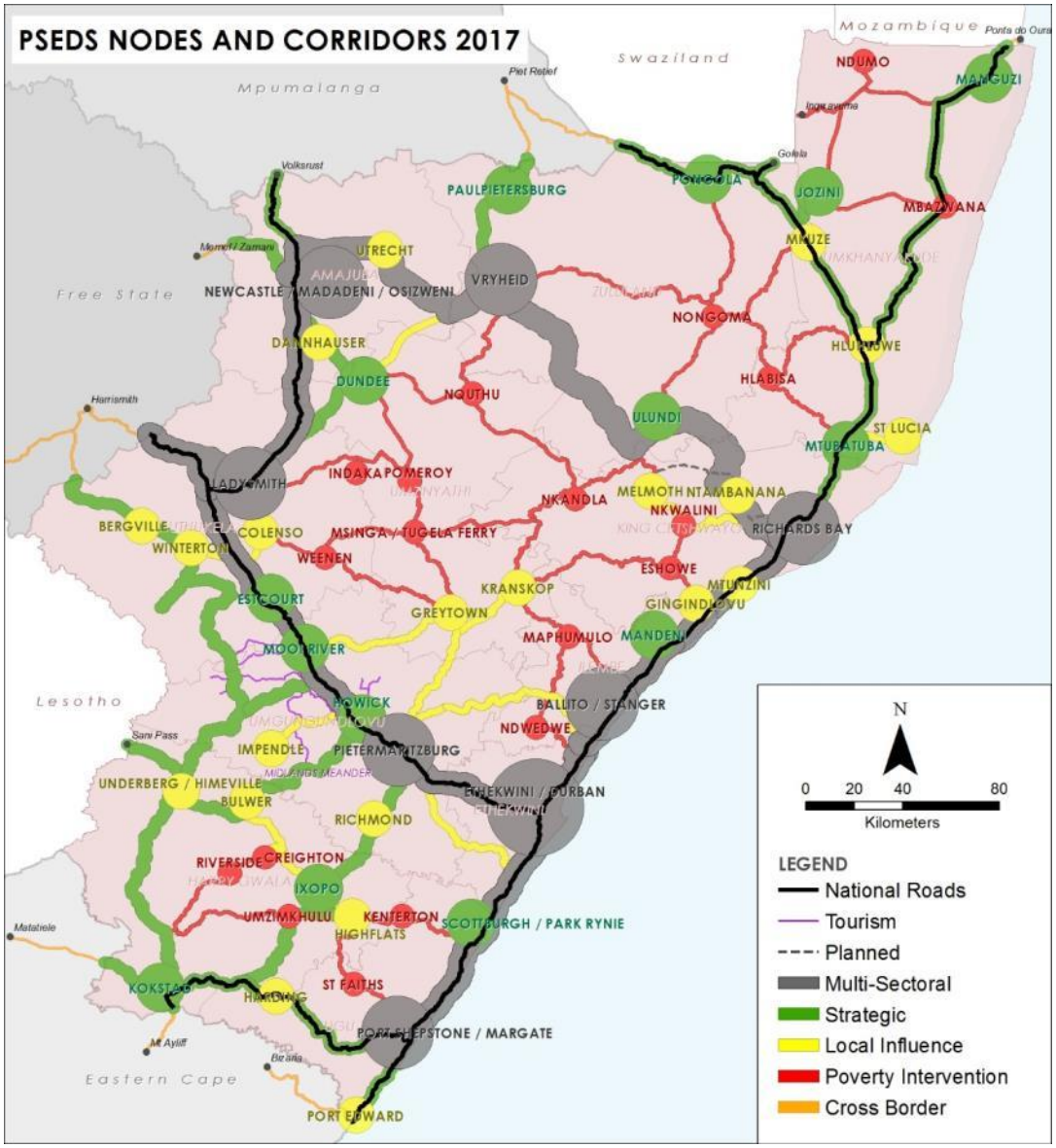


Figure 1: PSEDS Nodes and corridors in 2017

2.3.3 Regional policy

2.3.3.1 ADM Development Planning

Development planning involves the development of a number of planning tools at the national, provincial, district and local authority levels (Figure 2). These are influenced by a number of different legislation, policies and best practices. During the development of both the integrated development plans (IDP) and the spatial development framework (SDF), the Amajuba district municipality (ADM) aimed to incorporate and adhere to all legislation. This included and was developed in conjunction with the municipal systems act (Act 32 of 2000), Municipal Finance Management Act (Act 56 of 2003), the intergovernmental relations framework (Act 13 of 2005), the spatial planning and land use management act and other related legislation. Batho Pele principles, the KwaZulu-Natal 2035 vision and the alignment with national and provincial strategies were also adhered too.

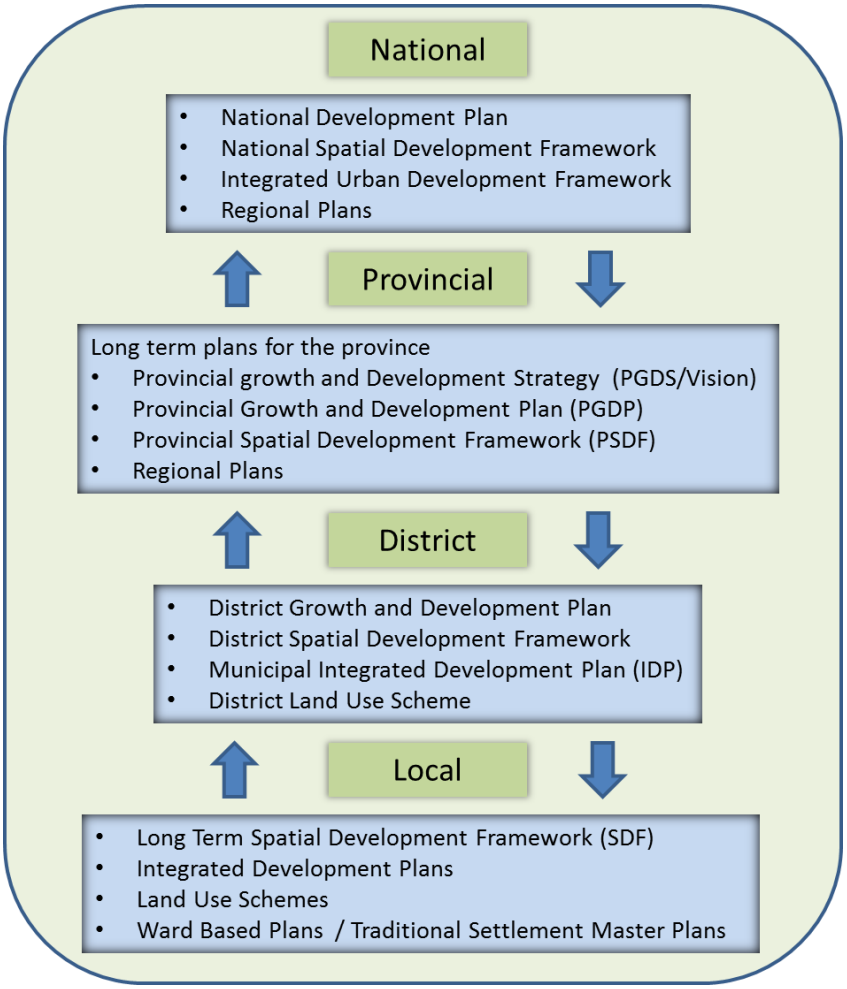


Figure 2: Interactions between levels of government development planning

The primary planning tool at a Regional Level is the District Spatial Development Framework (SDF). The SDF gives effect to the PSEDS, especially those requirements relating to sectors with economic development potential and Nodes and Corridors. Newcastle is consequently included as a multi-sectoral node: In addition, the following district corridors occur in Amajuba:

- *Local Influence corridors:* Newcastle - Utrecht
- *Local Influence node:* Dannhauser
- *Poverty intervention:* Newcastle - Volksrust

A number of development issues and aspects were indicated in the SDF and the IDP. Some of these are summarised below:

Demographics- The demographics of ADM are indicative of a developing municipality. However life expectancy is increasing indicating that there are improvements in health care and general livelihoods of the residents within ADM. The demographics also indicate that 52% of the population is female. This is characteristic of a developing area as there are more females due to migration even though there is an increase of financially active females in the population.

Sanitation- about 50% of the municipality have access to flushing toilets however within the eMadlangeni and Dannhauser municipalities service delivery is very limited. In many cases the residents of these municipalities don't have access to any form of toilets including a pit toilet with no ventilation. The areas with a high percentage of toilets are usually pit latrines associated with unhygienic conditions and poor sanitation.

Solid waste management- This is the responsibility of the local municipality and not the ADM. Data has indicated that solid waste management is improving in terms of waste collection within the local municipality. There are only two licensed landfill sites in ADM. Some of the problems associated with solid waste management include inconsistent waste removal and limited waste disposal. Some proposed interventions include a litter control programmes, recycling programmes and the identification of suitable waste disposal sites.

Air quality management- In an effort to comply with the Integrated Pollution and Waste Management Policy and the National Environmental Management: Air Quality Act (Act 39 of 2004) an establishment of atmospheric emissions standards have been developed. For each development activity that triggers these legislations, an atmospheric license will be required to operate.

Transportation infrastructure- Due to the importance of road infrastructure and networks which have the ability to bridge the geological divide and also to provide communities with access to better social and economic opportunities, the ADM have focused on key areas to improve transport infrastructure. These areas include: hospitals, clinics, police stations, schools and government departments both at a provincial and district level. Some of the challenges in terms of road infrastructure that the ADM faces include: lack of qualified workers, lack of qualified audits for financial bookkeeping and performance indicators, the lack of coordination of projects between the head office and cost centres and the lack of capacity in project monitoring and compliance.

Telecommunications- There has been some progress according to the stats SA data around the improvement of telecommunications infrastructure within the ADM. A GIS initiative has been set up within the ADM to act as a spatial information support function. This will be used to derive optimum benefits by taking strategic planning functions, access and maintenance of geospatial data into account. This system will also be used for land use management geospatial data.

Energy- Eskom supplies the energy to the ADM and it is demand driven. Presently the ADM is in the process of developing an Electricity Supply Development Plan (ESDP) which aims to provide a rational for the extension of grid and non-grid supply of electricity to the population of ADM

Human settlements- ADM is characterised by a human settlement patterns that is fragmented and disintegrated. There has been an increase in the growth of human settlements within the ADM. In order to combat this, ADM has made attempts to develop these areas into sustainable integrated human settlement clusters. A large number of households within ADM consist of informal dwellings that do not adhere to the objectives of the South African constitution. Ongoing work is being done to improve this situation.

Another key aspect of the District SDF is the designation of Agriculture priority areas. These are "*areas where high potential agricultural land exists, and where non-agricultural development which would detract from the production potential of these areas should be discouraged*". A large portion of Amajuba Municipality including more than half the study area has been designated as such. Provincial policy requires that more detailed agricultural assessments must be done at a local level to determine the location of high potential land, and appropriate control measures should form part of local SDF's and LUMS. Identifying areas with high agricultural potential has therefore formed an important component of the EMF. Figure 3 indicates the land use framework within the ADM includes areas demarcated for agriculture, commercial use, industry and settlements. Important transportation corridors including the N11 and primary, secondary and the tertiary corridors for

development activities are indicated. The map also shows important areas such as the mining hub in Dannhauser, the agricultural hub in Utretch and the economic hub in Newcastle.

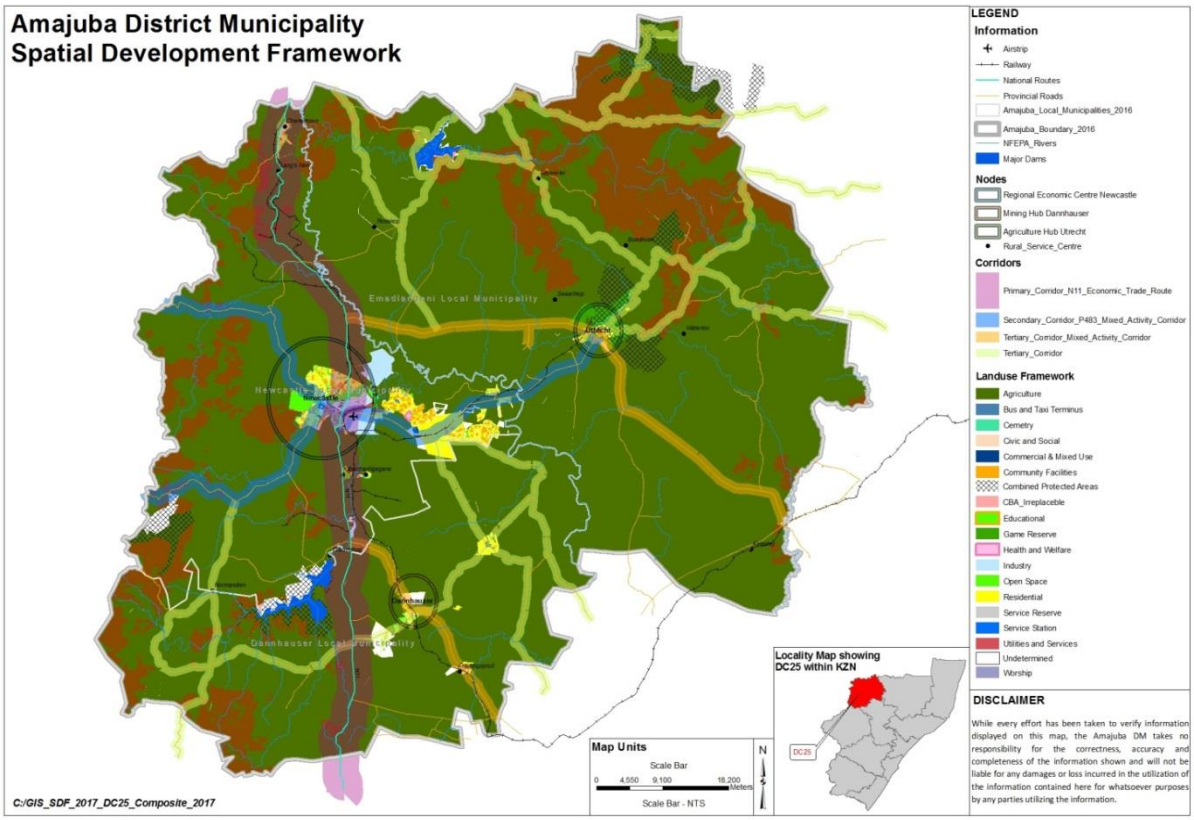


Figure 3: ADM Spatial Development Framework

2.4 NATIONAL ENVIRONMENTAL MANAGEMENT FRAMEWORK REGULATIONS

2.4.1 National Environmental Management Act (Section 24(3))

The national environmental management act has legislation in place that provides guidelines for the development of an environmental management framework (EMF). These guidelines are in section 24(3) of NEMA. This legislation stipulates that the minister and MEC can compile information and maps that identify specific attributes of a geographic area. These attributes include location, extent, sensitivity and relationships between the natural and social environments. These significant attributes needs to be interrogated by the competent authority.

2.4.2 National Environmental Management Act (NEMA) (Section 24 (5)) Government Notice R.547 June 2018

Subsequent to previous legislation the Minister of Water and Environmental Affairs in regulation 24 (5) pertaining to EMFs in government notice R.547 of June 2018 stipulates that the purpose of the regulation is to ensure that:

- The maps created are used to inform environmental management frameworks, environmental authorisations and the geographical areas within which these frameworks apply.
- The regulations also provide specifications around the procedure that needs to be followed in terms of preparation, evaluation and adoption of EMFs
- The regulations governing the EMFs have been put into place to promote sustainability, cooperative environmental governance and secure environmental protection.

2.5 INSTITUTIONAL ARRANGEMENTS

Within the ADM, environmental management is housed within the planning and development services directorate. The organisational structure of this directorate is indicated in Figure 4.

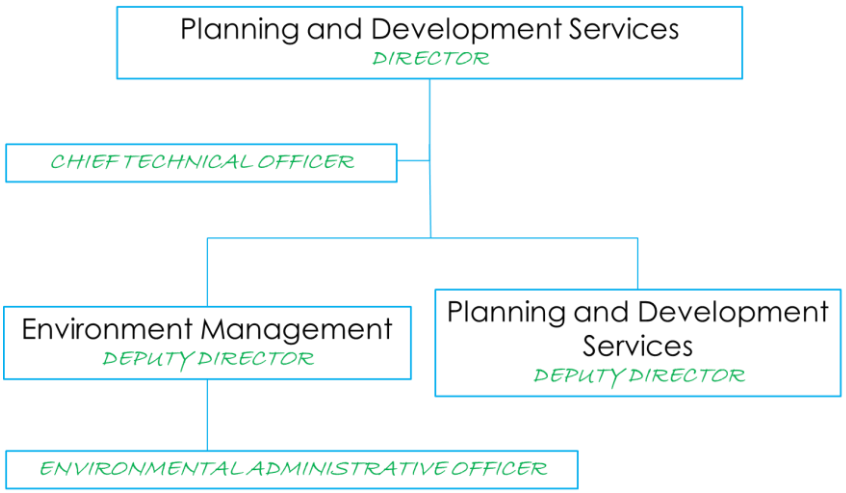


Figure 4: Organisational structure of the planning and development services directorate of the ADM

These functions sit within a broader framework of cooperative governance which includes important relationships with the National Department of Environmental Affairs (DEA), the Provincial Department of Economic Development, Tourism and Environmental Affairs (EDTEA), and relationships with the three local municipalities in the District; Newcastle Dannhauser and Emadlangeni.

Importantly, the District hosts the Amajuba District Committee for Environmental Co-ordination (ADCEC). This committee is integrally involved in environmental management and its members comprise representatives from a wide variety of stakeholder groups including:

1. Different sectors in the various levels of government e.g. environment, planning, agriculture etc from local municipalities, the district municipality, the provincial department and the national environment department.
2. The provincial nature conservation authority (Ezemvelo KZN Wildlife)
3. Bulk services providers such as uThukela Water
4. Private sector stakeholders representing industry and other sectors
5. NGOS that are active in the District such as the World Wide Fund for Nature (WWF), the Endangered Wildlife Trust (EWT) and the Newcastle Environmental Justice Aliance (NEJA).

This committee acts as the steering committee for the development of this EMF.

Functions and areas of responsibility of the District's planning and development services directorate, specifically the environmental management department, include:.

- Climate Change section.
- Environmental awareness.
- Assessment of BID, Scoping and EIA reports.
- Policy Advice to other units.
- Conducting investigations or attending to complaints related to water or waste management pollution.
- Coordination of environmental related matters within the district.
- EPWP projects for Environment and Culture Sector: Develop business plans & implement projects.

3. PROJECT AREA

3.1 GEOGRAPHY

3.1.1 Municipal Boundaries

The ADM comprises three local municipalities (LMs) i.e. Newcastle LM, Dannhauser LM, and Emadlangeni LM. The project area is shown in Figure 5. The Newcastle LM[3] is considered the economic hub of the ADM. The key economic activities of the ADM include commercial agriculture, coal mining and industrial manufacturing. As an example, the area constitutes the largest producer of chrome chemicals in Africa. There are transport and nodal links to Johannesburg, Durban and Richards Bay ports. Newcastle is also a retail hub for this and neighbouring districts.

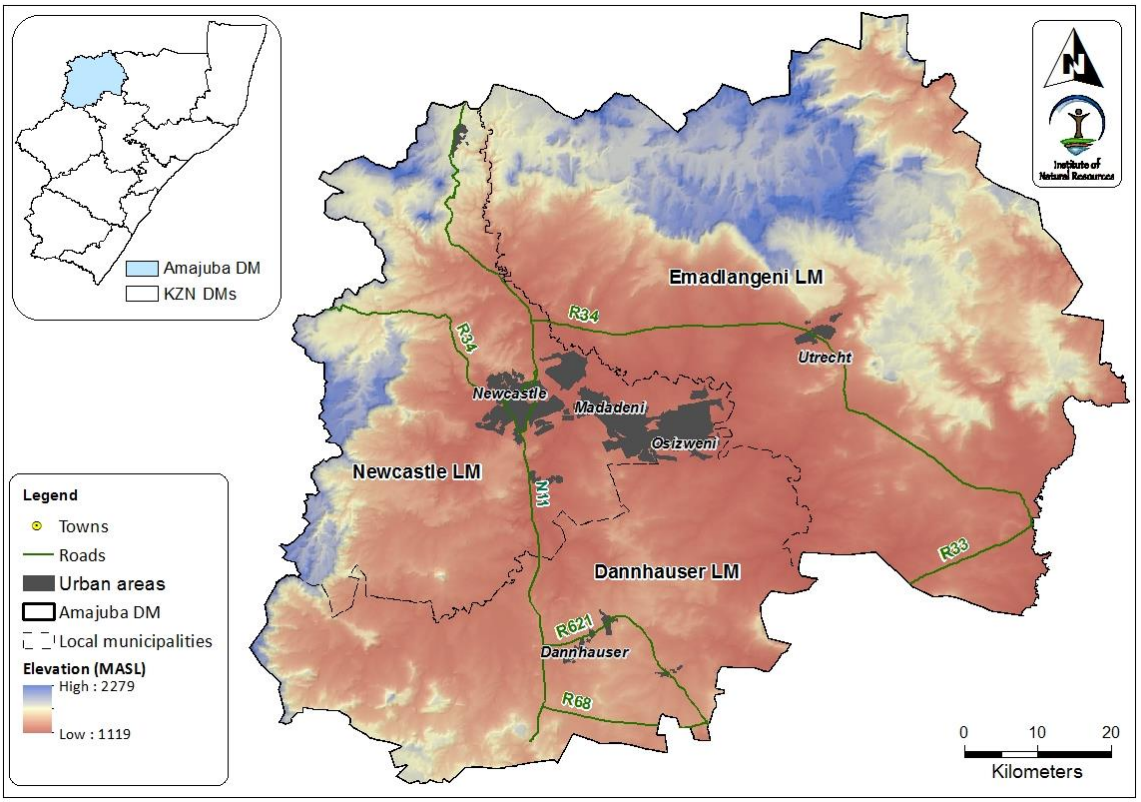


Figure 5: ADM Project area

3.1.2 Topography and Land forms

The ADM is characterised by a horseshoe of high lying western, eastern and northern regions. The western areas comprise a section of the Drakensburg escarpment, while the northern and eastern areas comprise the Balelesberg and the Skurweberg mountains. The Biggarsberg Mountains are located to the south of the District with the majority of this landform falling in neighbouring Districts. These higher regions drain into the Buffalo River basin in the middle of the District supplying water to the lower lying, flat central regions of the ADM (Figure 6). The District ranges from 1042m to 2290m above mean sea level, as listed in Table 4. This range in altitude results in a diverse range of habitats and ecosystems which are the subject of this report.

3 An EMF has been developed for the Newcastle EMF. The EMF has not been gazetted and the information will be integrated with the District EMF where still current and relevant.

Table 4: Topographical variables of the Amajuba District per Local Municipality

Local Municipalities			
	Newcastle	**Dannhauser**	**Emadlangeni**
Area (km2)			
Area	1855	1516	3539
Elevation range (meters above mean sea level)			
Min	1140	1143	1149
Max	2247	2104	2276

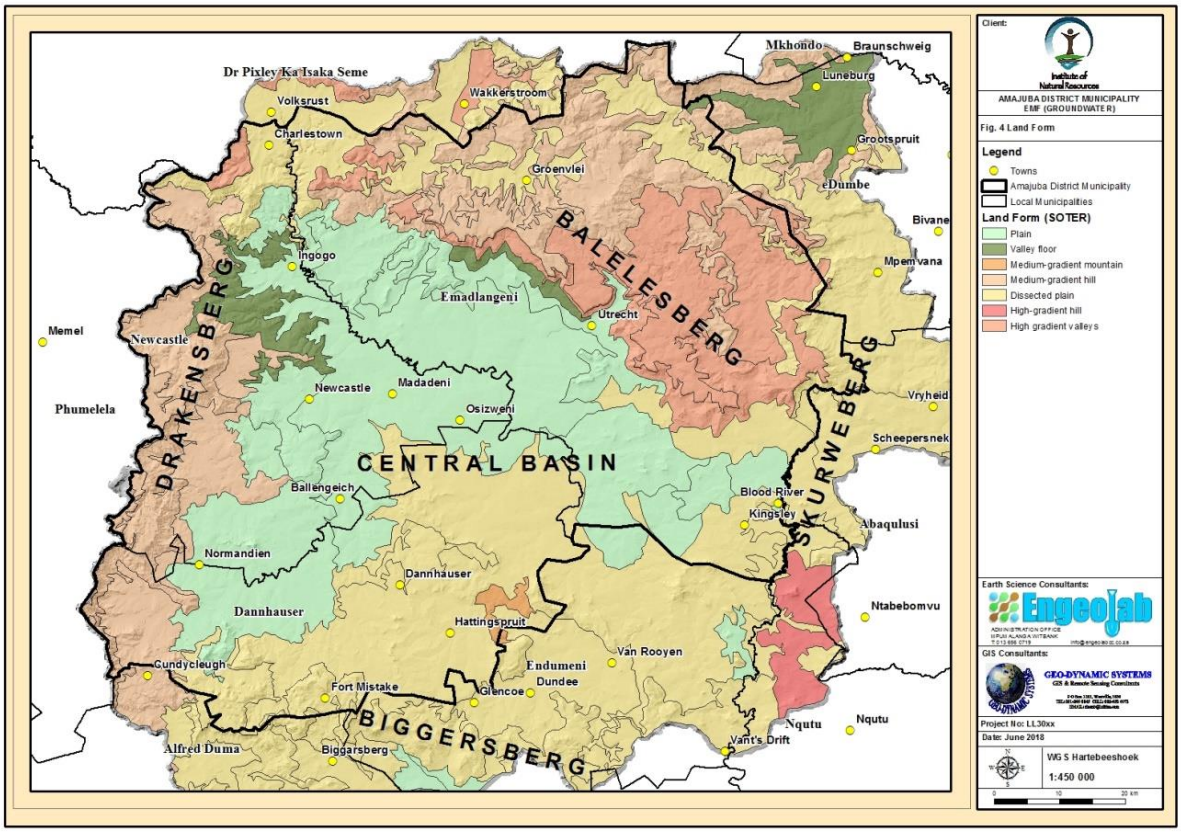


Figure 6: Land forms of the ADM

3.1.3 Climatic Characteristics

There is a substantial difference in temperature between summer and winter months in the ADM. Winter is noticeably cold with temperatures usually dropping below 0 degrees. Frost in the colder autumn and winter months is a common occurrence. Summer is far warmer with temperatures exceeding 30 degrees. An average annual temperature of 17 degrees has been measured across the district (Figure 8).

Altitude plays an important role in the varying average annual rainfall measured across the 3 municipalities. The Mean Annual Precipitation map for the district varies between 500mm in the low lying areas and 1150mm in the high lying areas, as illustrated in Figure 7.

Table 5: Mean annual rainfall per local municipality

Precipitation (mm)			
	Newcastle	**Dannhauser**	**Emadlangeni**
Annual Min RF	504	587	517
Annual Max RF	1149	1015	1127

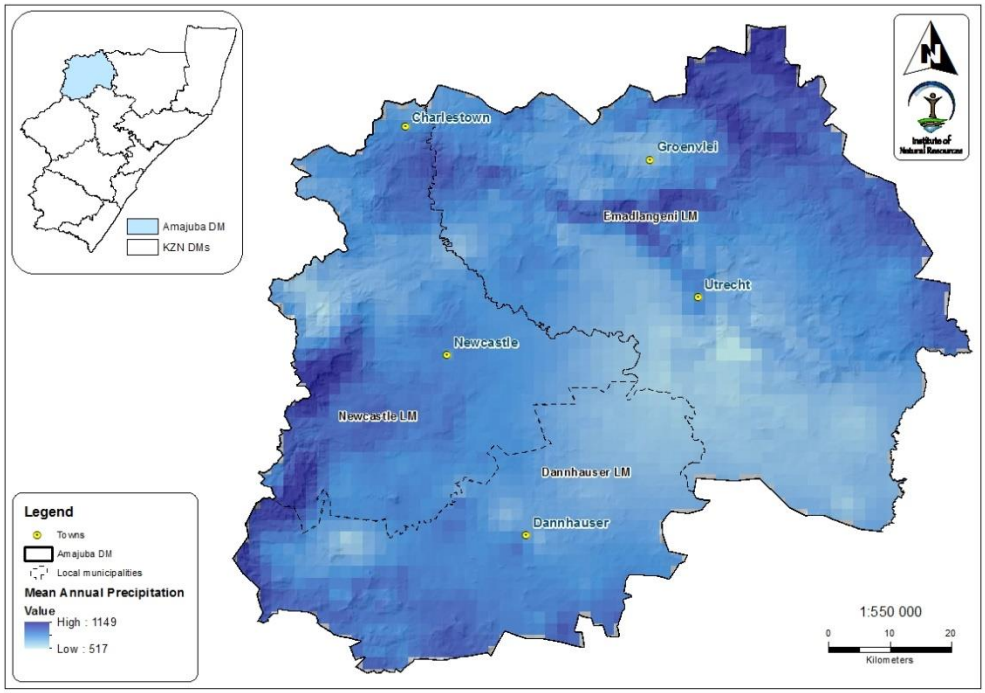


Figure 7: Mean Annual Rainfall for the ADM (Schulze et al 2011)

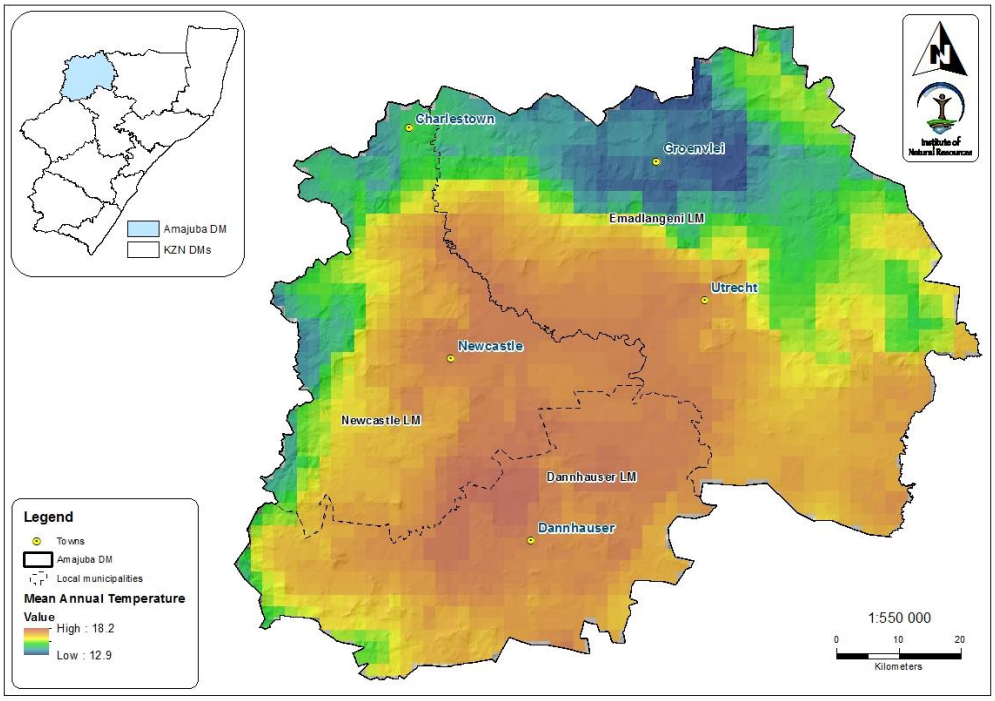


Figure 8: Mean annual temperature for the ADM (Schulze et al 2011)

3.1.4 Geology and Soils

The underlying geology of the central portion of the ADM is underlain by Karoo Sequence sediment with higher-lying areas underlain by a combination of geological foundations. Varying soil types occur in the area consisting of Dolerite, Mudstone, Sand and Shale amongst others. The over texture of the soil appears to be predominantly clay. Due to the numerous wetlands in the area, it is usual for the soils to have an expansive property, meaning that they have the ability to shrink and swell based on their water content (typical of wetland type soils) (Figure 9).

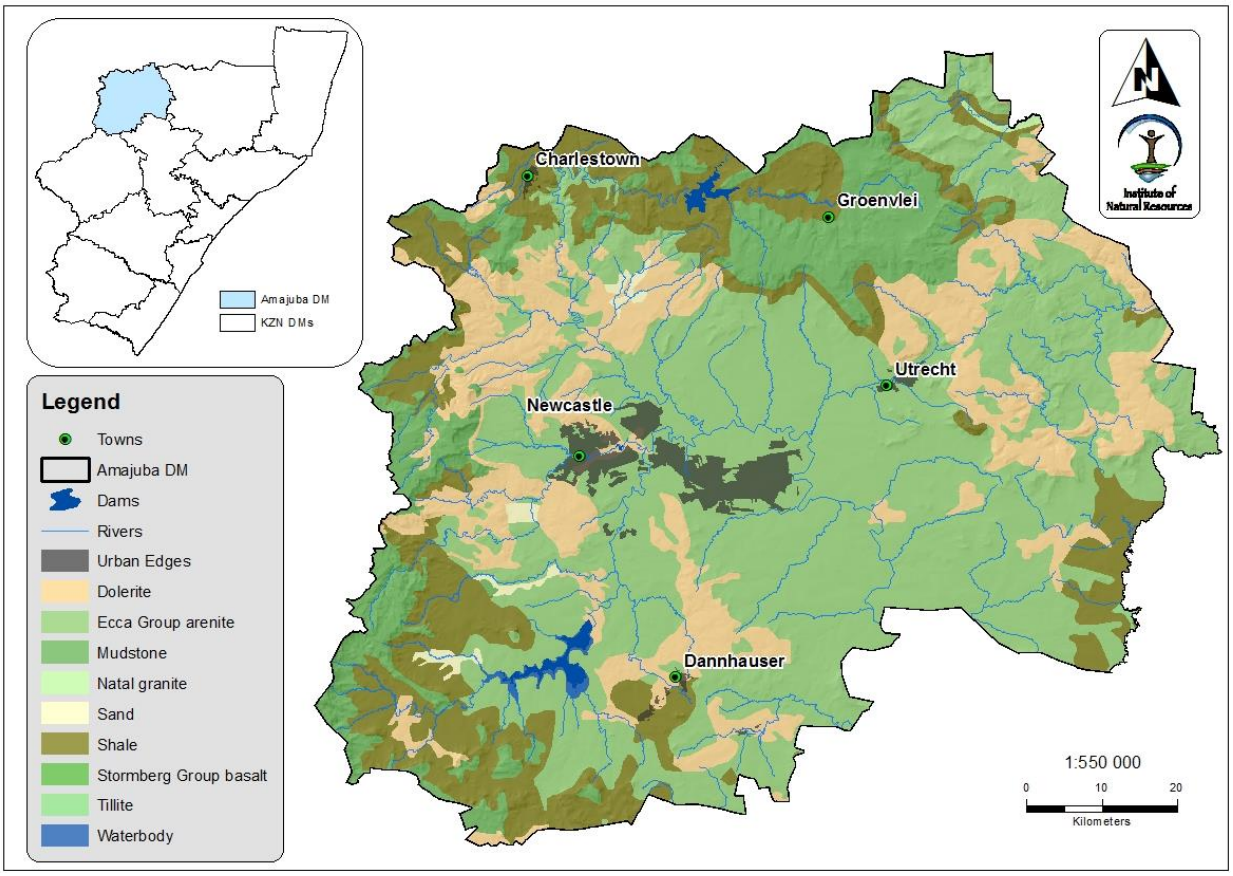


Figure 9: Geology of the Amajuba District

3.2 CURRENT USE OF LAND

Land use in the ADM consists of an assortment of agriculture (commercial and subsistence), afforestation, industrial uses, mining and high density urban settlements and sparse rural settlements. The vast majority (74%) of the District's land cover consists of natural untransformed vegetation (Table 6). In almost all areas, this is grassland which is utilised as grazing land for livestock. The more densely populated settlements include Newcastle (central economic hub), Dannhauser, Madadeni, Osizweni and Utrecht. The central and southern portion of the ADM features, to a large degree, highly utilized small holder or subsistence agriculture as seen in Figure 10. Natural areas are dominated by grasslands but significant areas of wetlands and forests exist. Mining occupies a relatively small area of the land on the surface, but underground this area is substantially (orders of magnitude) bigger.

The ADM is reliant on the natural regions for a number of key ecosystem services including water production, biodiversity conservation, and provision of grazing to stimulate the economy. Tourism and agriculture are key beneficiaries of these services and have been highlighted as key sectors for economic growth in the District. The grasslands of the District are particularly important for activities linked to these sectors and their conservation and careful management are critical for sustainable development in the District. A number of indigenous forests and biodiversity hotspots are also formally protected (Chelmsford Nature Reserve, Ncandu Nature/Forest Reserve, Pongola Bush).

Table 6: Areas associated with different land uses in the ADM

Land use	Km^2	%
Dams and Rivers	57	0.8
Wetlands	240	3.5
Natural Untransformed	5 124	74.2
Dryland Commercial Agriculture	615	8.9
Irrigated Commercial Agriculture	84	1.2
Subsistence Agriculture	193	2.8
Plantations	227	3.3
Mines and Quarries	21	0.3
Natural Degraded	76	1.1
Urban Commercial	7	0.1
Urban Industrial	6	0.1
Urban Residential	72	1.1
Urban Open Space	3	0.1
Sparse Settlements	170	2.5

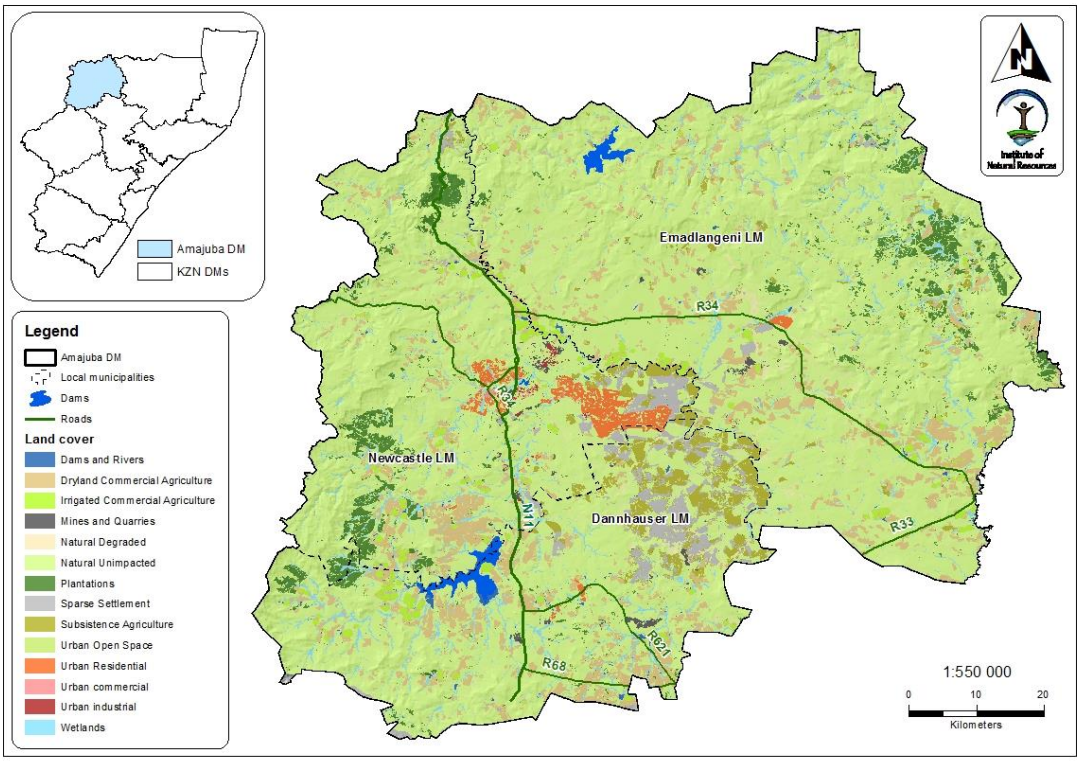


Figure 10: Distribution of land cover categories across the ADM

4. SOCIAL AND ECONOMIC DEVELOPMENT CONTEXT

4.1 SOCIO-ECONOMIC ENVIRONMENT

4.1.1 Population Profile

Amajuba District Municipality (ADM) is located to the north-western corner of the KwaZulu- Natal Province and comprises of a total population which is estimated at 531 327 people who are accommodated in 110 963 households (Stats SA 2016 Community survey). Newcastle Local Municipality has the highest population which is estimated at 389 117 people (84 272 households) within 34 wards followed by Dannhauser 105 341 people (20 439 households) within 11 wards and Emadlangeni with 36 869 people (6 252 households) within 4 wards (Ibid) (Figure 11).

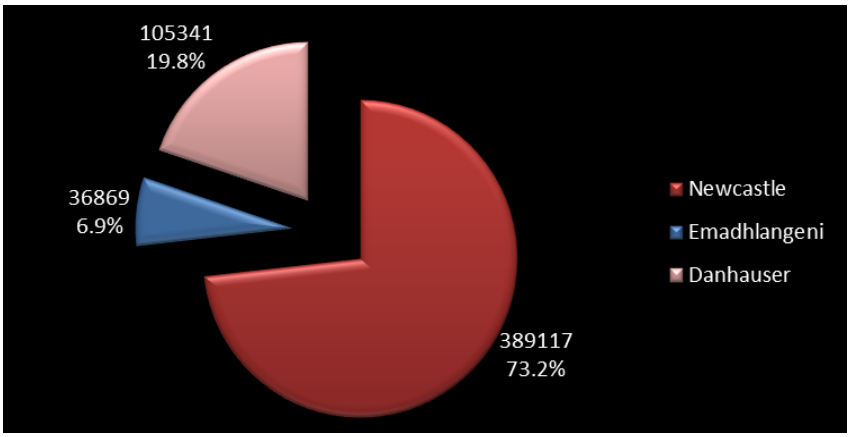
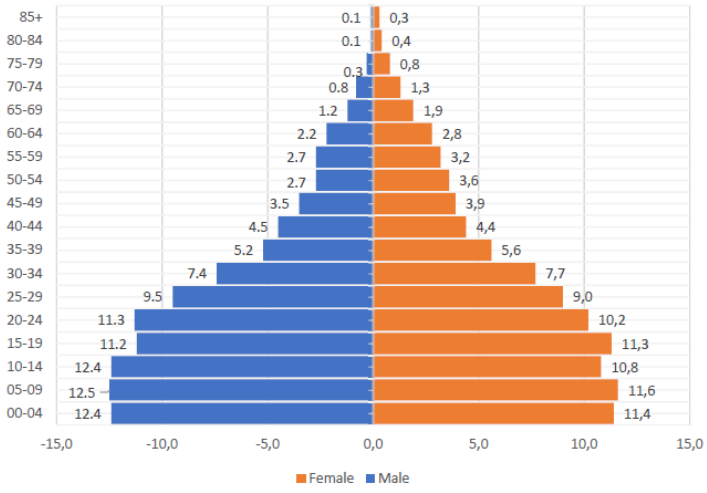


Figure 11: Distribution of the Amajuba District population between Local Municipalities (Stats SA 2016)

The Amajuba DM population is a youth dominated population (Figure 12)
– taken from Draft ADM IDP 2018/19). This is distributed as follows:

- Age 0-14 = 35.4%.
- Age 15-65 = 60.9%
- Age > 65 = 3.7%

Of those in the EAP proportion, 36% are unemployed.



Source: Statistics SA – 2016 Community Survey no 30-06-2016

Figure 12: Age and gender distribution of ADM population (taken from Draft ADM IDP 2018/2019)

Table 7: Population size and growth trends in Amajuba DM

Population size and Distribution				
Municipality / Year	Newcastle LM	Emadlangeni LM	Dannhauser LM	Amajuba DM
1996	283939	23530	98424	405893
2001	332981	32277	102779	468037
2011	363236	34442	102161	499839
2016	389117	36869	105341	531327
Growth Rate 2011-2016	5.2%	6.5%	3.0%	5.9%

Statistics SA – Census 2016 Community Survey no 30-06-2016

Although all LMs show an overall growth in population, the data show distinctly that more people are moving to the large urban centre, Newcastle / Madadeni / Osizweni (Table 8). The smaller urban centres of Utrecht and Dannhauser show a net reduction in population. Importantly, there is a trend towards smaller average households (Table 8) meaning many more homes are being built to accommodate this change. This has implications for various sectors such as agriculture, biodiversity, local government and energy.

This distribution of population and its trends show that economic and natural resources are under pressure, particularly in the Newcastle area. Demand for housing, jobs and economic growth is strongly centred in this area.

Table 8: Urbanisation trends in ADM urban centres (taken from Draft ADM IDP 2018/19)

Urban Settlements	Wards	2001	2011	% of Growth/Decline
Newcastle Urban Complex	2-5 and 20	49 094	52 371	6
Madadeni Urban Complex	14, 19, 22-24, 26-29	83 560	92 362	9
Osizweni Urban Complex	7-13, 15-18 and 30	133 536	141 906	6
Dannhauser Town	2	9 816	8 095	-21
Utrecht Town	2	5 488	5 290	-4
Total		281 524	306 024	6

Source: Census 2011

Table 9: Household size trends in the ADM (taken from Draft ADM IDP 2018/19)

Number of households and household size			
Local Municipality	Year	Number of households	Average Household Size
Newcastle LM	2001	55217	5,1
	2011	71164	4,6
	2016	84272	4,2
Emadlangeni LM	2001	3378	6,2
	2011	6187	4,7
	2016	6252	5,2
Dannhauser LM	2001	15555	6,2
	2011	19320	5,3
	2016	20439	4,9
Amajuba DM	2001	74150	5,4
	2011	96671	4,7
	2016	110963	4,4

Community Survey (30-06-2016)

4.1.2 Education, Employment and Income

A key aspect of the socio-economic profile of the ADM is the low level of education. The 2011 census (Stats SA) shows that 60% of the people living in this area do not have a matric level qualification and only 5% have any form of tertiary education (Figure 13). Admittedly this includes children still at school and thus still with the potential to achieve a matric and tertiary education. But with 64% of the population older than 15, the number without this level of education is still very high. This statistic highlights a significant impediment to economic growth in the District.

Unemployment is high across the district. According to the official definition, employment stands at above 33% of the District's working age population (Table 10). Using the expanded definition, this figure stands at 71%.

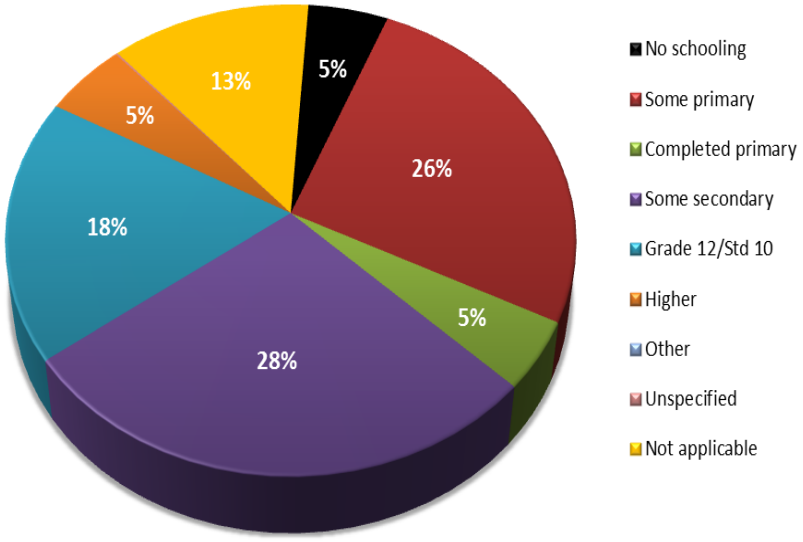


Figure 13: Level of education of the ADM population

Table 10: Unemployment rates across the District according to official definition (taken from Draft ADM IDP 2018/19)

Year	Amajuba	Newcastle	eMadlangeni	Dannhauser
2014	31,9%	30,3%	30,3%	40,7%
2015	31,9%	30,3%	30,2%	40,8%
2016	33,7%	32,0%	31,7%	43,0%

Source: KZN Provincial Treasury (HIS Markit: Regional Explorer)

Given the low level of education, and high levels of unemployment, it is unsurprising that the average annual income in the District is also very low (Figure 14). The 2011 Census shows that 50% of people earn less than R20 000 a year (R1666 /month). The vast majority of people earn between R10 000 and R40 000 per year.

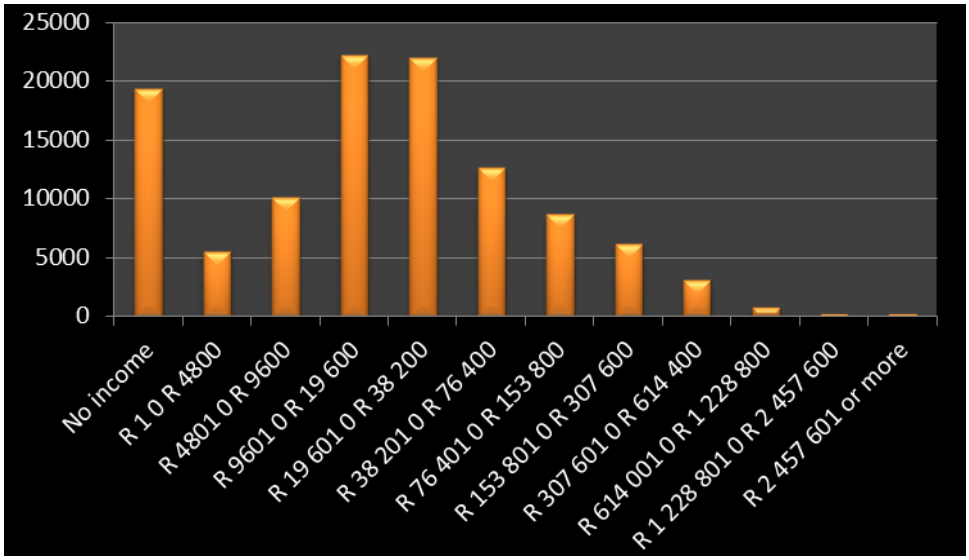


Figure 14: Distribution of per annum income levels in ADM (Census 2011)

4.1.3 Land ownership

Land ownership within the ADM is predominantly private with some areas under traditional authority located in the central part of the district. There are additionally scattered portions of communally owned land (Figure 15) located predominantly in Emadlangeni LM.

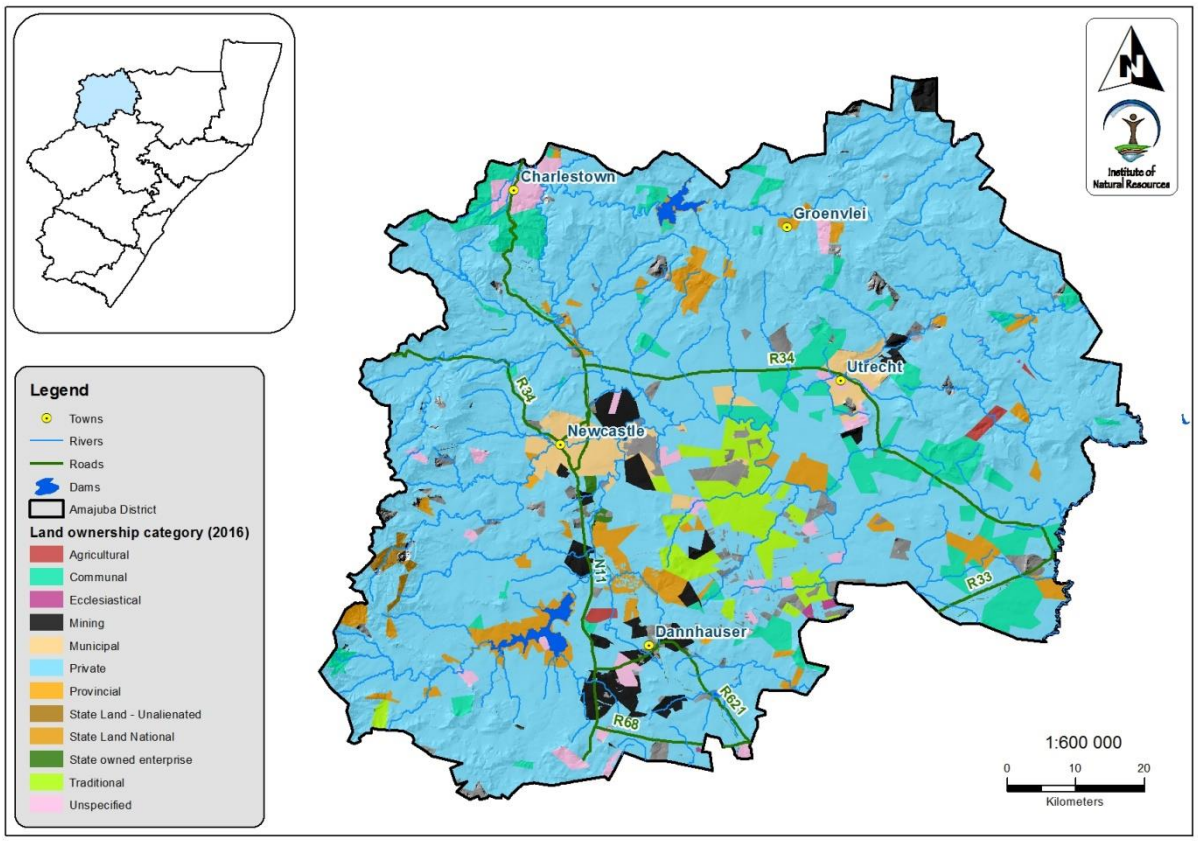


Figure 15: Landownership types within the Amajuba District Municipality

Land ownership has important implications for environmental management and governance arrangements. As an example, findings of this study have shown that environmental management regulatory instruments are not effectively implemented in areas under the leadership of traditional authorities. This is evidenced by the dramatic increase in housing developments without environmental authorisation or the implementation of other regulatory tools such as water use licences where necessary.

There are also large areas of the District under land claim. The distribution and status of these claims are shown in Figure 16. Numerous strategic planning documents in the District (SDF, IDP etc.) have pointed to the fact that the slow progress in the settlement of land claims has hampered the growth and development of the agricultural sector in the District. This has environmental management implications such as the fact that uncertainty around land tenure discourages investment in agricultural resources and facilitates the neglect of sound land management.

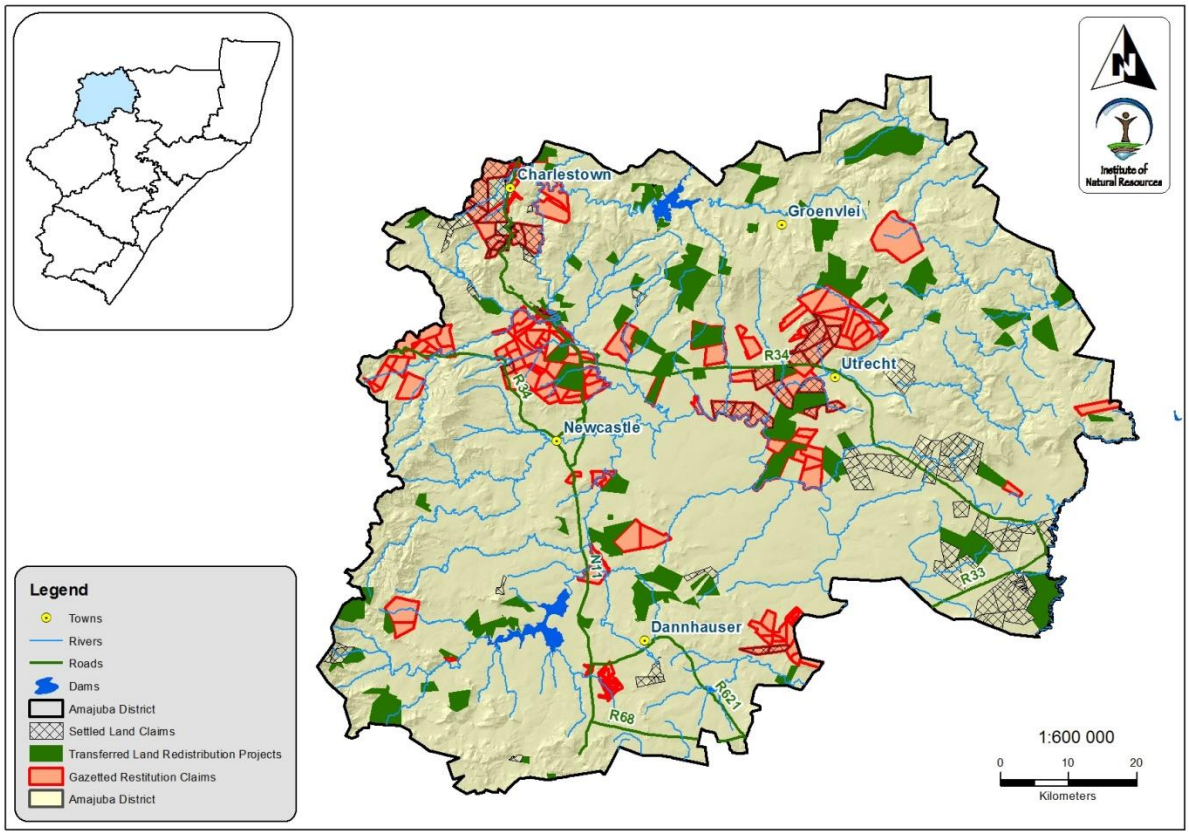


Figure 16: Distribution of land claims within the Amajuba District Municipality

4.2 INFRASTRUCTURE AND SERVICES

4.2.1 Introduction

Infrastructure and services influence the state of natural resources and quality of life in the following ways. Where there is inadequate supply of services, either in terms of the coverage (waste collection limited to urban areas) of supply, or the quality of the supply (unstable power supply), the state of the receiving systems is impacted. In the case of inadequate waste water treatment (WWT) and sanitation infrastructure, it is the water resources that are impacted. This has negative

consequences for people directly reliant on these resources for water domestic use. It may also negatively impact the recreational value of water and use by other sectors such as irrigated agriculture. Likewise, where electricity is not supplied, people rely on natural resources like natural forests, which have a negative impact on the biodiversity and state of these systems. Air quality is also impacted through the burning of fossil fuels. It is therefore important to understand the coverage and quality of supply of services as a driver of environmental quality. This has been done in the following way for the following services. The coverage is depicted via a map of infrastructure for each service. The 'state' of supply is then described.

- Electricity
- Roads
- Water and Sanitation
- Solid Waste

Responsibility for different services infrastructure within ADM varies across different sectors. In addition, responsibility for bulk supply and distribution are separated in several cases.

uThukela water is the primary bulk water service provider to Amajuba District. Responsibility for distribution then rests with the two water services authorities in the District – The Amajuba District Municipality WSA services Emadlangeni and Dannhauser LMs and Newcastle LM WSA is responsible for servicing its own municipal area.

Eskom is the bulk supplier of electricity to Amajuba DM. Newcastle and Emadlangeni LMs possess licenses to supply electricity in certain areas within their LM boundaries. Typically, the CBD and suburbs are supplied by the LM, while outlying townships and rural areas are supplied directly by Eskom.

Individual LMs are responsible for waste management in their municipal areas and are solely responsible for the collection and disposal of waste and the management of their waste disposal sites.

Road hierarchy is a significant determinant in road infrastructure governance as national roads are the sole responsibility of National Department of Transport (DOT) and are maintained through the South African Roads Agency Ltd (SANRAL). Provincial roads (both Provincial main roads and Provincial district roads) are the responsibility of the KwaZulu-Natal Provincial DOT.

4.2.2 Electricity

4.2.2.1 Extent of Electricity Supply

The spatial extent of supply and location of electricity within ADM can be used to determine areas that are well serviced, hence conducive to development, as well as areas that require further attention in order to encourage development. The spatial extent of electrification within small areas of ADM was mapped by integrating readily available spatial datasets. The relationship between the spatial distribution of Eskom transmission powerlines and the level of electrification is evident as illustrated in Figure 17.

Eskom transmission networks within Amajuba DM have coverage across all three LMs. Specific regions that have no coverage in terms of transmission lines include the north eastern areas of Emadlangeni LM and the extreme western regions of Newcastle LM.

4.2.2.2 State of Electricity Infrastructure and Supply

The capacity of Eskom electrification networks within Amajuba DM is considered the key state indicator with respect to the provision of electricity to the municipality. The capacity of Eskom transmission and distribution lines were spatially represented into three categories (Figure 18), those being: (1) – Constrained; (2) Not constrained and (3) Slightly constrained. These were subsequently used to form linkages between poorly serviced areas within Amajuba DM and current Eskom capacity.

The majority of networks within the district municipality are not constrained, with certain areas being exceptions. Urbanised areas in Madadeni, Dannhauser and Emadlangeni LMs show some constrained networks, with areas on the outskirts of urban regions indicating slightly constrained networks. The only concern is situated in the northern regions of Emadlangeni and the south-western regions of Dannhauser LMs, as electricity networks in these areas are constrained. The abovementioned regions are situated within rural and agricultural communities, who rely on electricity for daily household and farming activities (Figure 17).

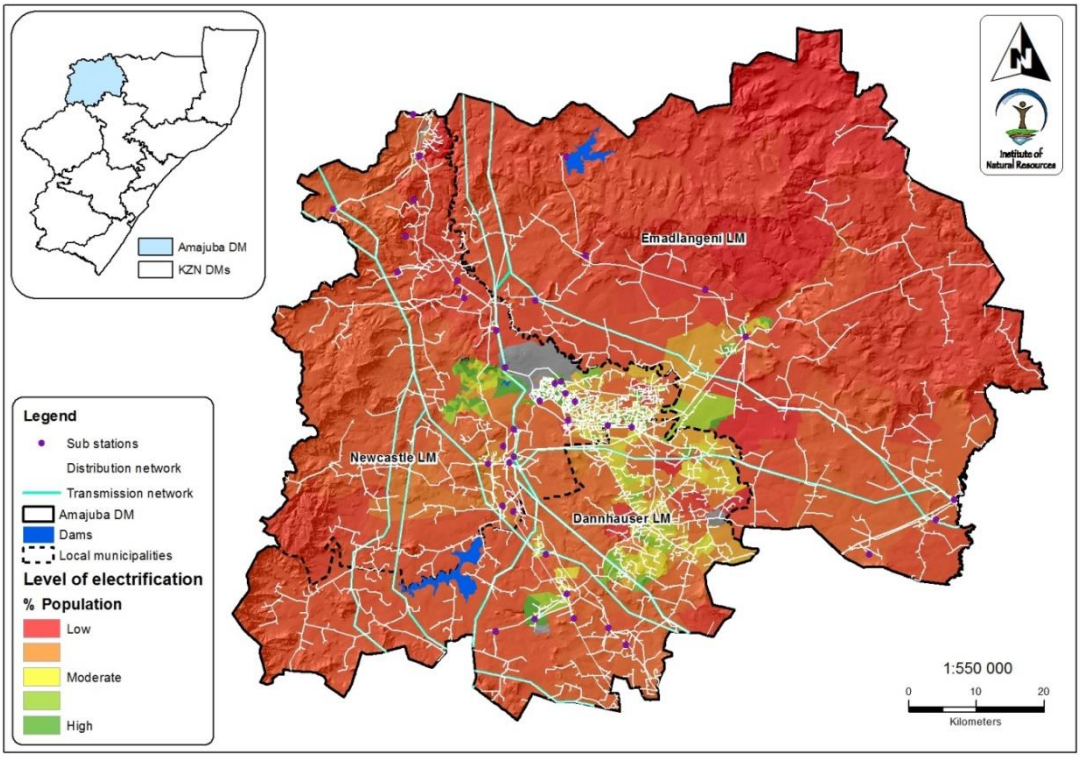


Figure 17: Locations and extent of Eskom distribution and transmission powerlines (excludes LM operated urban distribution lines)

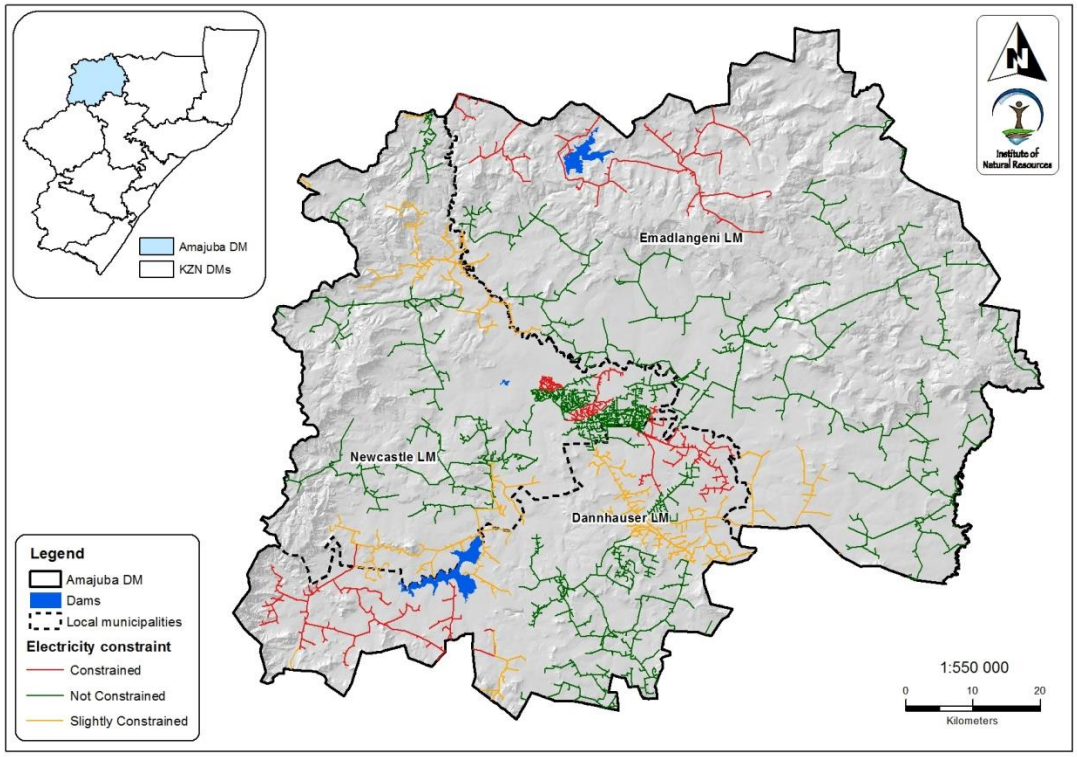


Figure 18: Capacity of Eskom distribution and transmission powerlines

4.2.3 Road Network

4.2.3.1 Extent of the Road Network

The relevant road authorities in South Africa at different government levels are obligated to provide a reliable, effective and efficient integrated transport system. This is to be done with an overarching goal of supporting sustainable economic and social development objectives. Roads play an important role in connectivity and mobility and have the potential to bridge not only geographical divides but also the ability to provide communities with access to improved economic and social opportunities.

The majority of road infrastructure in the ADM is understandably centred around the urbanised centres in the eastern areas of the Newcastle LM as well as the north eastern areas of the Dannhauser LM. These areas are indicated by having high road densities per small area unit (Figure 19) though this does not account for road class. Road density decreases as one moves away from these urban centres within the rural regions of Amajuba DM.

From a strategic perspective, the importance of the road network is illustrated in the fact that the Strategic Development Framework is effectively built around key road infrastructure (Figure 20). This foundational document identifies the N11 as a primary development corridor and roads linking Dannhauser and Utrecht to Newcastle as secondary mixed activity corridors.

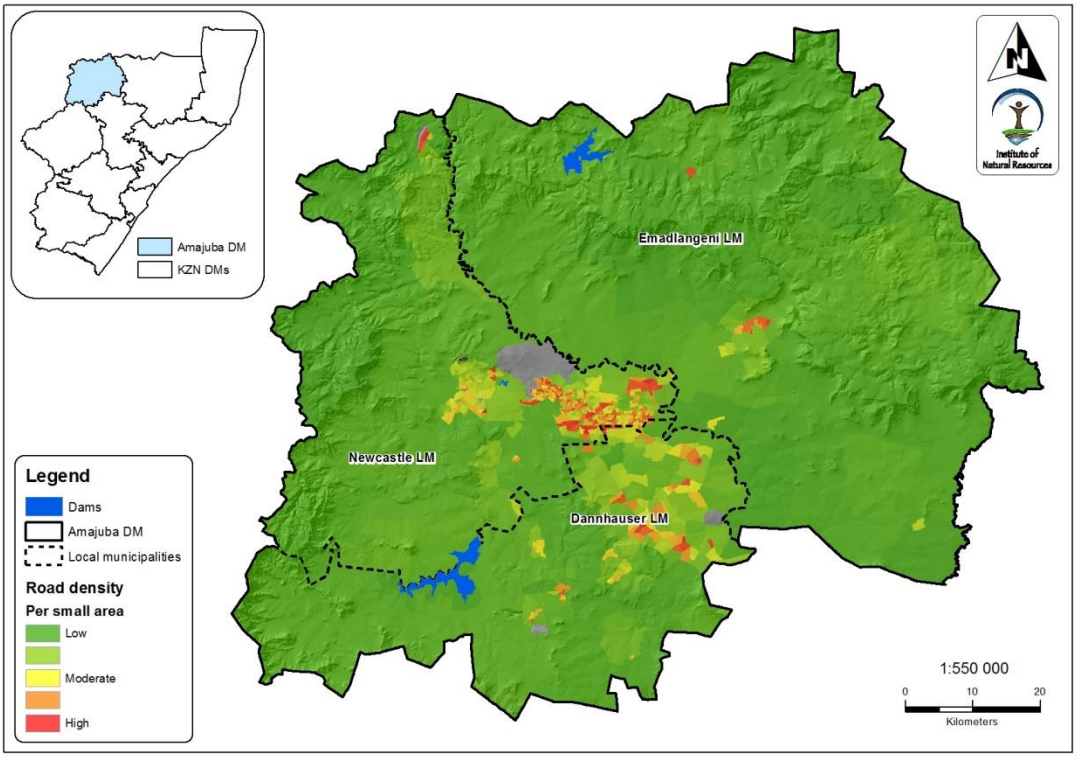


Figure 19: Density of roads (all classes) per small area of Amajuba DM

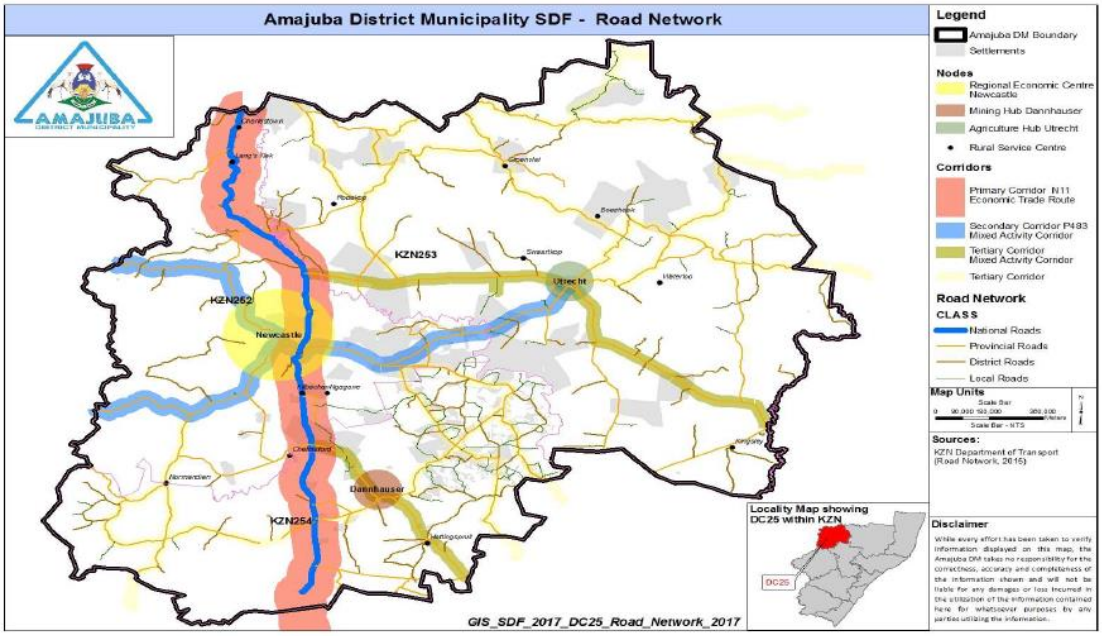


Figure 20: ADM SDF - road network (Source: ADM SDF)

Road infrastructure is a critical element in the growth and development of regional economies. The Road Infrastructure Strategic Framework for South Africa (RISFSA) embodies the Road Infrastructure Policy and provides a blue print for roads planning and development. This identifies six classes of road infrastructure (Figure 21

Table 11). The distribution of these classes across the ADM is shown in Figure 21

Table 11: Road Infrastructure Strategic Framework for South Africa road classifications

Class	Name
Class 1	Primary Distributor
Class 2	Regional Distributor
Class 3	District Distributor
Class 4	District Collector
Class 5	Access Roads
Class 6	Non-Motorised Accessways

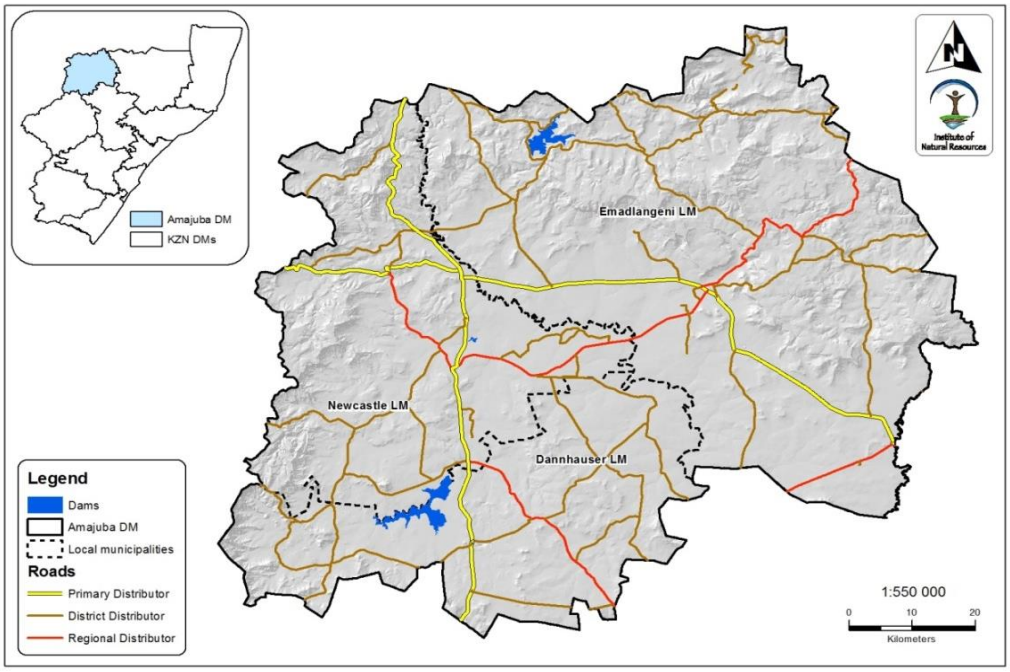


Figure 21: Road classes as outlined by RISFSA

4.2.3.2 State of Road Infrastructure

The majority of road surfaces within ADM are gravel (Figure 22), with the majority of these gravel roads classed as district distributors. Blacktop (tar) roads cover a significant portion of ADM (Figure 22) and are classified as primary and regional distributors.

The Draft ADM IDP 2018/19 identified the poor state of several regional roads as a weakness. This is corroborated by the 2012 Amajuba spatial economic overview (Isikhungusethu 2012) which identifies the poor condition of roads as a major challenge in economic development in the region. The majority of community access roads are unsurfaced gravel roads and according to the ADM IDP, they are not constructed according to geometric design standards. The high level of usage by public transport vehicles results in high vehicle maintenance costs and unsafe traveling conditions for

passengers. During wet periods, these surfaces become slippery or impassable resulting in unreliable transport options for the communities dependent on these roads.

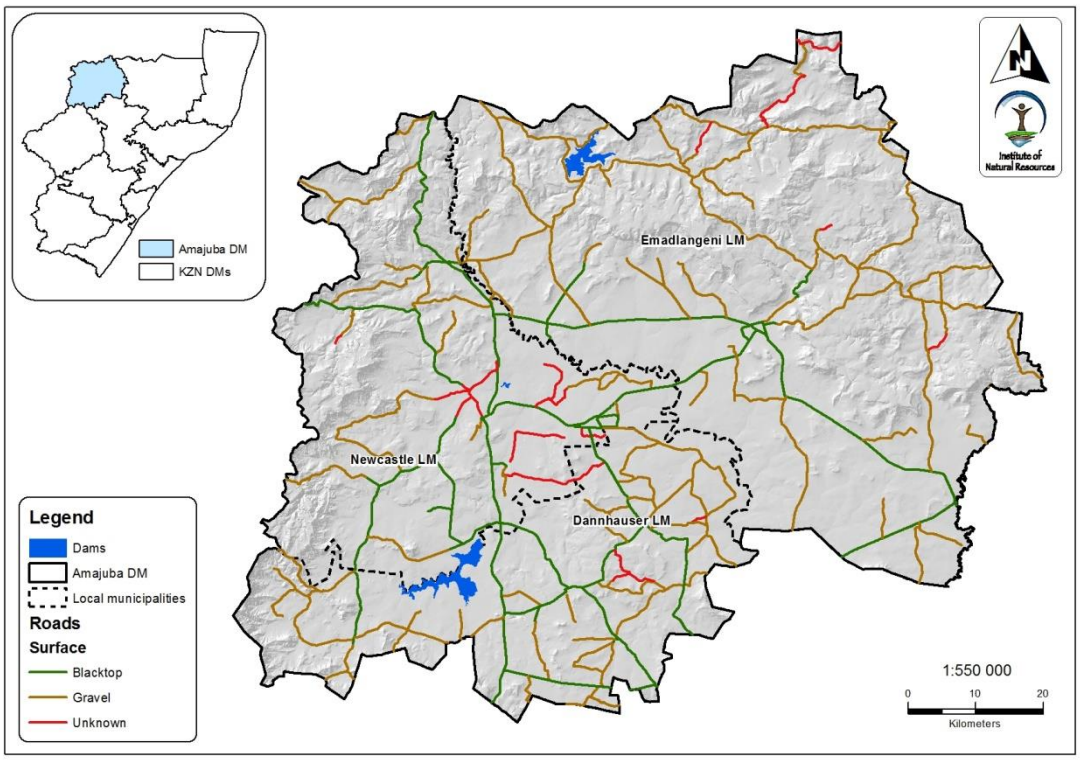


Figure 22: Road surface of national, provincial and district roads within Amajuba DM

4.2.3 Water Supply

4.2.3.1 Extent of Water Supply

Water and sanitation supply are essential services to ensure and facilitate social and economic development, business security and environmental health. Lack thereof has serious social, economic, environmental, health and security risks. There are two water service authorities (WSA) in ADM area. Those are the Amajuba District Municipality WSA, which services Dannhauser and Emadlangeni Local Municipalities and the Newcastle LM WSA which services the Newcastle LM area. uThukela Water is a registered Water Services Provider and services both WSAs.

In the 2016/17 Amajuba Annual Report, the backlog with respect to supply of water services is described in terms of the 2011 Stats SA Census data. This is reported here in Table 12. Water reticulation pipelines within Amajuba DM are concentrated around urbanised areas (Figure 23), with bulk water pipelines showing supply of bulk water services to all local municipalities. The Emadlangeni LM displays sparse water reticulation pipeline distribution, as large areas within this municipality are agricultural communities serviced by via boreholes and other water sources. Many of the areas within Emadlangeni LM receive tanked, rudimentary, traditional and yard tap water supply.

Table 12: STATS SA Data taken from the 2016/18 ADM Annual report showing water services backlogs

Type of access	Year	Newcastle	Emadlangeni	Dannhauser	Amajuba
Yard Connections	1996	37 765	1 257	2 578	41 600
	2001	43 886	1 947	2 798	48 631
	2011	71 635	2 410	10 175	84 220
Communal Connection	1996	9 835	117	4 781	14 733
	2001	18 175	1 154	7 693	27 022
	2011	9 347	1 260	7 595	18 202
No access to piped water	1996	6 346	1 935	7 821	16 102
	2001	9 103	3 086	8 829	21 018
	2011	3 290	2 581	2 669	8 540

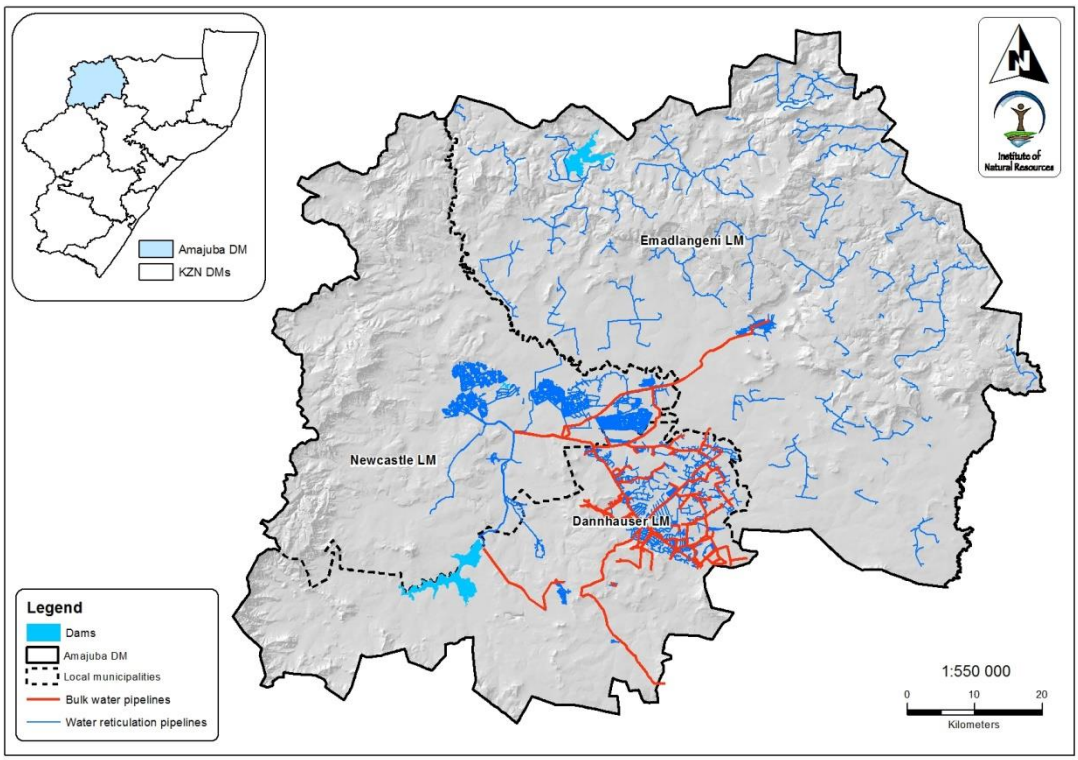


Figure 23: Water reticulation pipelines within Amajuba DM

The provision of water by municipal schemes within Amajuba DM shown in Figure 24 closely aligns to the distribution of water reticulation networks illustrated in Figure 23. Areas that have high levels of municipal water provision coincide with areas highly concentrated with water reticulation pipelines.

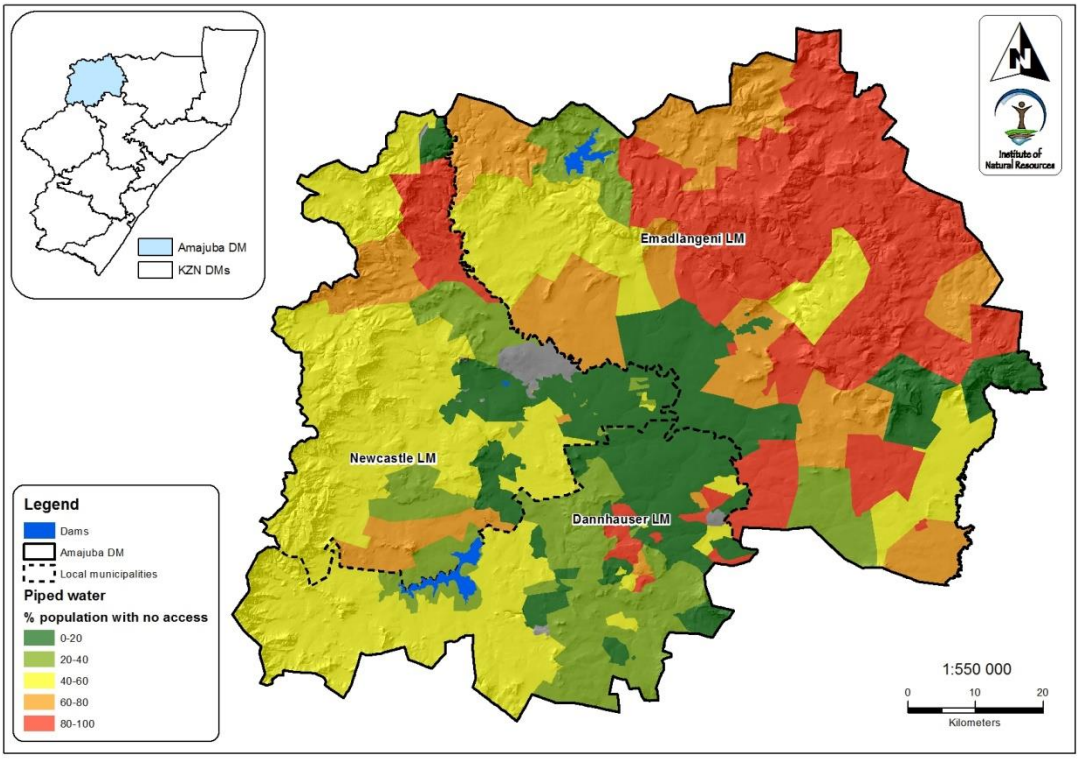
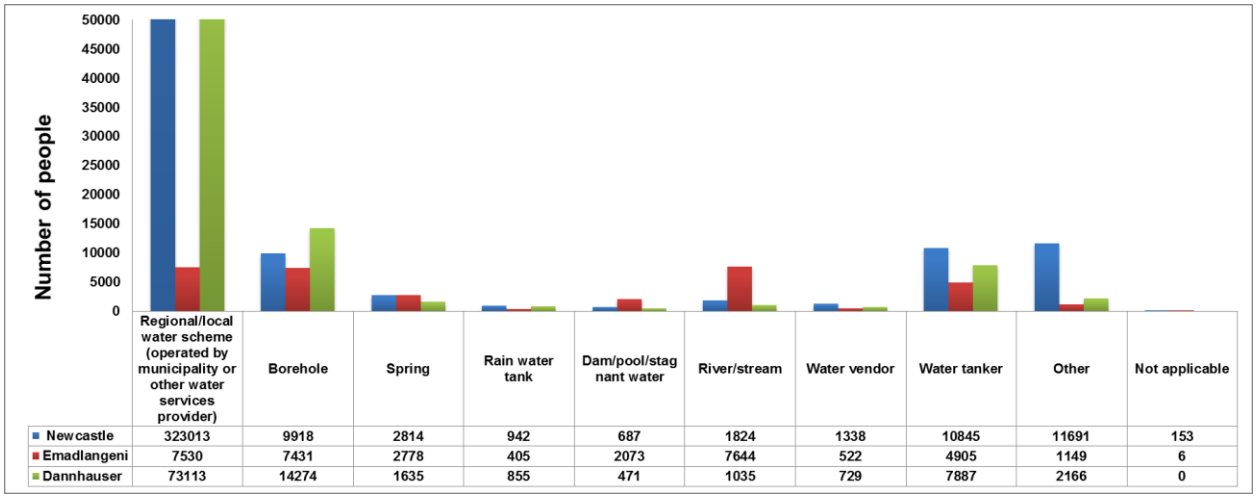


Figure 24: Percentage of people per small area who do not have access to piped water within 1km for dwelling/residence

4.2.3.2 State of Water Supply

Newcastle and Amajuba municipalities are both Water Services Authorities (WSA). Amajuba services both Emadlangeni and Dannhauser municipal areas, while Newcastle is responsible for its own municipal area. Based on the 2016 Stats SA Community Survey (Figure 25):

- 11,1632 households have piped water supply either to inside the home or on site,
- 17% of households rely on communal stand pipes
- 7.9% of households are reliant on boreholes or springs as opposed to the previous and are reliant on other sources of water. The quality of the water obtained from these sources is unknown and cannot be guaranteed, thus possibly leading to health problems.



	Regional/local water scheme (operated by municipality or other water services provider)	Borehole	Spring	Rain water tank	Dam/pool/stagnant water	River/stream	Water vendor	Water tanker	Other	Not applicable
Newcastle	323013	9918	2814	942	687	1824	1338	10845	11691	153
Emadlangeni	7530	7431	2778	405	2073	7644	522	4905	1149	6
Dannhauser	73113	14274	1635	855	471	1035	729	7887	2166	0

Figure 25: Numbers of households with access to different water sources.

Census 2011 data shows that there are still significant portions of the population who do not have access to safe drinking water (as defined by the Department of Water and Sanitation – 25l/p/day within 200m of your home) (Figure 26).

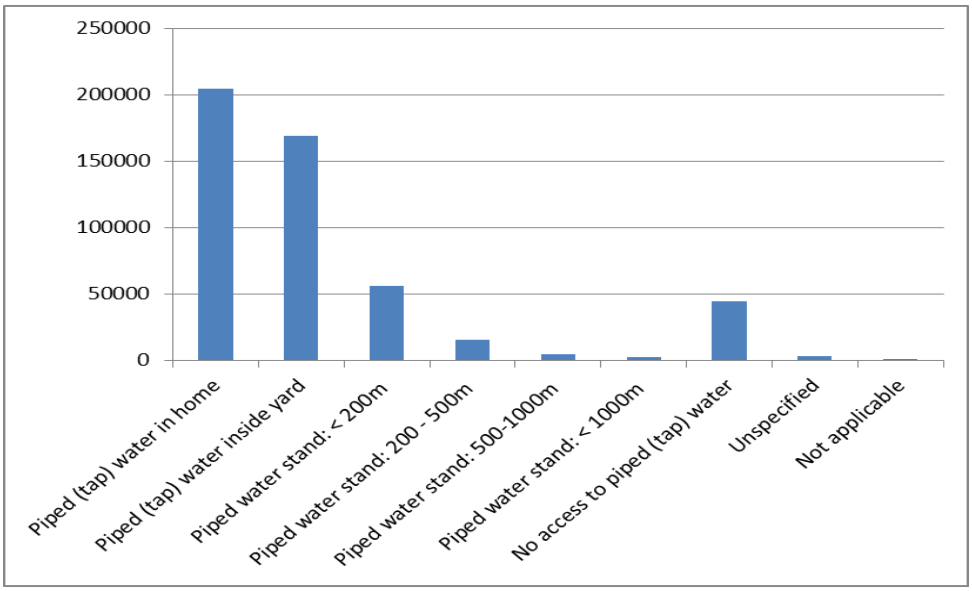


Figure 26: People's accessibility to piped water.

4.2.4 Sanitation

4.2.4.1 Extent of Sanitation Infrastructure and Services

There are currently twelve waste water treatment facilities registered on the DWS Integrated Regulatory Information System (IRIS). These are split equally between the two water service authorities in the study area – Amajuba District WSA and Newcastle LM WSA. These are listed in Table 13. According to the Newcastle LM EMF Status Quo report, there are only five facilities in the Newcastle LM. This suggests that the IRIS list contains a duplicate record, presumably the Madadeni STP is a duplicate of the Madadeni WWTW.

Table 13: Waste water treatment facilities listed on IRIS located within the ADM

Amajuba District WSP	Newcastle LM WSP
Durnacol WWTP	Charlestown Ponds
Gulela STW	Kilbarchan WWTP
Tweediedale Ponds	Madadeni STP*
Utrecht Ponds	Madadeni WWTP
Utrecht Welgedaght WWTP	Newcastle WWTP
Welgedagt	Osizweni WWTP

*Likely a duplicate record

These facilities service the urbanised areas in the District. This is evident in the 2011 census data showing the distribution of people with access to improved sanitation services (Figure 27)

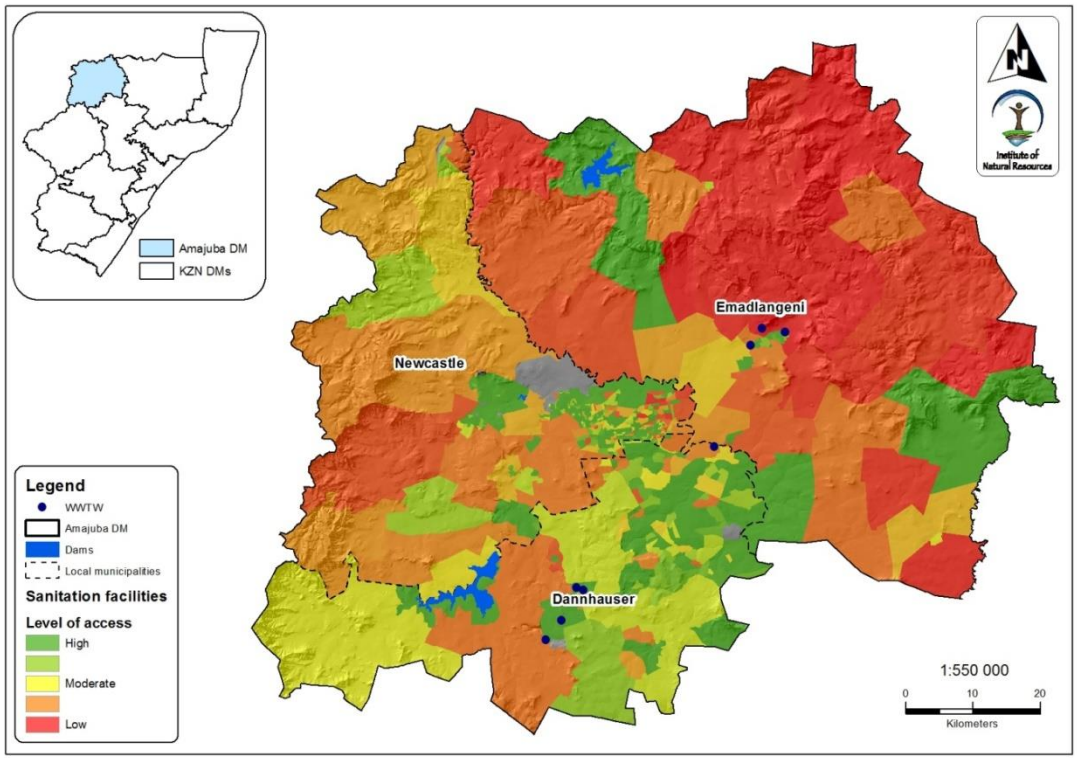


Figure 27: Percentage of people per small area without access to improved sanitation facilities

About 46% of the households in the Amajuba DM have flushed toilets that are connected to a sewerage system, 30% of households utilise unventilated pit latrines and 4% of the households in the Amajuba DM do not have any form of sanitation (Census, 2011) (Figure 28).

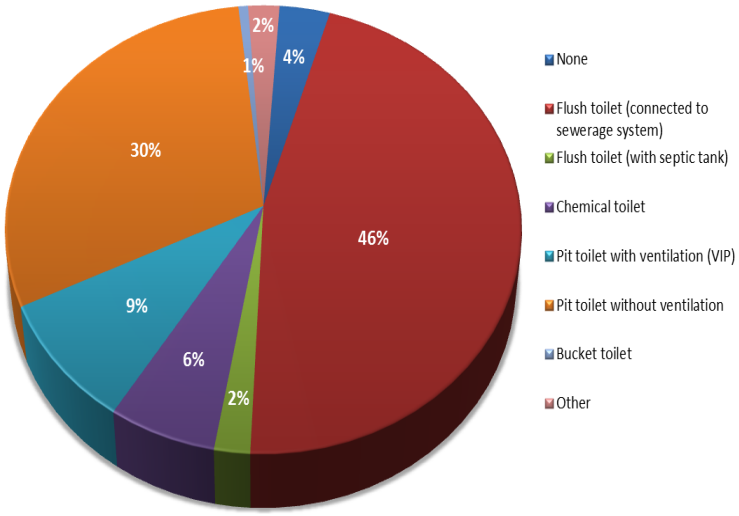


Figure 28: Households' access to different forms of sanitation

While the statistics reflect that a substantial proportion of the households in the ADM have adequate sanitation, it has however been noted that many homes are still faced with unhygienic conditions due to pit latrines and that many of these are full, thereby exacerbating the problems associated with such low tech sanitation systems.

4.2.4.2 State of Sanitation Services

According to the 2014 Newcastle LM EMF Status Quo report, Madadeni WWTW was at that stage overloaded while Osizweni WWTW was running at full capacity. This suggests that these facilities are stretched and potentially unable to meet standards for the discharge of effluent. This is consistent with the latest green drop results reported on the IRIS website for the Newcastle LM WSP which reports that the Madadeni WWTP is only 50% compliant with Microbiological category risk metrics and 75% compliant with chemical category metrics. Newcastle WWTP is greater than 99.9% compliant with Microbiological and Physical category metrics, but is only 87.5% compliant with chemical category metrics (Figure 29).

Newcastle Local Municipality								
	Microbiological		Chemical		Physical		Operational	
	Comply	Monitoring	Comply	Monitoring	Comply	Monitoring	Comply	Monitoring
Charlestown Ponds	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kilbarchan WWTP	>99.9%	8.0%	>99.9%	8.0%	>99.9%	8.0%	0.0%	0.0%
MADADENI STP	0.0%	>99.9%	0.0%	>99.9%	0.0%	0.0%	0.0%	0.0%
Madadeni WWTP	50.0%	16.0%	75.0%	16.0%	>99.9%	12.0%	0.0%	0.0%
Newcastle WWTP	>99.9%	16.0%	87.5%	16.0%	>99.9%	12.0%	0.0%	0.0%
Osizweni WWTP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Newcastle Local Municipality	83.3%	7.0%	85.0%	8.0%	>99.9%	5.0%	0.0%	0.0%

Figure 29: December 2017 Extract from IRIS for the Newcastle LM managed WWTPs.

Zero compliance of operational category metrics is reported by all facilities and zero compliance results for all of the four categories of metrics are reported for Osizweni WWTP and Charlestown Ponds. This may simply reflect non-reporting as opposed to complete failure of the treatment works,

but this is still of concern given the importance of monitoring and reporting in ensuring sustainability.

Zero compliance with all metrics is reported by all of the ADM WSP facilities. Although this may also only reflect non-reporting (only the Welgedagt facility indicates monitoring is occurring), laboratory results from these facilities show that in virtually all results reviewed, Soluble Reactive Phosphate (SRP) results are non-compliant with national standards and that microbiological results were often poor.

According to uThukela Water (2012), all of the facilities in the Newcastle LM fleet struggle with aging sewer infrastructure, storm water ingress and resultant hydraulic overloading during summer storm events. This results in the discharge of large volumes of partially treated or untreated effluent.

4.2.5 Solid Waste Management

4.2.5.1 Spatial Extent of Waste Collection and Management Services

An increase in population leads to an increased rate of waste generation, which ultimately requires effective waste management strategies and policies. Ten registered landfill sites are located within the NLM of which nine are classified as H:H – that is hazardous facilities. These H:H sites are managed by private sector entities. A registered general waste disposal site is located in Newcastle adjacent to the Newcastle airport (Figure 30). This facility is the largest in the District and is managed by Newcastle LM. Unregistered waste disposal sites are located in Charlestown, Dannhauser and Waterval Prison whilst a general waste landfill site is located in Utrecht.

Figure 30: General waste landfill site located adjacent to Newcastle Airport

There are also existing buyback centre facilities in Newcastle LM and Madadeni, these facilities play a role in economic development and additionally contribute to the longevity of landfill sites through diversion of waste.

4.2.5.2 State of Solid Waste Services

Solid waste management is of critical importance to achieving sustainable development and social well-being. Solid waste can not only impact on human and ecological health but also on

infrastructural integrity as storm water drains are often blocked by solid waste resulting in flooding and damage to infrastructure.

Land fill sites are predominantly used in the ADM to dispose of solid waste. The largest facility is the registered general waste landfill site in Newcastle LM. In 2004, this site was reported as having sufficient airspace for another two years of operation (Sivest 2004). This site is still being used today, although a new site has been identified and the Newcastle LM is in the process of seeking environmental authorisation for this facility. The site is understood to be operating relatively well, despite the limited capacity (ADM SDF) (Figure 31).

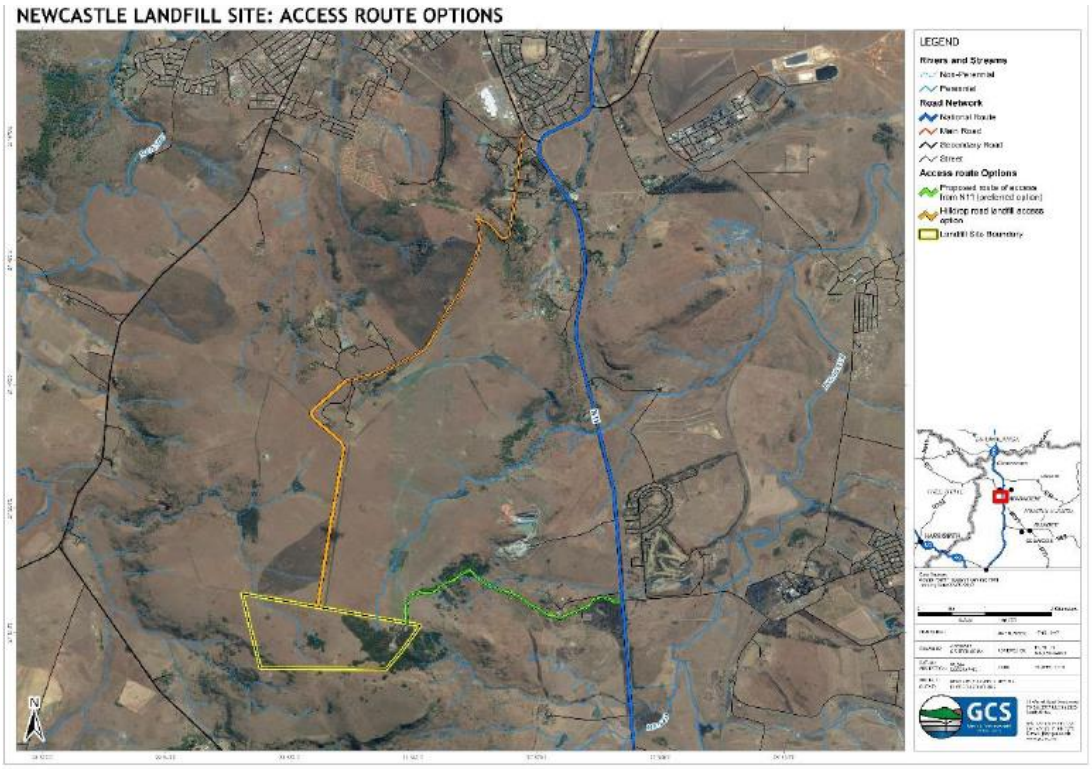


Figure 31: Location and access to the proposed new Newcastle landfill site (Extracted from the EIR report (GCS 2018))

The conditions of the other sites listed in the Amajuba DM SDF are as follows:

- The Newcastle East and Rural landfill is understood to be adequate with regards to collection and disposal equipment.
- Utretch landfill site requires further attention and upgrades in order to improve overall operation and disposal capacity.
- Waterval Prison landfill site is still undergoing the process of acquiring a permit, this process is guided by the relevant legislation, which will dictate whether the permit received is for closure or to continue operating.
- The Dannhauser site is in a similar situation to Waterval Prison, as the permit process is still ongoing, be for closure or continued operation.

At present a major challenge to waste management is the limited disposal sites within urban centres. It is therefore critical that new sites be located and identified in order for future

development. A key environmental concern with the siting of a landfill site is the potential for such a facility to contaminate groundwater, particularly given the shallow groundwater table across much of the Buffalo River basin.

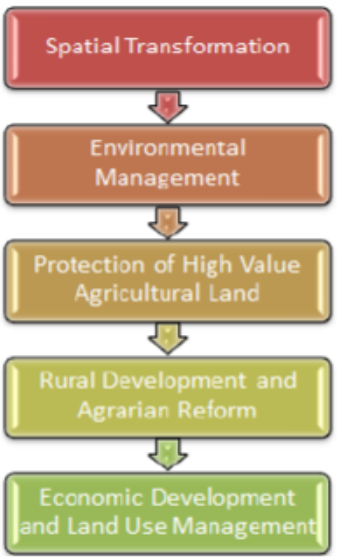
4.3 DEVELOPMENT PRESSURE

4.3.1 Local Economic Development within ADM

Local economic development (LED) is an area of importance within the ADM. Some of the challenges experienced around LED within the ADM include: the fact that development potential of the municipality which is rated as an area where resource potential is low, human need is medium-high and economic activity is low. Agriculture is the largest sector within the ADM together with wholesale and retail. There has been a noticeable decline in the agricultural sector within the ADM, this can be attributed to large areas under land claim, difficulty in accessing funding for infrastructure especially as small scale farmers and a lack of access to markets and support structures. An important step to local economic development is an emphasis on infrastructure development. Although areas such as Newcastle have good infrastructure and development, other areas within the ADM lack both social and economic infrastructure. This lack of infrastructure includes a lack of roads to support agricultural and mining activities, a lack of commercial and industrial spaces and a lack of irrigation for agricultural activities. Unemployment and poverty remain one of the main hindrances to LED and therefore a lot of focus has been put towards increased investment and economic growth.

4.3.2 Potential Areas of Development within the ADM

Development within the ADM has to adhere to specific guidelines and directives in terms of development including:



N11 main travelling route- the N11 is one of the main travelling routes within the province and is a major link between Durban and Johannesburg. There are high volumes of traffic on this road and also acts as the main route for trucks and other fright vehicles. The heavy reliance on this road therefore provides an opportunity for development in terms of road improvement and provision of facilities to capitalise on the existence of this heavily utilised route.

Settlement- The ADM is characterised by a mix of urban and rural dwellings with strong community and traditional land practices undertaken which shape settlement patterns. Commercial and office spaces are predominantly found in Newcastle as well as service industries and community commercial centres. In terms of the development proposed, most of this development is set to take place within the Newcastle municipality. This development includes the development of office spaces, restaurants and motorcar showrooms. There is also an emphasis placed on the refurbishment of buildings that are underutilised or vacant because of the economic downturn or relocation. The main development in terms of settlement is that off mixed land use and commercial nodes together with areas of residential development.

Mining- There has been a decrease in the mining sector especially within the Dannhauser municipality which has in turn resulted in the decline of the economy. The Durnacol mine's assets after closure including warehouses, offices and workshops were made available to the municipality for local economic development. This area would be ideal for small scale manufacturing and agricultural related industries as well as act as a business incubator for the district. However, progress in utilizing this space is delayed because there are disputes over the use of the facility.

Manufacturing- Most of the manufacturing related activities occur in Newcastle and is a heavily relied on sector by the municipality. Manufacturing with ADM includes aluminium based products, leather goods, textiles and textile products, clothing, motor vehicle components, metal products and machinery.

Commerce and trade- ADM is dependent on both secondary and tertiary sectors. Commerce and trade constitutes the second largest contributor to the districts economy.

4.3.3 Mining

An important economic activity in the study area is undoubtedly coal mining and this also has a significant impact on various environmental and development components in the District. The study area falls within the Newcastle – Klip River coal field and primarily in the Hattingspruit – Newcastle coal sector with a small portion of the Glencoe-Dundee-Hattingspruit sector spanning the southern boundary of the UDM with the UThukela District Municipality.

Various ranks of coal are present within the two coal sectors, namely coking coal, anthracite and bituminous coal. In the central section of the Newcastle-Dundee coal sector, the Durban Navigation Colliery (Durnacol) with a production of 68,000 tonnes of coking coal per month used to provide Newcastle, Pretoria and Vanderbijlpark Steel works with coking coal. The mine was closed in 2000. Other underground mines in the Hattingspruit-Newcastle sector include Ballengeich, Kilbarchan and Ingagane which have been closed. Most of the underground mine workings are 100 to 200m deep and the coal seams are frequently overlain by thick dolerite sills.

However, the Natal coal field production has steadily decreased from 20Mt in 1982 to 2.5Mt in 2005. This is primarily due to difficult mining conditions, rising costs, decrease of demand for export of anthracite, gas explosions and competition with low cost mines of Mpumalanga (Figure 32).

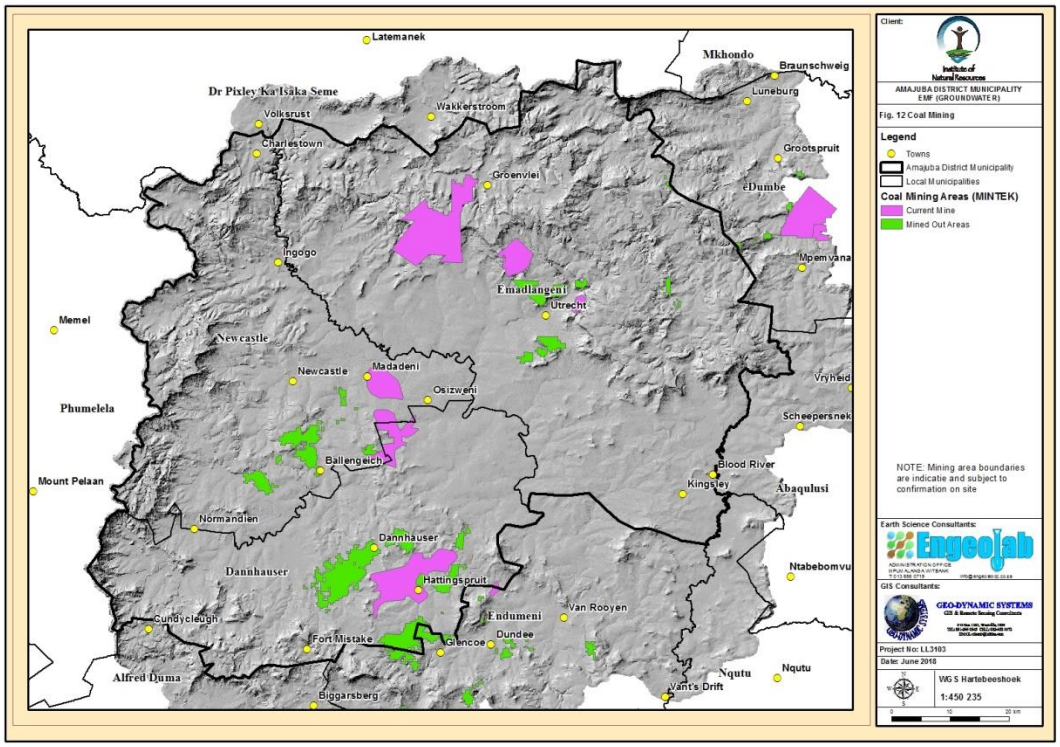


Figure 32: Distribution of mining activity across the ADM (Source: MINTEK 2007).

Numerous abandoned mines exist in the District and importantly, rehabilitation works have not been carried out or are incomplete at many of these. This has significant implications for environmental management, particularly development, ground stability and water quality in the District.

4.3.4 Development applications

Development applications that have been lodged in the ADM in the last five years have been collated and their locations illustrated in Figure 33. There are various applications located in and around the Newcastle urban area.

Mining

Relatively few mining applications have been confirmed to have been lodged in the ADM in the last few years. There are currently four mining related projects in EIA or startup phase in the Amajuba District. These are listed as follows:

1. Ikhwezi Mining- DC25/S24/0001/2013- About to commence mining
2. Keldron Newcastle Colliery-DC25/0013/2012- Status unclear
3. Proposed Alleen 2 open cast extension of the Magdalena Colliery in Dannhauser- DC25/0018/2013
4. Proposed extension of the Magdalena Colliery Discard Dump in Dannhauser -DC25-0018-2012

The Ikhwezi application and the Magdalena applications have been spatially located, together with an application for an extension of the open cast mining at the Chelmsford Colliery (not included in the above list). These are shown in Figure 33. The location of the Keldron Newcastle Colliery application could not be confirmed.

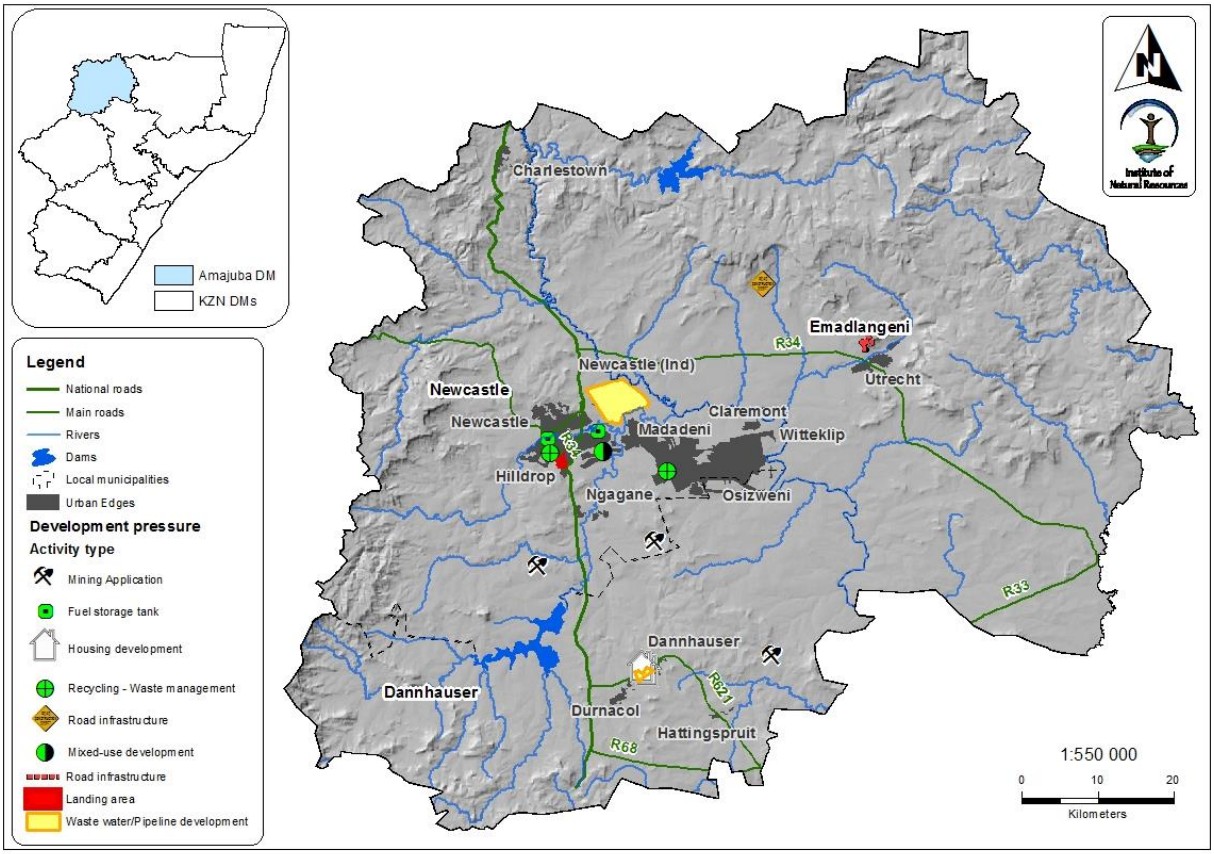


Figure 33: Development authorisation applications 2013 – 2018

4.4 CROSS CUTTING ISSUES

A key driver of environmental change related to the socio-economic profile of the District is the ongoing increase in urban and peri-urban population size and the trend towards smaller sizes and a greater number of households. The effects of a growing population and the global urbanisation trend are widely documented and reflect people migrating to areas where job opportunities and

better services are more easily accessible. When coupled with the decreasing average household size, this trend means that considerably more houses are being built (formal and informal) and this places additional pressure on service delivery infrastructure and on municipal and natural resources.

In Amajuba DM, the urbanisation trend described above typically manifests as a steady and unplanned creep of low density settlements, particularly in the areas to the south of Madadeni and Osizweni. Apart from being extremely difficult to service, these distributed settlement areas coincide with areas of important biodiversity and high agricultural potential. The loss of these resources to unplanned and often illegal housing development is extremely problematic and points to a notable failing in governance mechanisms.

In the context of the ADM socio-economic situation, this trend towards bigger, more sparsely settled urban areas means that infrastructure development and maintenance expenditure is increasing in an area where education, employment and income earning potential are low and where costs of infrastructure development and maintenance are not being supported by growing tax or rates base, placing the services sector under pressure (Figure 34).

Figure 34: Sprawling low density settlement south of Madadeni.

This trend particularly threatens the quality of both groundwater and surface water resources. Importantly, waste water treatment facilities in the District are already under pressure and many are

not functioning adequately[4]. The increasing numbers of households will only place an additional burden on these facilities and ultimately result in declining water quality in the receiving environment.

A notable feature of the areas on the Buffalo River flood plain is the very shallow ground water table, often within a few metres of the surface. This area is also a focal area for the growth of peri-urban informal settlement. Pit latrines are commonly utilised in this area and many people rely on boreholes for their household water requirements. This combination results in a threat to human health. This can generate a negative feedback mechanism where by reducing people's health, their ability to sustain a livelihood and their economic resilience is reduced, thereby enhancing existing poverty levels. This has been demonstrated in the past by cholera outbreaks related to contaminated groundwater.

This area is also particularly prone to flooding and the expansion of settlement onto flood plains places the settlement and its inhabitants at risk. In addition, the disturbance of the flood plain also limits its ability to attenuate floods and therefore places people and infrastructure downstream at additional risk. Disaster and risk management are thus considerations growing in importance, particularly in the light of climate change which is likely to result in greater frequencies of flooding.

The increasing urban population and growing number of households in the Newcastle / Madadeni / Osizweni area is also a key driver of change with respect to infrastructure. This overarching factor is increasingly putting pressure on existing and in many cases aging infrastructure. It is also placing increasing pressure on responsible authorities to develop new additional infrastructure to supply critical services. This is particularly evident in ADM with respect to water, sanitation and solid waste, but it applies to all infrastructure covered by this report. Much of this growth is occurring in the peri-urban areas particularly on the Ingonyama Trust land to south of Osizweni. This is particularly significant since these areas are not subject to municipal rates and taxes meaning that infrastructural development demands are not accompanied by a growth in municipal income.

Water is an important cross cutting issue. The supply of fresh water to a growing population is in itself a challenge. Water resources in ADM are limited and without the development of additional dam infrastructure, domestic water supply is competing directly for available supply with economic development opportunities in agriculture and industry. Declining water quality is furthermore reducing the availability of fresh water and the options for its use. Aging and poorly maintained waste water and solid waste infrastructure is partially responsible for this decline whilst the lack of sewerage infrastructure in areas also contributes to the contamination of water resources.

[4] Waste water effluent analysis results from several District WWTWs show phosphate concentrations in effluent consistently exceeding 10mg/l. The national standard for this is 1mg/l.

5. WATER RESOURCES

5.1 OVERVIEW OF THE WATER RESOURCES OF THE ADM

This section provides an overview of the surface water resources as context for discussing the various elements (surface water, wetlands) in more detail (groundwater is dealt with separately (see section 7). In order to map the important water production areas of the ADM, it is necessary to define sub-catchments that lie within the district boundary at a scale that is useful for intra-district planning. The use of the quaternary database was ruled too course for this study. A set of "flow derived" quinnary catchments was sourced from the UKZN and refined to allow for alignment with other data sets. The PES / EI quinnaries (part of the National project) were nested within these flow derived quinnaries to allow transfer of information between them. Larger flow derived quinnaries were split / re-delineated based on the outline of the PES information. The result is a fine scale catchment network. These catchments have formed the basis for the majority of the aquatic resources studies carried out as part of the EMF.

5.1.1 Surface Hydrology

The Amajuba District Municipality (ADM) falls entirely into two primary catchments namely the Thukela and Pongola catchments. Within these catchments there is an extensive network of rivers and tributaries. The District is characterised by a horseshoe shaped area of high lying land in the western and northern regions of the District which forms part of the Drakensburg escarpment. These regions drain into a central lower lying basin which hosts the Buffalo River which is the largest river system in the ADM and which is a key tributary of the Thukela River (Figure 35).

The Ngogo, Ncandu, Horn and Ngagane Rivers are important tributaries of the Buffalo River draining from the western highlands while the Slangspruit, Doringspruit and Dorpspruit form the main tributaries in the north. The headwaters of the Pongola River (including the Bivane River) are found in the high lying north eastern areas of the ADM and drain eastwards out of the District (Figure 35).

The high lying areas of the ADM are important water source areas. The northern areas form part of the Enkangala Drakensberg Strategic Water Source Area and the south western highlands form part of the Northern Drakensberg Strategic Water Source Area (Le Maitre *et al* 2018). Importantly from a District perspective, all of the water used within the District is sourced from catchments entirely located within it (barring very small areas at the top of the Ngagane and in the Buffalo River headwaters). This highlights the importance of the catchment areas for socio-economic wellbeing in the District (Figure 35).

These catchments however also supply surrounding areas, including the Vaal River catchment through the Zaaihoek transfer scheme, the Bivane and Pongolapoort Dams which support large scale irrigation farming and the Richards Bay economic hub through a transfer from the Thukela River into Goedetrouw Dam (Figure 35).

The Ntshingwayo Dam (formally known as Chelmsford Dam) and Zaaihoek Dam are the largest impoundments in the ADM. The much smaller Tom Worthington Dam is located near Hattingspruit. The Ntshingwayo Dam is fed by the Ngagane River and is situated at the boarder of the Newcastle

and Dannhauser Municipalities. This dam is the most important water supply point for Newcastle – the most densely populated area and economic hub of the District. Water is pumped from the dam to the Ngagane water purification plant from where it is supplied to users in Newcastle, Osizweni, Madadeni, Braakfontein, Kilbarchan, the Eskom village, Ballengeich and the Amajuba District areas of Emadlangeni, Buffalo flats Alcockspruit and Steildrift (Figure 35).

The Zaaihoek Dam is situated in the Emadlangeni Municipality and is used to primarily supply water to Majuba Power Station, but also Volksrust town and to supplement the Vaal catchment. Water is pumped to Uitkyk reservoir from where the water can flow via a gravity main to Majuba Power Station. There is however a diversion at Uitkyk to Mahawane Dam to supply Volksrust. The water for the Vaal catchment is released into the Perderwaterspruit, upstream of Amersfoort Dam (Figure 35).

The Buffalo River is a key water supply feature for users located downstream of the ADM, and in particular, the Biggarsberg Water Treatment Plant which supplies the towns of Dundee, Glencoe and Sibongile with potable water. This water is abstracted at the Tayside Weir (outside ADM) and is supplemented from smaller dams such as the Tom Worthington Dam (inside ADM) and other small dams located outside the District when these have sufficient water (uThukela) (Figure 35).

5.1.2 Wetlands

The Blood River Vlei, Boschoffs Vlei, Groenvlei and the Paddavlei are four of the most sensitive and important wetlands in the ADM (among approximately 9200 smaller wetland features). These features are highly important from a hydrological point of view due to their specific functions of water regulation and purification in the Buffalo River system. They are also important because of the fact that they provide unique habitats for various wetland biota. Even though it lies beyond the boundary of the ADM, the Wakkerstroom wetland together with Groenvlei regulate flow into Zaaihoek Dam (Figure 35).

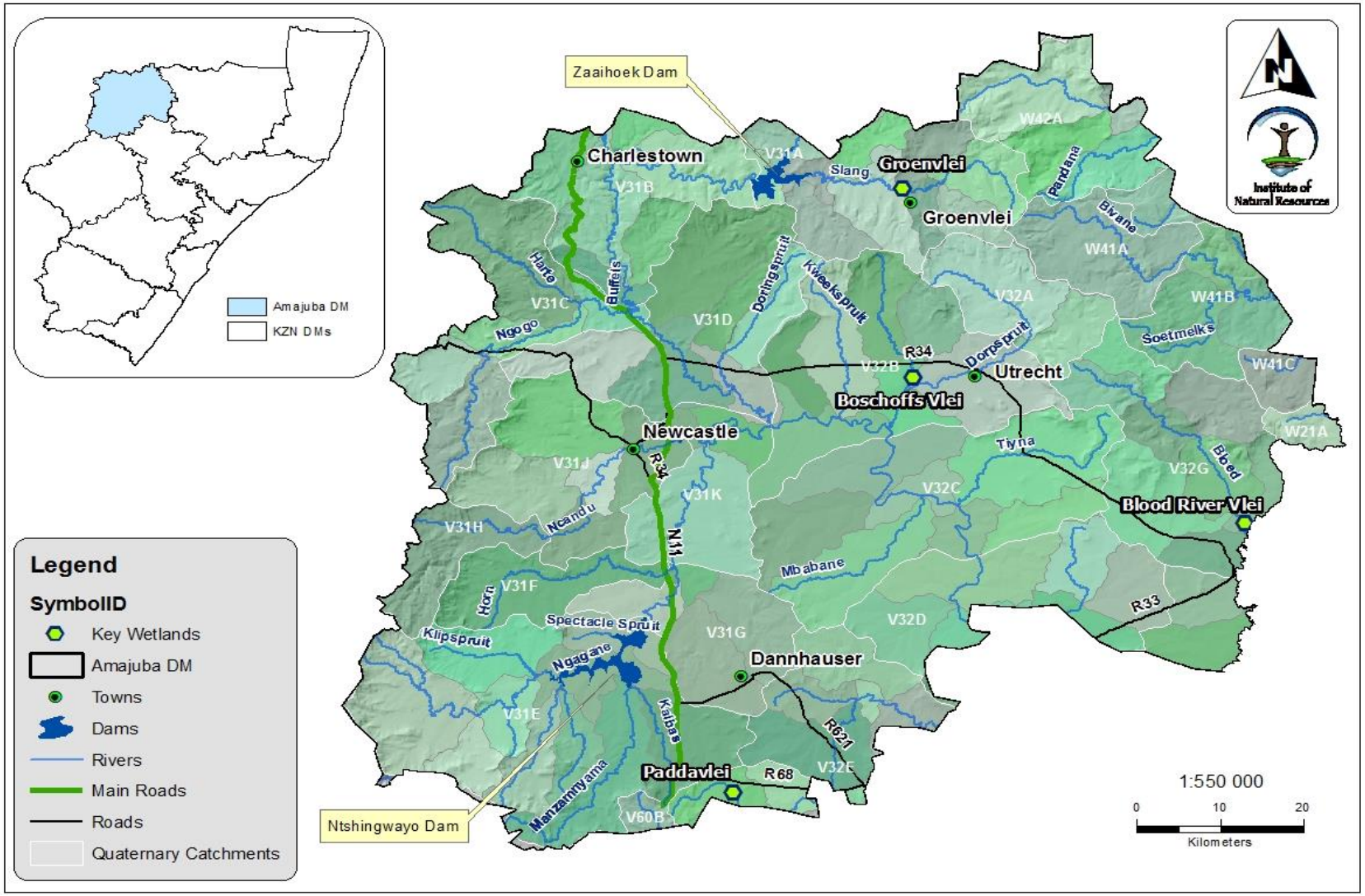


Figure 35: Surface water hydrology within the Amajuba District Municipality (flow derived quinnaries mapped in colour but not reflected in the legend)

5.2 SURFACE WATER YIELD

5.2.1 Introduction

Yield is the average amount of water that runs off the landscape in an unregulated watershed. Water yield is the difference between precipitation and evapotranspiration. Changes in water yield indicate changes in annual runoff in an area and are important for watershed hydrology. Water yield is affected by rainfall, soil type, drainage density and land use. Water yield includes both overland and subsurface flow that reaches the stream.

Good management practises are essential for water generation regions, in that they yield the necessary water required for a wide range of societal needs (domestic, spiritual and recreational uses) and economic growth. Strategic water regions “produce” water for basic human needs, to maintain environmental processes, agriculture and industry. Maintaining these catchments is essential in ensuring a steady supply of water, particularly in dry winter seasons where subsurface flows play a critical role in recharging rivers and streams.

5.2.2 Spatial Extent

In order to highlight strategic water source areas, it is necessary to quantify the volume of water generated by each quinnary catchment within the ADM. Thereafter, the volumes per hectare can be visually mapped and used to prioritize important water generating catchments.

The CSIR 1 x 1 minute grid raster Mean Annual Runoff layer (Nel *et al.,* 2013) developed for identifying strategic water source areas for the country was clipped to the ADM boundary. Zonal statistics (as a table) – a tool in ArcGIS was used to calculate the sum of the runoff associated with the pixels within each quinnary to determine the MAR of each catchment.

The cumulative MAR was then divided by the area of the catchment. This mm/Ha value was used to identify strategic water source areas because it is able to negate the bias caused by large quinnaries generating a larger summed runoff value.

The results were then spatially represented (Figure 30) using three quantiles (equal numbers of catchments in three categories). The National Strategic Water Source Area Data was then overlaid to demonstrate the level of agreement between nationally important water source areas and those identified at a local level.

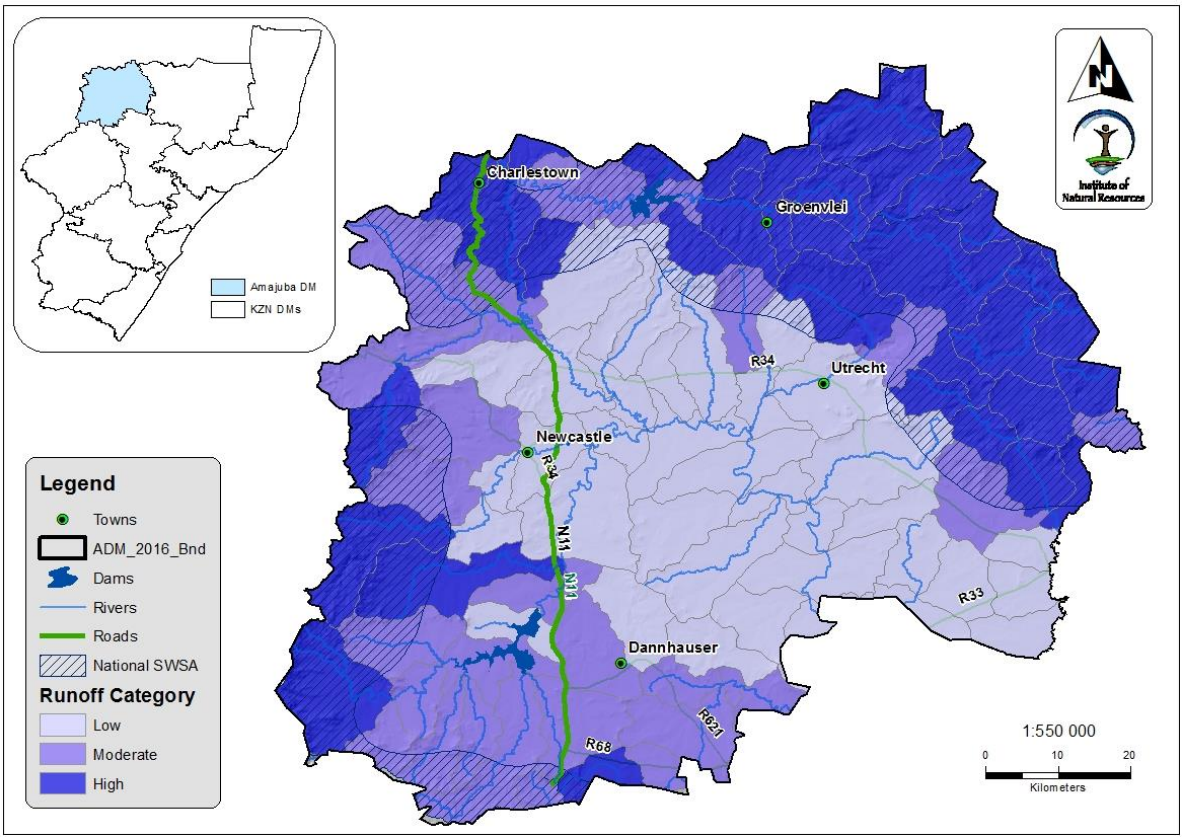


Figure 36: Distribution of water yield and national strategic water source areas across the ADM

5.2.3 Socio-economic and Conservation Value of the Resource

The socio-economic use value of water production cannot be overstated, particularly in the wake of the crippling 2015/16 drought experienced by large areas of South Africa. Water supply not only underpins basic human needs, but almost all economic activity is dependent of the availability of water to a greater or lesser extent.

Because of the District's topographic situation, all of the water used in the Amajuba District comes from the catchments contained within the District's boundaries. This includes water for agriculture, industry and domestic use. Without the water generated in the Amajuba catchments, economic activity in the district would be largely impossible. There are no transfers of water into the District and no catchments feeding into it.

In addition, these catchments supply water to help meet major demands downstream of Amajuba DM including water for Glencoe, Dundee and surrounds and water that contributes to the Bivane Dam and the large scale irrigated agriculture in the Pongola and Mkuzi regions. The area also supplies water to meet demand in other catchments via downstream water transfers including the Amajuba power station and Gauteng demand via the Vaal River catchment (from Zaaihoek Dam) and the Richards Bay economic hub (transfer from the Thukela River to Goedetrouw Dam).

The development of dams is important in meeting the bulk water supply needs of the ADM. A number of potential dams have been earmarked for catchment areas. According to the IDP in order to ensure sustainable management of water, strategic infrastructure has to be

developed to ensure this resource is conserved because of its important socio economic value (IDP, 2017).

5.2.4 Condition of the Resource and Drivers of Change

5.2.3.1 Invasive alien plants

All of the water available within the ADM is produced in the District's own catchment areas. Higher water yields are generated at the top of the catchments where there is higher precipitation. Water yield from these catchments is directly affected by prevalent vegetation types and cover. In the ADM catchment areas, the overwhelmingly dominant vegetation type is grasslands, but invasive alien woody species are increasingly present in these catchment areas. An invasive alien plant assessment in the Enkangala grasslands (Quayle et al., 2011), shows that there is significant infestation by alien invasive species in the areas of high base flow (Figure 37).

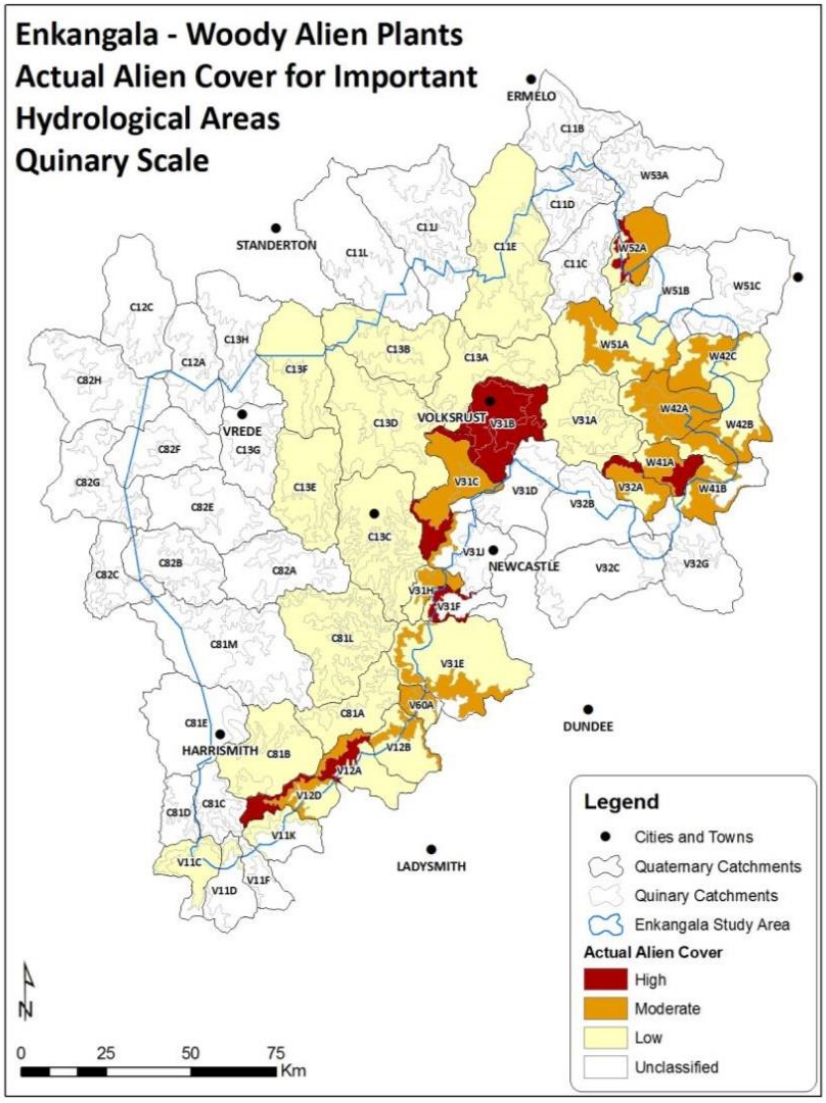


Figure 37: Woody alien plant distribution in hydrologically important areas (Source: INR 2011).

It is known that alien invasive species are significant users of water in South Africa and one of the greatest users is *Acacia mearnsii* (Table 14). In Amajuba District, wattle species (*A. dealbata* and *A. mearnsii*) are the most common and widely distributed alien invasive species. This intersection of high water using alien plants with critical water production areas is thus a significant concern or water security.

Table 14: Month by month A-pan equivalent water use coefficients including *Acacia mearnsii* *(Schulze and Schutte 2015)*.

Veld Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal Forest	0.85	0.85	0.85	0.85	0.75	0.65	0.65	0.75	0.85	0.85	0.85	0.85
Highland Sourveld	0.70	0.70	0.70	0.50	0.30	0.20	0.20	0.20	0.50	0.65	0.70	0.70
Lowveld	0.80	0.80	0.80	0.65	0.55	0.40	0.40	0.40	0.60	0.75	0.75	0.80
Mistbelt Ngongoni Veld	0.70	0.70	0.70	0.50	0.35	0.25	0.20	0.20	0.55	0.60	0.70	0.70
Ngongoni Veld Zululand	0.70	0.70	0.70	0.65	0.55	0.50	0.50	0.55	0.60	0.65	0.65	0.70
Southern Tall Grassveld	0.75	0.75	0.75	0.50	0.40	0.20	0.20	0.20	0.55	0.70	0.75	0.75
Valley Bushveld	0.75	0.75	0.75	0.65	0.55	0.20	0.20	0.40	0.60	0.75	0.75	0.75
Zululand Thornveld	0.80	0.80	0.80	0.70	0.65	0.50	0.50	0.60	0.75	0.80	0.80	0.80
Eucalyptus grandis	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Acacia meansii	0.90	0.90	0.90	0.88	0.85	0.86	0.89	0.90	0.92	0.92	0.90	0.90
Sugarcane Coast	0.95	0.97	0.97	0.84	0.88	0.75	0.78	0.73	0.83	0.83	0.92	0.88
Sugarcane Inland	0.90	0.96	0.98	0.84	0.83	0.69	0.71	0.64	0.70	0.76	0.81	0.83

5.2.3.2 Land use change and degradation

Water yield is also affected by land use changes. Conversion of natural veld to agriculture, industry, mining and urbanisation affects runoff and infiltration and in turn water yield in terms of quantity, quality and the timing of flows. Vegetation changes resulting from grazing decrease the surface cover and affects water yield. Decreased surface cover results in bare areas of soil resulting in erosion, increased runoff and decreased infiltration. Drought conditions and limited rainfall contribute to the decrease in water yield.

In the context of the ADM, the key land use change impacts can be linked to mining (predominantly quality impacts), agriculture (quality and quantity), and the increasing area being degraded through the expansion and densification of settlements (predominantly in the peri-urban areas surrounding Newcastle, Madadeni and Osizweni - Figure 38).

Figure 38: Expansion and densification of settlement between 2010 and 2018 north of Osizweni

5.2.3.3 Climate Change

An important driver of change in water yield is climate change. The Long Term Adaptation Scenarios Flagship Research Programme (LTAS) a DEA initiative, aimed at responding to climate change through mitigation, have developed various scenarios in attempts to understand the potential outcomes of South Africa's climate (DEA, 2013). Modelled results for Zone 2 represented by the Pongola-UMzimkhulu WMA (this includes the ADM), indicate the following climate change projections for years up to 2050;

- Overall warming across the country with a noticeable increase of 5-8°C in the interior cooling slightly over coastal regions
- Four potential outcomes have been predicted:
    - Warmer (<3°C above 1961–2000) and wetter with greater frequency of extreme rainfall events;
    - Warmer (<3°C above 1961–2000) and drier, with an increase in the frequency of drought events and somewhat greater frequency of extreme rainfall events.
    - Hotter (>3°C above 1961–2000) and wetter with substantially greater frequency of extreme rainfall events; and
    - Hotter (>3°C above 1961–2000) and drier, with a substantial increase in the frequency of drought events and greater frequency of extreme rainfall events.
- Climate change is likely to have the most noticeable impact on water resources (effecting rainfall and evaporation rates)
- Under all four scenarios, an increase in extreme events such as floods and droughts are expected
- The wetter scenarios indicate an increase in flooding events whilst the drier scenarios predict more droughts
- Indicators show that KZN and therefore the ADM are at risk to increases in runoff and flooding events

Broadly summarised, this equates to an increase in variability of rainfall. This includes a potential increase in Mean Annual Precipitation (MAP), but a concomitant decrease in the number of rainfall events suggesting more intense events including more frequent and greater flooding. These changes are likely to result in increased run-off over much shorter periods during the wet season or lower flows in the dry season. It also suggests increased drought intensity and frequency. It is therefore critical that storage of water in the catchment is maximised. Natural storage capacity is held in the soils and wetlands of the catchment. These areas should be closely protected and evapotranspiration by alien invasive plants minimised.

5.3 WATER AVAILABILITY

All water used in the District is sourced from within the District. There are only two large surface water impoundments in the ADM. These are Ntshingwayo Dam (formally known as Chelmsford Dam) and Zaaihoek Dam (Table 15 below). Ntshingwayo Dam serves as the primary source of potable water for Newcastle, Glencoe, Dundee and surrounding areas.

Zaaihoek Dam serves the primary purpose of providing raw water to the Majuba Power Station and then an additional transfer to the Vaal River system via first the Sandspruit - and then the Klip River.

Table 15: Major surface water impoundments

Dam	River	Full Capacity ($m^3 \times 10^{6)}$	Drainage Basin No (and order)
Ntshingwayo	Ngagane	199	V31 (tertiary)
Zaaihoek	Slang	193	V31 (tertiary)

In addition to the Dams, the Buffalo River is a critical resource with two run-of-river extraction points supplying water to the District and its neighbours. The first is from a point close to the confluence of the Buffalo with the Ngogo River which provides water to the Ngagene Treatment plant supplementing the supply from Ntshingwayo Dam on the Ngagane River, and the second being at the Tayside weir, just downstream of the District. The Tayside weir supplies the Biggarsberg water treatment plant which services the Glencoe area.

Water availability for agricultural purposes is constrained. With the exception of the Ngagane River, the major rivers in the study area are fully allocated and presently have no water available for irrigation abstraction. The quality of the water from the Ngagane is furthermore a concern (Thornhill and Richardson, 2014). The ADM Agricultural Plan indicates that without further resource development, there is no opportunity for expansion of irrigated agriculture in the District: “Without a programme to construct dams in the rivers, there is practically no additional irrigation potential in the Amajuba district”. This limitation impacts not only irrigated crop cultivation, but also the potential for livestock as grazing on natural veld grass is by its nature limited.

Drought conditions exacerbate problems with limited supply. In a telephonic interview, Mr John Nhleko (Pers comm) stated that due to the severe water restrictions during drought, irrigation farmers suffered great losses as production declined. Some farmers could not service their production loans while other farmers had to reduce their stock to survive.

Consultations with stakeholders reveal that problems associated with water availability are not limited to annual crop irrigation. A Normandien farmer reported that. “The well-below average rainfall over the last three years has been very challenging from a pecan tree orchard perspective, and we have lost a large number of young trees as a result thereof” (Douglas, 2017). Moreover, Mr Smith of the Ngogo Farmers Association added that the drought relief programme that was set in place was not managed properly for instance small-scale farmers that needed the drought relief funding did not receive it (pers comm).

5.4 WATER QUALITY

5.4.1 Introduction

Water quality is affected by a number of processes, including natural changes due to seasonal fluctuations, climatic changes or rock and soil type changes as water moves through the landscape. Most well-known changes are however related to anthropogenic activities. There are many types of pollutants that negatively affect water quality. These include:

- micro-biological pollutants including viruses and bacteria,
- physical pollutants such as sediments
- organic pollution such as that from human or animal waste and
- Inorganic pollution from activities discharging metals and salts.

In the context of the ADM, key water quality impacts are related to industrial activities, the discharge of waste water and impacts associated with mining such as high salinity and low pH's resulting from acid mine drainage.

5.4.2 Spatial Distribution of Water Quality

Water quality has been assessed and spatially depicted using the flow derived quinnary catchments (FDQCs) developed for this study (in the water production component). This was in order to gain a finer level of resolution than that afforded by the more-often used quaternary catchments and to ensure continuity with the water production and aquatic ecological specialist studies. This approach also allows the consideration of the impacts of land based activities on catchment scale water resource units. Activities taking place in the terrestrial environment are key drivers of change in the quality of water in the aquatic environment through continuous sub-surface and surface flow interactions.

The current water quality situation across the District has been assessed using water quality data supplied primarily by the Department of Water and Sanitation. These data are associated with specific monitoring points located strategically in the catchment and provide measured information providing insight to impacting activities in upstream catchment areas. The limitation of this approach is the limited number and relatively biased (towards key dams) distribution of monitoring points. This means that large areas of the District have no data with respect to water quality. For this reason, the Automated Land-based Activity Risk assessment Method (ALARM)[5] has been used to supplement the measured data in order to provide an indication of water quality concerns across the district.

5.4.2.1 Water quality status quo in Amajuba DM

It is not feasible to characterise the district with respect to every potential pollutant. The monitoring data available also varies in which pollutants are monitored. This means that indicator pollutants need to be selected to characterise specific water quality issues across the district. Catchment monitoring data was therefore initially assessed to identify problematic pollutant groups in the District. The pollutant groups assessed were based on the groups used in the ALARM tool and are as follows:

[5] ALARM – Automated Land Based Activity Risk Assessment Method developed for DWS by the INR

- Nutrients
- Suspended Solids
- Dissolved Salts
- Microbiological indicators
- Toxins

Based on this initial screening, the following conclusions could be drawn:

- **Nutrient loading** is a significant concern in several of the monitored rivers. Nutrient loading is responsible for significant water quality problems in key resources and can result in significant damage to aquatic ecosystems. This group is thus included in the EMF evaluation and soluble reactive phosphate has been used as an indicator.
- Electrical Conductivity (EC) data indicates that **dissolved salts** are largely at natural concentrations along the western and northern escarpment, and increase significantly in the lower catchments due to urban, industrial and mining related activities. Given the strong concern around acid mine drainage in the District, this group has been selected to take forward using EC and Sulphate as indicators.

Based on the DWS monitoring data for these indicator groups, a clear gradient / shift in water quality can be noticed moving from the high lying mountainous areas to the lower lying Buffalo River Basin as a result of various anthropogenic activities, particularly around Newcastle and Dannhauser (Figure 39, Figure 40 and Figure 41. The lack of monitoring points in the Emadlangeni area is evident in these maps.

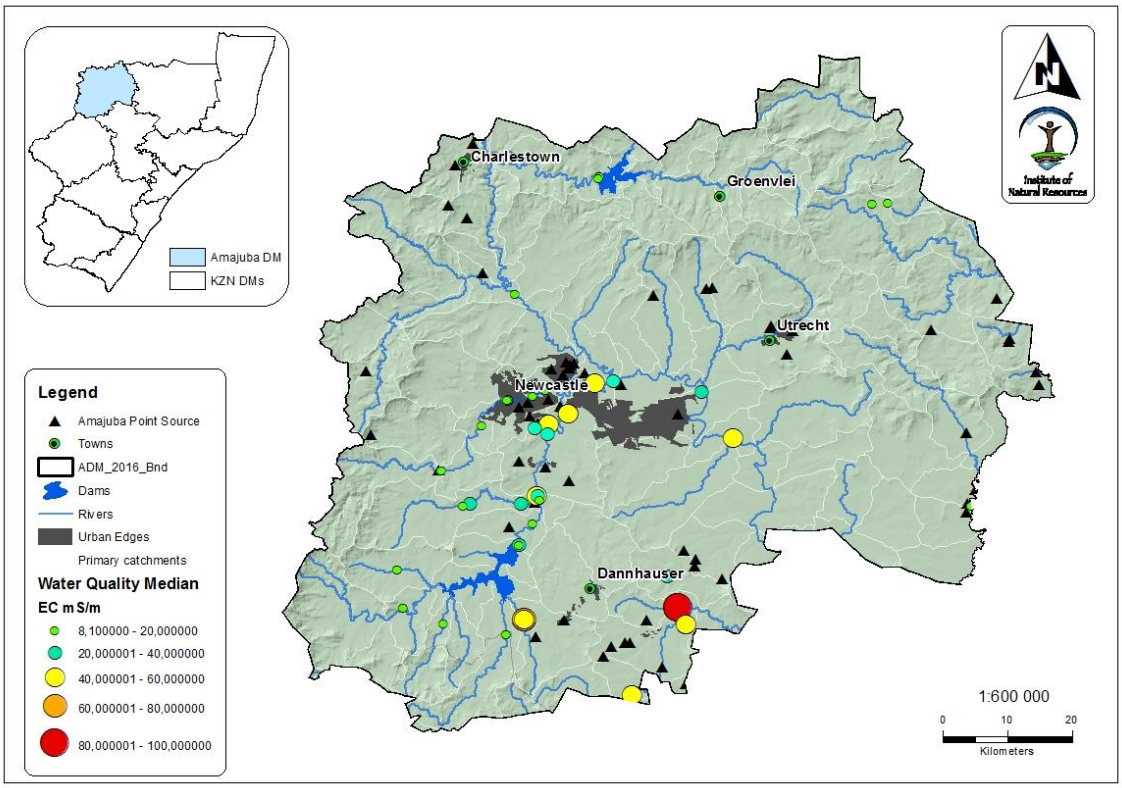


Figure 39: Catchment status based on monitoring data results – Electrical Conductivity

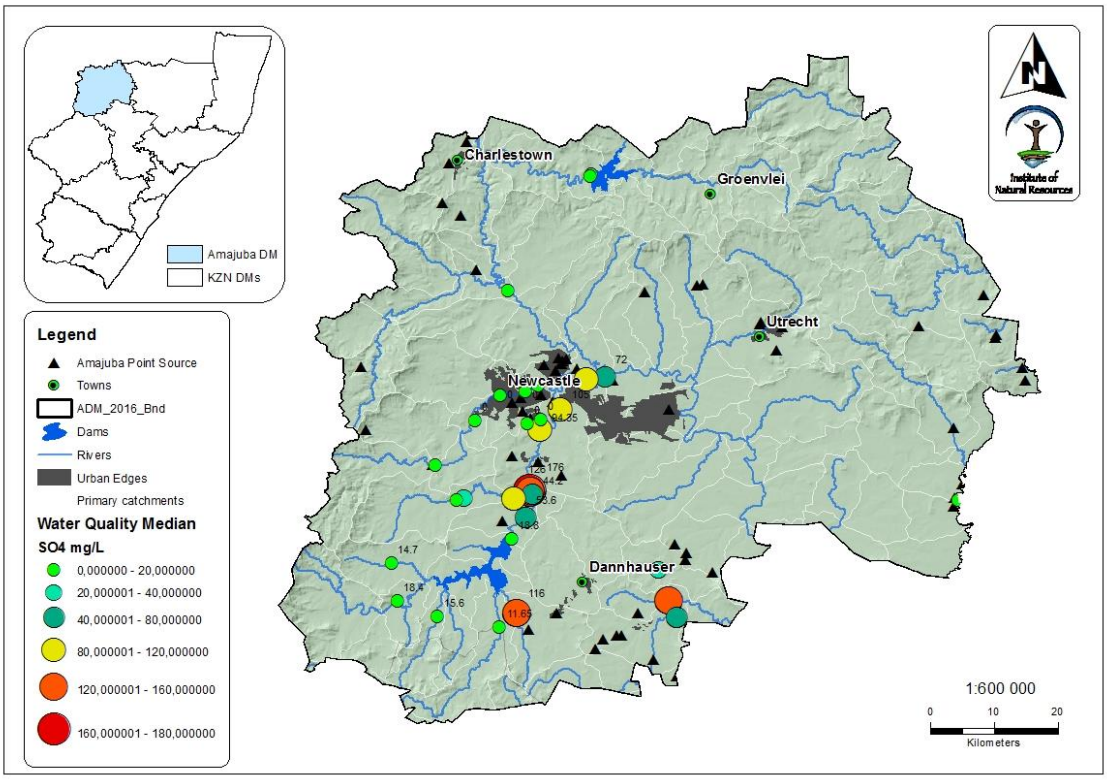


Figure 40: Catchment status based on monitoring data results – Sulphate

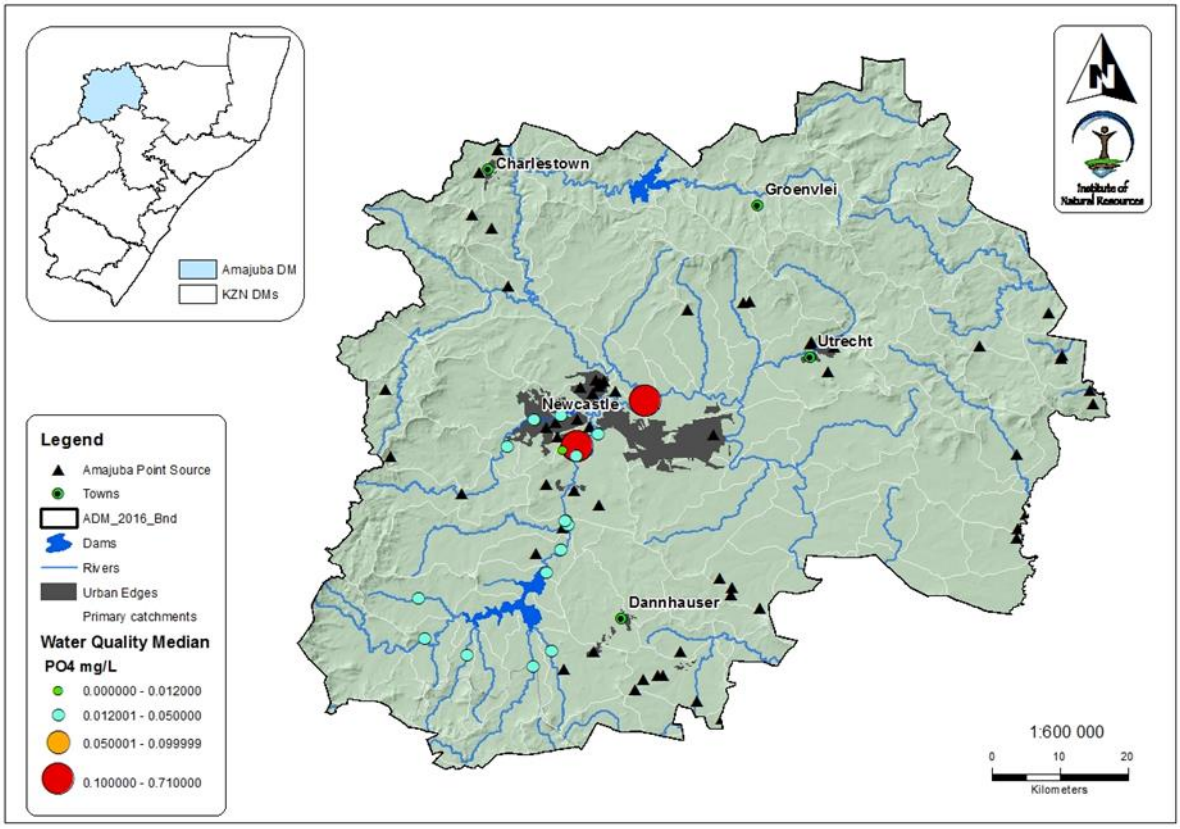


Figure 41: Catchment status based on monitoring data results – Phosphate

5.4.2.2 Modelled water quality risk data

In the absence of monitoring data, the outputs of an ALARM assessment have been used to provide a classification of catchments (risk posed by land based activities to water quality). Land cover/use is used to identify areas where there is a high potential (risk) for diffuse pollution impacts. Point source data captured during this project are used to identify catchments where point source discharges pose a high risk to water quality.

The ALARM scores for diffuse pollution potential for each of the catchments were then classified using the threshold of the mean value plus one standard deviation to identify areas where diffuse pollution potentially contributes significantly to pollutant loading. Activities with the potential to generate point sources of pollution were scored according to their potential to impact a catchment relative to industry, which is assumed to have the highest potential for pollution in the ADM. Scores were then combined to identify areas where land based activities pose the most risk of water quality impacts. This result is shown in Figure 42.

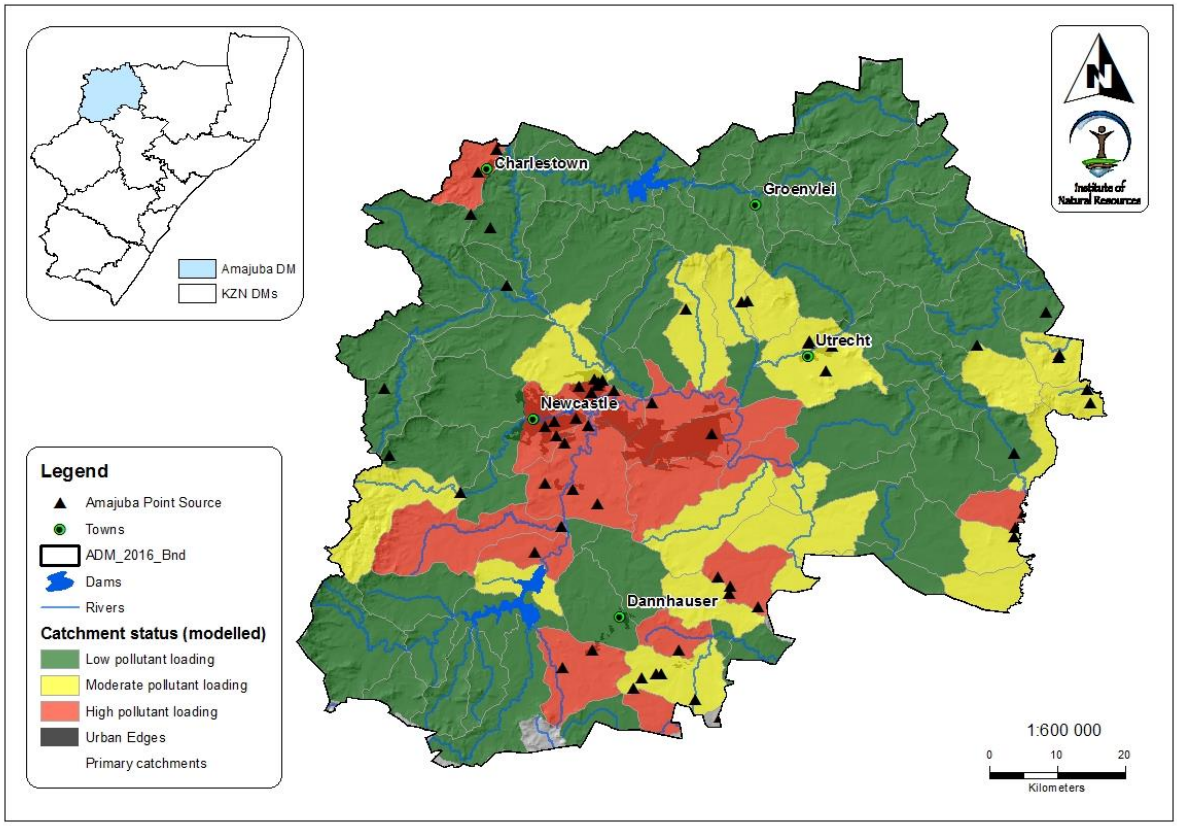


Figure 42: Catchment status with respect to modelled risk sources of pollution

5.4.3 Socio-economic and Conservation Value of the Resource

As with the production of water, the socio-economic value associated with water quality in ADM is significant. Poor water quality limits the value of water resources, the utility of the water they produce and places additional stress on water treatment costs and the economy.

Good water quality stewardship is also important from a partnership perspective as activities within a catchment may not necessarily only affect users in that particular region but may be detrimental to downstream users (Newcastle EMF SQ, 2014). Amajuba DM is located immediately upstream of the Tayside pump station on the Buffalo River which supplies water to Glencoe, Dundee and a number of other areas.

Deteriorating water quality can result in serious impacts not only on human and ecosystem health but also on the economy through affecting sectors such as industry, mining, agriculture, tourism and recreation. Deteriorating water quality results in an increase in the resources required to treat water to potable standards, an obvious and direct cost related to poor water quality. From an agricultural perspective, any significant further growth in the sector is critically linked to the availability of good quality irrigation water. The increased salinity of irrigation water can result in decreased agricultural yields.

Avi-tourism and recreational activities rely on these water resources to attract tourists and therefore need to be kept in as close to a pristine condition as possible. Tourism and recreational activities focused on the District's large dams have been highlighted as being a key area for economic growth, and this obviously relies on good quality water. Wetland and river systems within the ADM need to be carefully managed and conserved where possible for this purpose.

5.4.4 Condition of the Resource and Drivers of Change

Water quality within the ADM is mainly affect by anthropogenic pollution resulting from the domestic, industrial, agricultural and mining sectors. This has been demonstrated in the preceding sections where monitoring information was presented. The Thukela River reserve study undertaken in 2004 showed the water quality component of the Present Ecological State (PES) in the Buffalo River below the Utrecht / Osizweni road bridge (Table 16) to be heavily impacted, particularly with respect to various sulphate salts and nutrients. This illustrates the impact of mining, industry and non-compliant waste water discharges

Table 16: Ecological reserve PES categories identified for the Buffalo River below the Utrecht / Osizweni road bridge

River	Buffalo River	DWAF Water Quality Monitoring points	
QRU	25	RC	No Reference condition data
IFR number	13	PES	V3H010 (1997 – 2000), n=140
Water Quality Constituents		**A – F system**	**Descriptive system**
$MgSO_4$		E/F	Poor
Na_2SO_4		E/F	Poor
$MgCl_2$		A	Natural
$CaCl_2$		B	Good
NaCl		A	Natural
$CaSO_4$		A	Natural
SRP		E/F	Poor
TIN		D	Lower Fair
Chl-a: phytoplankton		-	-
Chl-a: periphyton		-	-
Biotic community composition (invertebrates)		C/D	Fair
Overall site classification for WQ		**D**	**Lower Fair**

5.4.4.1 Domestic waste water

River water quality is widely affected by domestic waste water. Waste water impacts surface water quality in two ways 1) through sewerage spills and 2) through the discharge of substandard effluent to the environment by WWTWs. The Green Drop programme was established in 2008 to measure and compare the performance of water services authorities with respect to waste water. The Green Drop requirements assess the delivery of municipal waste water services and treatment functionality of the WWTWs. There are two water services authorities in the Amajuba District – Amajuba District Municipality and Newcastle Local Municipality, both of which operate WWTWs.

The last Green Drop analysis to determine the status of WWTWs in Kwazulu-Natal made publically available was undertaken in 2011. According to that report, the ADM WSA 2011 Green Drop score is 58.1%. All the waste water treatment services improved within ADM relative to the 2009 score with the exception of Durnacol (DWS, 2011).

The following key findings were noted for the Amajuba DM WSA:

1. *All of the wastewater treatment works operate below their design capacity yet fail in terms of effluent discharge quality. This transgression is considered serious as it impacts negatively on public health and the receiving environment.*
2. *The continued functioning of the 4 systems is not sustainable, when considering the lack in technically skilled and registered staff.*
3. *Three of 4 plants do not have adequate monitoring in place.*

The Newcastle LM WSA is reported to be performing better in comparison to the ADM WSA. Their 2011 Green Drop score was 71.5%. The following key findings were noted for the Newcastle LM WSA:

1. *Three of 5 wastewater systems have inadequate skilled and registered technical staff.*
2. *100% of treatment plants are not compliant with effluent quality discharge standards. Two plants are compromised by having reached its design capacity.*
3. *All plants do not have existing lawful use in place or have not applied for water use licenses from the provincial water authority. This transgression implies that the*

Newcastle systems are not operated within the required legislative parameters of the National Water Act.

In comparing the results of the Green Drop assessments, two features are common to both WSAs. There are inadequate skilled and registered technical staff manning the facilities and there is non-compliance with effluent standards. The report goes on to suggest that the two factors are linked.

5.4.4.2 Industry and Mining

According to the Newcastle EMF SQ (2014), the Buffalo River and the lower reaches of its tributaries are in a poor condition which has come about through acid mine drainage from old coal mines and industrial effluent. The Ncandu River has poor water quality in the Newcastle area and has been negatively impacted by agricultural activities, urban runoff and industrial effluent. The Ngagane River is perhaps the most important water resource in the District and it is also characterised by poor water quality in its lower reaches as a result of mining activities, waste dumps and industrial activities. This pollution occurs mainly through increases in acidity, salinity and heavy metals.

As an example of water quality impacts in the region, the 2003 ADM EMP recorded that the storage dams on the Siltech complex (at the time) did not have sufficient capacity to cope with the runoff during particularly wet periods. Siltech would therefore apply for releases during rainy periods and these would be a source of calcium, alkalinity and salinity (EMP, 2003).

In particular, Acid Mine Drainage (AMD) is a very real threat to the water quality of the District. AMD results from the oxidation of sulphides (Figure 43), typically pyrite, and is characterized by low pH and high concentrations of SO_4^{2-} (sulphate), iron, metalloids, and many metals (Larsen and Mann 2005). Abandoned mines and tailings piles can be sources for AMD and represent risk to the equilibrium of different ecosystems (Moncur et al. 2005, Cravotta 2008), especially when efficient mitigating actions against acidity are not applied.
Unfortunately monitoring points are not sufficiently widely distributed across the District to adequately characterise this problem. Water quality monitoring points and thus available information is concentrated around the key water supply infrastructure. While this is understandable given limited monitoring budgets, it does not provide an accurate picture of the District's water quality and the factors that impact on it. The extent to which AMD is a problem across the district is thus not fully understood.

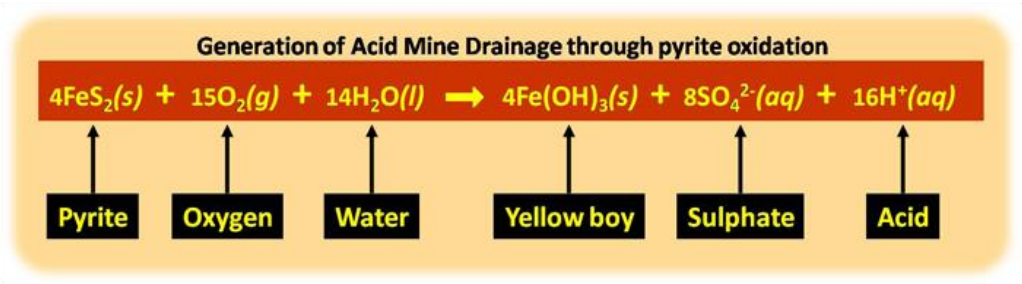


Figure 43: The process of Acid Mine Drainage formation (DWS)

5.4.4.3 Agriculture

Changes in water quality are also as a result of changes in land use activities. Agricultural runoff from fertilises and concentrations of animal waste can also cause changes in water quality, particularly nutrients such as phosphorous and nitrogen. Many cultivated areas within the ADM are situated alongside rivers which can cause contamination. Disturbance of the soil's vegetative cover and overgrazing on the banks of the river can also result in erosion of topsoil resulting in increased suspended sediment loads. Key irrigated agriculture areas are located in the upper Ngagane catchment around Ntshingwayo Dam. This will result in the ingress of nutrients and suspended sediments into this vital resource.

This pollution is generally difficult to quantify as pollutants largely enter water ways via diffuse means. Monitoring data also does not provide adequate information due to the scale at which PO4 in particular is measured. This powerful nutrient is a key component of fertilisers and effluent or runoff concentrations as small as 0.001 milligrams can cause eutrophication. Monitoring results do not allow for the measurement at this level. It is important to note that wetlands play a key role in mitigating this type of pollution.

5.4.5 Overarching Drivers

In the ADM context, one of the key overarching drivers of change in terms of both water quality and quantity is the combination of population growth, urbanisation, poverty and unemployment. Increased population in urban areas, particularly around Newcastle, Madadeni and Osizweni, results in an increased demand for water in these centres, an increase in the number of households that require access to safe potable water and an increase in the volume of waste water to be managed. Population growth in urban and peri-urban areas, particularly together with poverty and unemployment, results in the development of informal/unserviced settlements, often close to rivers which inevitably results in a deterioration of water quality through unmanaged sewage and solid waste. This has a critical negative feedback into the poverty cycle as in these settlements; water for domestic use is often sourced from the local rivers and streams which then places human health and livelihoods at risk.

5.5 FLOOD ATTENUATION ZONES

5.5.1 Introduction

Flood attenuation zones are those areas found adjacent to river systems and which are prone to flooding. Flooding usually occurs when a river channel's capacity is exceeded and overtopping occurs, allowing excess water to spill out onto a flood plain. Importantly, under such conditions, these areas play a significant role in dissipating the energy of a flood event and can reduce the impact of flooding on downstream people and infrastructure. It is obviously also important to identify flood zones from a development perspective as during a flood event these areas are flooded and any development or activities located within these areas are likely to be damaged or destroyed. Positively however, flood zones provide areas of flood attenuation especially of downstream users.

5.5.2 Location of Flood Attenuation Areas

In order to safeguard human life and property it is necessary to identify potential flood zones. This will be achieved by categorising and buffering rivers and streams by slope and altitude, based on the premise that high potential flood zones occur in larger rivers in lower lying flatter regions versus smaller rivers located higher up in mountainous regions. This buffering approach was applied to the 1:50 000 rivers layer and was then used to improve the Flood Risk Information System (FRIS) 1:100yr flood risk layer a provincial layer developed by the Department of Human Settlements, to create a buffered flood risk layer. This layer is illustrated in Figure 44. Importantly, many of the largest flood zones intersect with urbanised areas such as Newcastle and Madadeni.

5.5.3 Socio-economic and Conservation Value of the Resource

From a risk management perspective, flood zones need to be identified due to the potential risk they pose both socially and economically. Flood zone areas are obviously hazardous and flooding of these areas can cause loss of life, loss of or damage to homes, infrastructure and livelihoods. Informal settlements are particularly at risk given the fact that they are often situated on flood plain areas as they are generally relatively flat and uninhabited. It is however not only informal settlements that are at risk. Illustrative of this is the fact that parts of the Newcastle CBD are built on the Ncandu River floodplain and have on several occasions been inundated by flood waters (Figure 45).

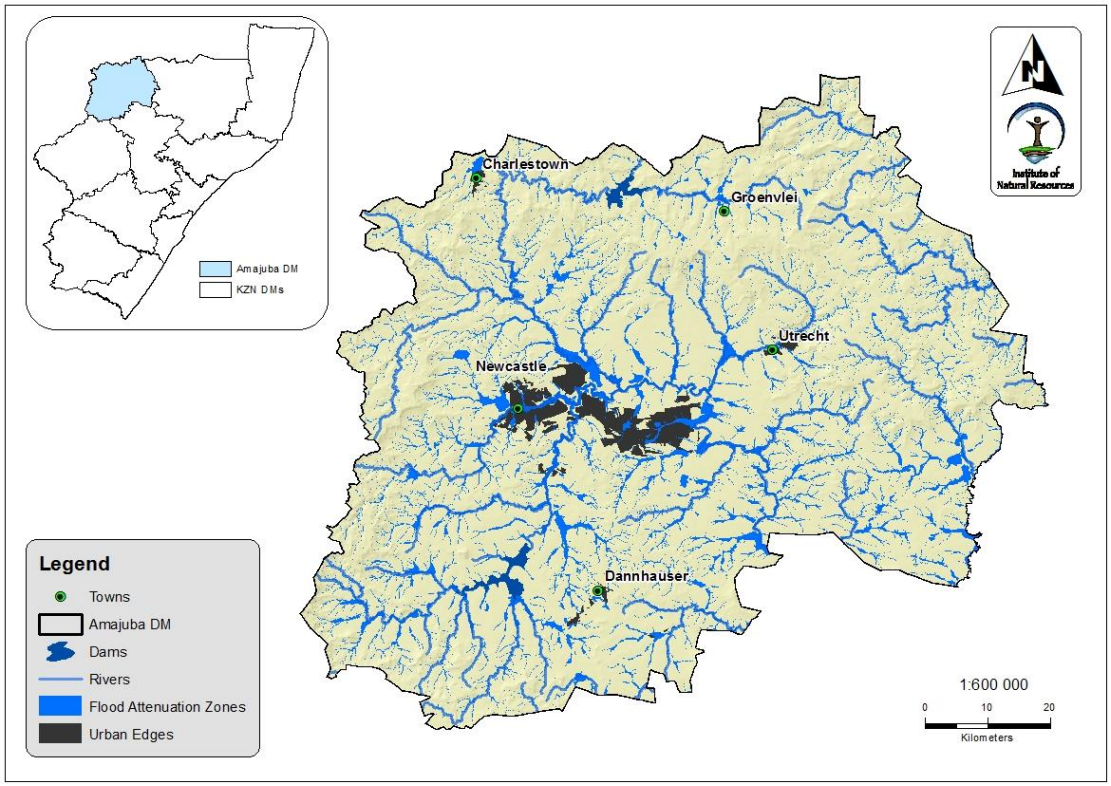


Figure 44: Flood attenuation zones within the Amajuba district municipality

Figure 45: Newcastle CBD under flood

From an ecosystem services perspective, flood zones provide the benefit of erosion control, flood water quality improvement and flood attenuation which are especially important for downstream infrastructure, residents and users. Perhaps most importantly, flood zones allow flood water to spread out over a much larger area than their confined river channel. This dissipates energy, stores water temporarily, allows water infiltration and thus lowers the potential of the flooded river to inflict significant damage to infrastructure downstream. Where development occurs on flood plains, surfaces are hardened and many of these services are lost. Flood water is then allowed to push downstream with higher energy and destructive power.

Because of the deposition of sediments, flood zones are also usually rich in fertile alluvial soils providing good conditions for crop growth. Their topography is also conducive to cultivation meaning that they are often utilised for large scale commercial crop cultivation. This does place agricultural infrastructure at risk, though the greater rewards offered by cultivating in such fertile areas is likely to justify such risk.

5.5.4 Condition of the Resource and Drivers of Change

Historical records indicate that flood events have occurred within the study area at regular intervals. The Ncandu and Ngagane Rivers are known to have repeatedly burst their banks following high levels of rainfall. Climate change and its effect on rainfall and other factor may influence the frequency and intensity of these flooding events (Newcastle EMF SQ, 2014).

Flood zones in ADM are already highly impacted by agricultural activities (Figure 46) and the development of formal and informal settlements. These zones are being further impacted by population growth as more people settle in these flood zones which in turn increases human vulnerability.

One of the major drivers of change of the condition of flood zones within the ADM is sand mining. Whilst the mining of sand for construction is an essential activity, sand mining can result in severe degradation in the riparian zone, changes the soil profile and damage to soil surfaces. Areas of the Buffalo River flood plain have been extensively impacted by sand mining (Figure 47).

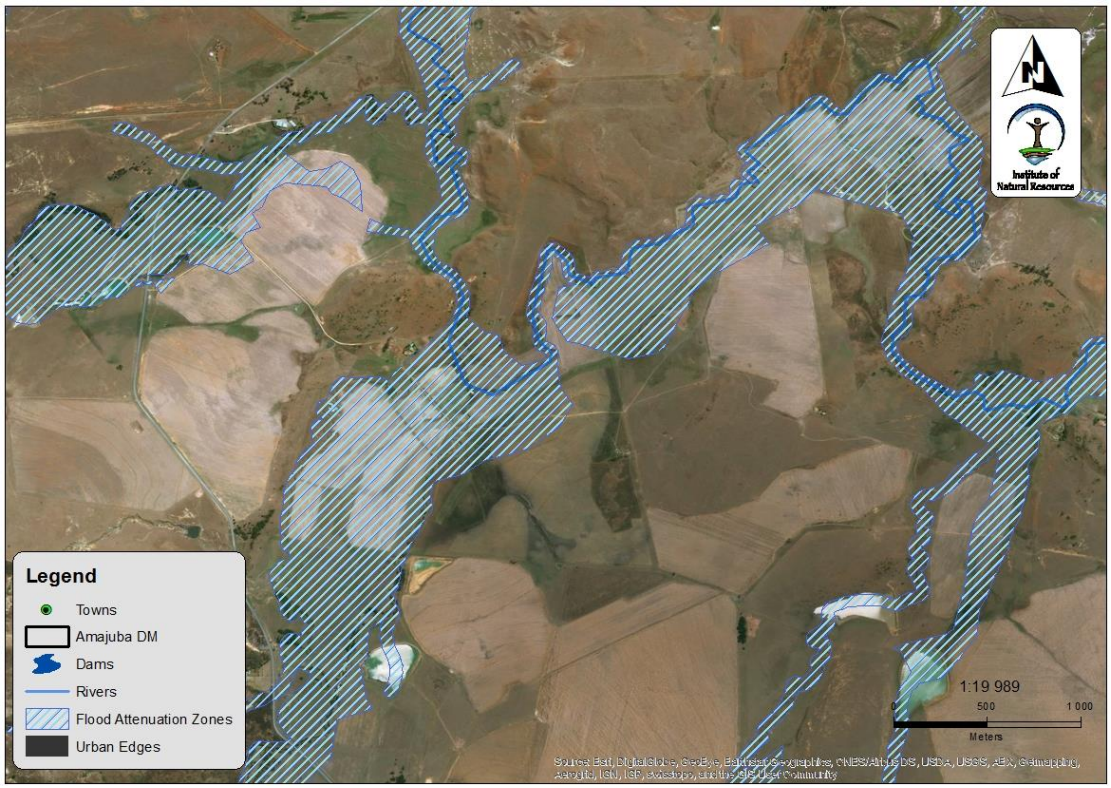


Figure 46: Agricultural activities in flood attenuation zones of the upper Ngagane River

Figure 47: Sand mining on the Buffalo River flood plain.

5.6 RIVER HEALTH AND BIODIVERSITY

5.6.1 Introduction

River ecosystems provide essential goods and services for human and environmental well-being. In order to effectively manage the environment to ensure the achievement of a balance between use and protection of river ecosystems it is necessary to characterize each system in terms of its present ecological state (PES) and its ecological value. An assessment of river health not only takes the quality of water into account but looks at a number of biological components within the system which are used as bio-indicators to determine the state and health of rivers as integrated ecological systems. These bio-indicators can include fish, macro-invertebrates, diatoms and riparian vegetation.

5.6.2 Spatial extent

5.6.2.1 Ecological priority areas

The National Freshwater Ecosystem Priority Areas (NFEPA) data set highlights areas within the district that are important for meeting biodiversity conservation goals for freshwater ecosystems (Figure 48). Rivers that are a category A or B according to Present Ecological State data are considered good in terms of NFEPA for biodiversity conservation. Many of the river reaches within the ADM are characterised as river FEPAs. This indicates that these resources are in a good condition and are required to meet biodiversity targets for fish species and river ecosystems. In order to contribute to biodiversity of the region it is important for these resources to remain in a good condition.

The lower lying areas of the catchment have been characterised as fish support areas. These areas are fish sanctuary areas and are important in the migratory routes of fish species. The condition classes of these resources are fair to poor. It is still however important to conserve these areas in order to protect the threated fish species they contain.
A small area in the middle of the study area is defined as a phase 2 FEPA. This area is found in a moderately modified area and should not be degraded any further. The upstream management areas (MAs) have to be managed in terms of anthropogenic activities to prevent degradation in the downstream FEPA and fish support areas (DWS, 2011).

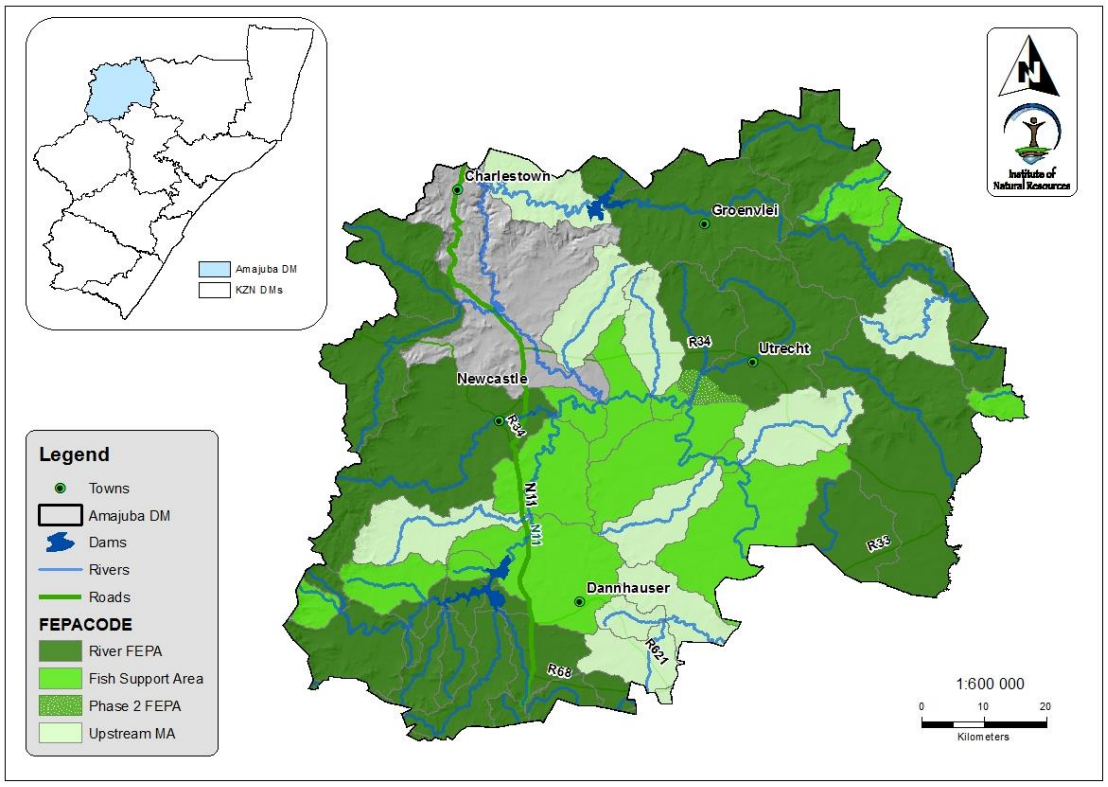


Figure 48: National Freshwater Ecosystem Priority Areas in ADM

5.6.2.2 Present Ecological State, ecological importance and sensitivity

The National Present Ecological State and Ecological Importance and Sensitivity (PES EIS) data set identifies the present ecological state of sub-quaternary catchments (Figure 49) and describes the ecological importance and sensitivity of the particular river reaches. The model provides access to information on the ecological importance and sensitivity of biota and habitat in terms of flow, geomorphic and physico-chemical changes.

The Present Ecological State (PES) information indicates that the Buffalo River is a category B. The Ncandu River is a category D and the Ngagane River is a category C. The results indicate that even though the tributaries are in a poor to fair condition, the main Buffalo River within the ADM is in a good condition which is largely natural with a few modifications. This data contradicts other sources of information (e.g. water quality data and riparian assessments) which suggest that the Buffalo River in the section below Newcastle is in a poorer state than a B. The definitions of the ecological categories are presented in Table 17.

Ecological importance (EI) refers to the uniqueness, diversity and rarity of habitats and biota and indicates the importance of protecting these from a local, national and international perspective. Ecological sensitivity (ES) refers to the ability of the ecosystem to tolerate disturbances and to recover from certain impacts. The more sensitive the system is, the lower its tolerance will be to various forms of alteration and disturbance. This serves as a valuable indication of the degree to which a water resource can be utilized without putting its ecological sustainability at risk. The Ecological sensitivity and ecological importance data

indicates that all of the reaches of the District which include the Buffalo River and the Ncandu and Ngagane tributaries are highly sensitive and highly important.

Table 17: Ecological categories and meanings used to interpret Eco status and river health data

Ecological Categories	Name	Description
A	Natural	Unmodified natural
B	Good	Largely natural with few modifications
C	Fair	Moderately modified
D	Poor	Largely modified
E	Seriously Modified	Seriously modified
F	Critically Modified	Critically or extremely modified

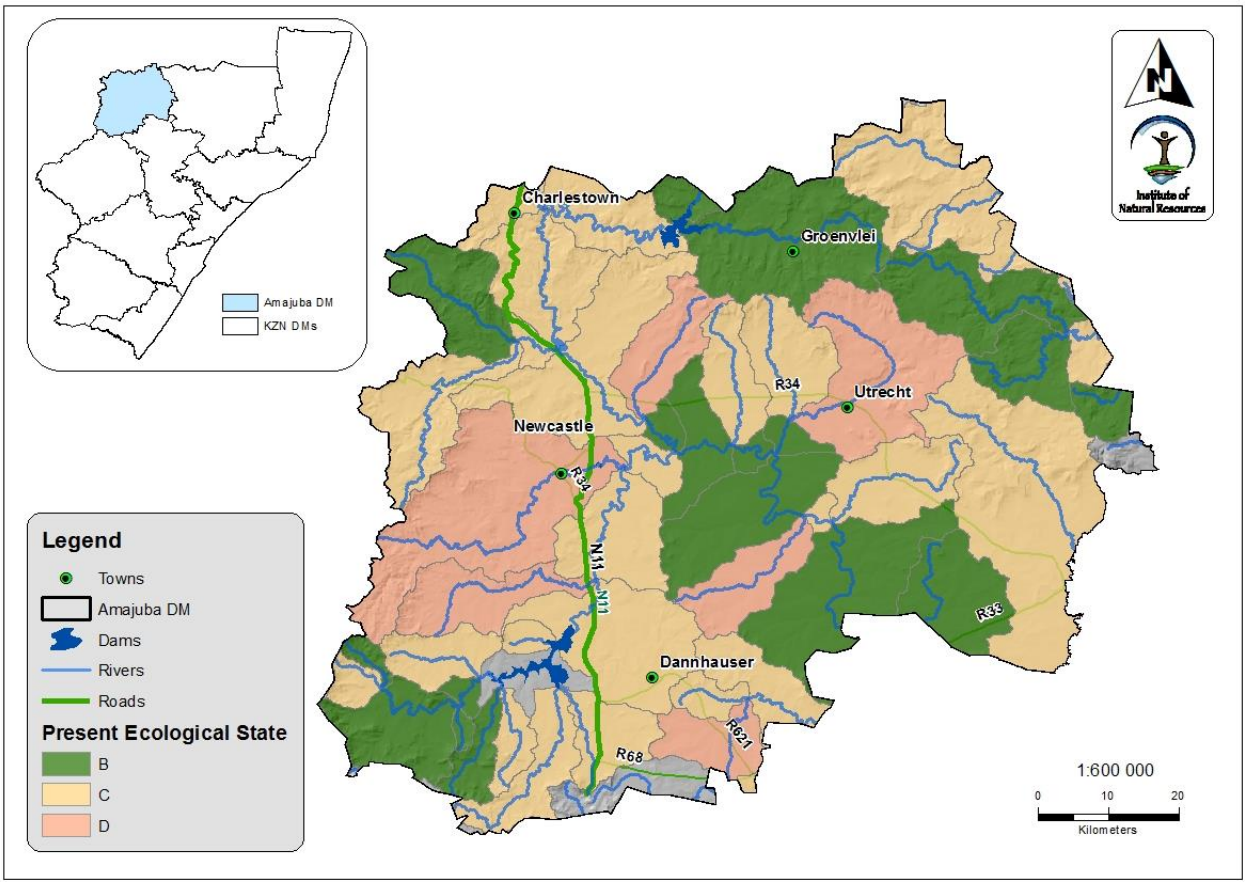


Figure 49: Present Ecological State of freshwater ecosystems in ADM

5.6.3 Socio-economic and Conservation Value of the Resource

From a socio-economic perspective, healthy river ecosystems provide a number of important ecosystem services including the supply of drinking water, water for irrigation, food (fish) and other harvestable products such as reeds. Recreational activities such as fishing, swimming and boating also rely on healthy ecosystems.

From a water quality perspective, clean rivers allow for water to be used for irrigation and other uses without expensive treatment costs, and importantly, they are a valuable resource for households with no access to piped water. The aquatic ecosystem plays a fundamental role in maintaining clean and useful rivers. Healthy ecosystems are able to ameliorate a certain level of pollution, performing a cleaning up job on contaminated water. In such systems, the ecosystem supports a variety of functional communities of flora and fauna. These organisms can remove excess nutrients and toxic substances from the water and they can stabilise riparian areas preventing bank collapse and sedimentation. In doing so, they act as a buffer against high levels of pollution from domestic industrial and mining waste especially acid mine drainage (Nel et al., 2011). Pushed too far however, this service, together with the benefits of an available resource are effectively lost.

In addition to the direct services they provide, many of the aquatic ecosystems of the ADM are presently in a fairly good condition and therefore hold good potential for biodiversity conservation and for contributing to the overall conservation targets for freshwater ecosystems.

These systems are ecologically important and ecologically sensitive. Even though the PES EI ES data shows that the catchment is mainly in a poor to fair condition, the upper Ngagane Catchment is said to have fairly good water quality (pollution problems in terms of high levels of metals and salinity have been observed lower down). This system has therefore been categorised by KZN wildlife as an area of high to intermediate value (SEA, 2003).

Healthy freshwater ecosystems support human needs, therefore the health of our ecosystems and the associated natural capital influences economic growth and social development (Nel et al., 2011),

5.6.4 Condition of the Resource and Drivers of Change

The condition of the rivers in ADM has been discussed in detail in preceding sections. Broadly speaking, according to PES data, the Buffalo River is in a relatively good ecological state. This is however contradicted by water quality results and by the WQ assessment of the Thukela ecological reserve study which shows that the river is in a fair to poor state. This is to a large degree due to the contaminated contributions from the Ncandu River (poor state) and the Ngagane River (fair to poor state) and the impacts of settlements located along the river.

One of the biggest drivers of change in terms of river health is pollution from activities within the domestic, industrial, mining and agriculture sectors. For example the industrial activities around Newcastle affect the quality of water in the Ncandu, Ngagane and Buffalo Rivers. Effluent and runoff from industrial areas contain pollutants such as ammonia, phenols, fluoride, salinity and heavy metals (EMP, 2003). Once river systems are polluted,

river health deteriorates and a change in biological diversity is experienced and ecosystem functions and services provided are decreased. The ability to ameliorate pollution is compromised, the provision of clean water becomes difficult and the need for the use of expensive water treatment processes is increased.

Another key driver of changes in aquatic ecosystems is invasive alien species. The infestation of riparian areas by alien vegetation can cause significant change in the health of river ecosystems. Aside from using a large quantity of water and reducing the available supply, wattle trees in particular shade out indigenous riparian vegetation, leaving river banks exposed and vulnerable to erosion and bank collapse. This increases the sediment load in rivers, smothering valuable cobble / stones in current biotopes and reducing light penetration which in turn reduces primary production. Many reaches of upper catchment rivers are heavily invaded by wattle trees.

Alien fish species also have a significant impact on the aquatic ecosystem. Largemouth bass (*Micropterus salmoides*) (Figure 50) have been recorded in various catchments in the District (PES EIS data, DWS). This species is an alien predatory species, and will prey on indigenous species such as barbs e.g. *Enteromius anoplus*, *E. viviparous* and *E. Paludinosus* and the fry of larger species such as Natal yellowfish (*Labeobarbus natalensis*). This may eliminate smaller species from reaches and dramatically reduce breeding success and recruitment of larger species. Common carp (*Cyprinus carpio*) have also been recorded in the catchment. These fish are detrimental to instream habitats in that they constantly disturb the river bed, stirring up sediments and increasing turbidity. This reduces the amount of light reaching the bottom of the river which in-turn reduces primary productivity. Both of these alien species have been introduced to support recreational angling which is seen as a key driver of tourism in the District.

Figure 50: Largemouth Bass (*Micropterus salmoides*)

5.7 WETLANDS

5.7.1 Introduction

Wetlands are defined as transitional areas between terrestrial and aquatic ecosystems (National Water Act). Wetlands are characterised as areas where the water table is at or near the surface and are periodically covered with shallow water. The wetland area is characteristic of being able to support vegetation that grows in saturated soils. Wetlands provide many functions such as water purification, flood control, groundwater replenishment, and sediment control and are areas of high biodiversity. The hydrology, geomorphology and vegetation within wetland systems are unique to provide their range of functions.

5.7.2 Spatial extent

Mapping wetlands as accurately as possible is critical for effective integrated catchment and water resource management and for the conservation and preservation of wetland biodiversity. Although the project scope did not allow for any field work, a thorough desktop mapping exercise was undertaken to inform the EMF. The process involved an analysis of the current provincial wetland layer (kznwetlands_wgsll - EKZNW), which makes up the KZN portion of the national wetland inventory, the refinement of this layer using recently developed wetland probability data (Hiestermann and Rivers-Moore, 2014) and finally, the compilation of a final wetland layer using a variety of filtering and cleaning methods. This process is described in detail in the Aquatic Resources specialist report of this EMF study.

This layer shows a high density band of wetlands in the higher lying areas in the north west of the District stretching from the important Blood River Vlei and its upper catchment, through the upper Bivane and Pongola River catchments up to the upper catchment of the Slang River which hosts Zaaihoek dam and Groenvlei wetland. The upper catchments of the Ncandu, Horn and Ngagane Rivers are similarly densely populated with wetlands. The low lying Buffalo River flood plain also hosts a number of wetlands, but the density here is lower. The important Boschoffs Vlei is located in this area (Figure 51).

A 500m buffer was added to the final wetland layer. The regulated area of a watercourse includes a 500m radius from the delineated boundary (extent) of any wetland or pan. Development within this area triggers a general authorization for section 21(c) or (i) (DWS, 2016). The same process was applied in adding a 32m buffer to the wetland layer, aligning with the NEMA setback regulations for constructing infrastructure within 32m of a water course (NEMA). This 32m buffer is regarded as an important measure to protect wetlands as it acts to buffer the wetland against sedimentation, erosion and other water quality impacts.

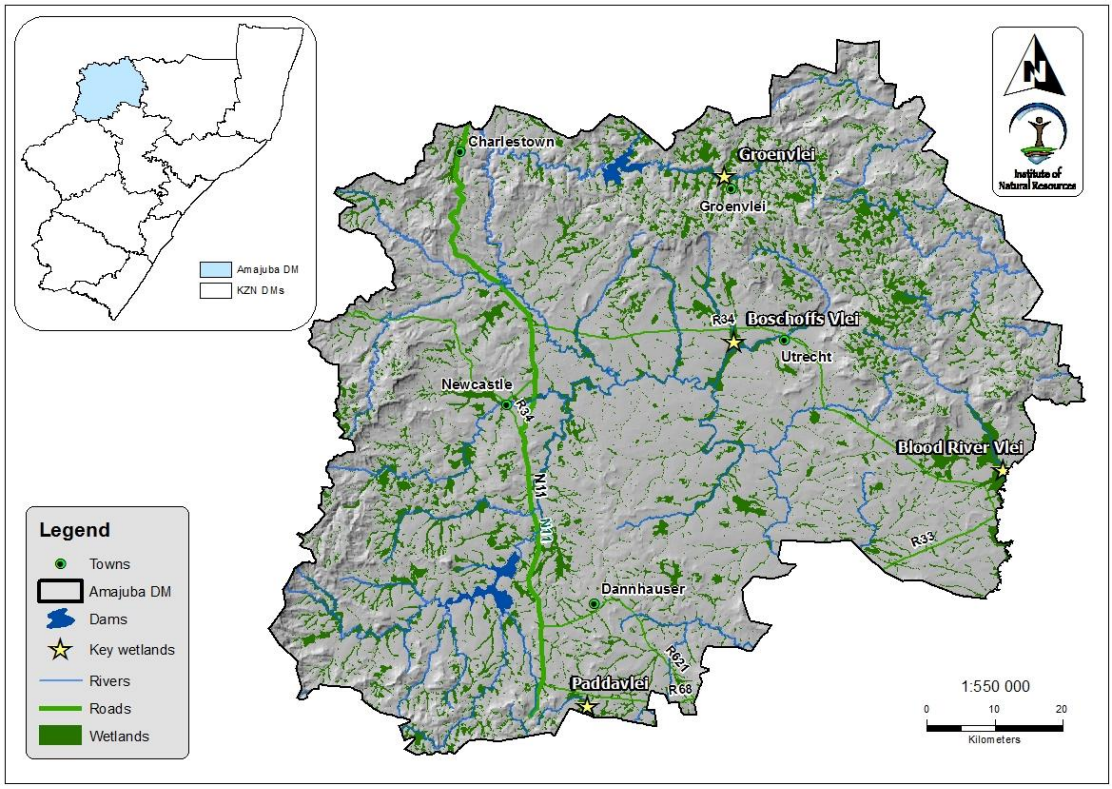


Figure 51: Wetland areas delineated in ADM

5.7.3 Socio-economic and Conservation Value of the Resource

Wetlands provide many ecosystem services such as water purification (Figure 52), flood control, groundwater replenishment, sediment control and are areas of high biodiversity. These functions and services are well documented and they iterate the important conservation value of the wetland with the ADM. In particular, the ADM is geographically located in an important water supply area, and water generated in the catchments of this District is not only critical to the continued economic growth of the District, but it is also vital to users downstream of the District and in other catchments. Wetlands are a critical component of the hydrological cycle and their value to both the economic growth and social well-being in the District cannot be over-stated.

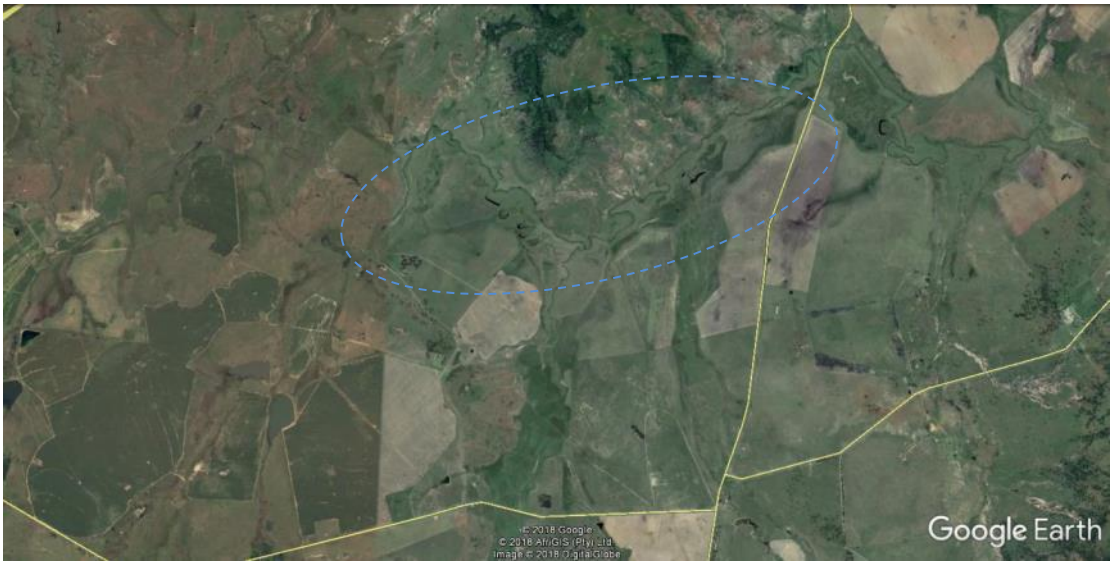


Figure 52: Major wetlands mitigating agricultural impacts upstream of Ntshingwayo Dam

Wetlands are important features in the ADM tourism plan of placing a strong emphasis on birding and avi-tourism. This niche market has potential to improve the district economically as it is known to be a birding region and there are over 400 bird species identified in the region. Even though it is situated out of the northern border of the ADM, the Wakkerstroom wetland is considered a “birding hot spot” and a major birding attraction. This status will therefore attract birders to the nearby birding attractions within ADM such as the Nandi forest and Balele Game Parks (ADM Tourism Plan, 2012). Avi-tourism is not only a method of job creation but is a more environmentally conscious method of economic development as the biodiversity associated with these features will be protected as well.

5.7.4 Condition of the Resource and Drivers of Change

According to the inland aquatic environment specialist report (ADM EMP 2003), ecological status and health of wetland assessments were conducted on priority wetlands. Priority wetlands are defined as those that have substantial resource value and ecosystem function. These high priority wetlands are important as far as management and policy formation are concerned. According to the report the Boschoffs Vlei is in a fair condition and the Groenvlei is in a good condition. There is no record of wetland condition for the thousands of smaller wetland systems in the ADM. There are however many factors which impact on their condition.

As was discussed in the previous section, a strong emphasis is placed on eco-tourism in the ADM, especially birding and avi-tourism. Wetlands in a good condition are important to make this economic venture viable. Wetland area loss and degradation through land use change negatively influence the ability of wetland systems to provide habitat for birds and many other ecosystem services. One of the main drivers of change in wetland extent and condition is the draining wetland areas for agriculture. This is generally undertaken to expand cultivation areas and because the conditions they provide in terms of soil fertility are good for good crop yields. Soil in wetland areas is typically high in organic nutrients and the terrain is generally flat, making them conducive and attractive to cultivation. Typically in

such situations, trenches are dug through the wetland to lower the water table and dry out the land (Figure 53).

Figure 53: Series of drains draining a wetland for agricultural purposes.

Developments such as dams and industrial and domestic housing complexes also drive change within wetland ecosystems. In particular, the flat Buffalo River flood plain has been heavily utilised for the development of housing, both formal and informal and other infrastructure. This has had a significant impact, particularly on riparian wetlands in this area. Sand mining and brick making activities are additionally prevalent in this area.

5.8 GROUNDWATER

5.8.1 Geohydrological features

The aquifer classes according to the mode of occurrence of groundwater adopted for the study area are recorded on the 1:500,000 hydrogeological map series. The simplified hydrogeologically relevant lithological units, stratigraphy, aquifer classes and – types are recorded in Table 18 and are indicated on the Groundwater Occurrence Map, Figure 54.

Table 18: Hydro-geologically relevant lithological units

Hydrogeologically Relevant Lithological Unit	Stratigraphy	Aquifer Class	Aquifer Type	
			Nature	Regime
Alluvium	Quaternary sediments	A	Primary	Intergranular
Lineaments/faults	Tectonic structures (l/f)	C	Secondary	Fractured
Dolerite sheets/dykes	Post-Karoo intrusive structures (Jd)	D	Secondary	Fractured-and-weathered
Shale/mudstones and Sandstone	Karoo Supergroup	C/D	Secondary	Fractured
Volcanic rocks; Granite	Archaean granite (Z-Rg)	D	Secondary	Fractured-and-weathered

Borehole yields provide an indication of the water yielding capacity of the various rock types and should be used as a guide only. The sub-division of the hydrogeological units according to the various ranges of borehole yields are recorded in Table 19 and indicated in Figure 54. Borehole yield data is

Table 19: Hydrological classification of groundwater occurrence and borehole yields

Borehole Yield		Aquifer Class		
Range	**l/s**	**A**	**C**	**D**
High	>3.0	A.1	C.1	D.1
Moderate	>0.5 - ≤ 3.0	A.2	C.2	D.2
Low	>0.1 - ≤ 0.5	A.3	C.3	D.3
Very Low	>0 - ≤ 0.1	A.4	C.4	D.4
		Intergranular	Fractured	Fractured-and-Weathered
		Aquifer Type		

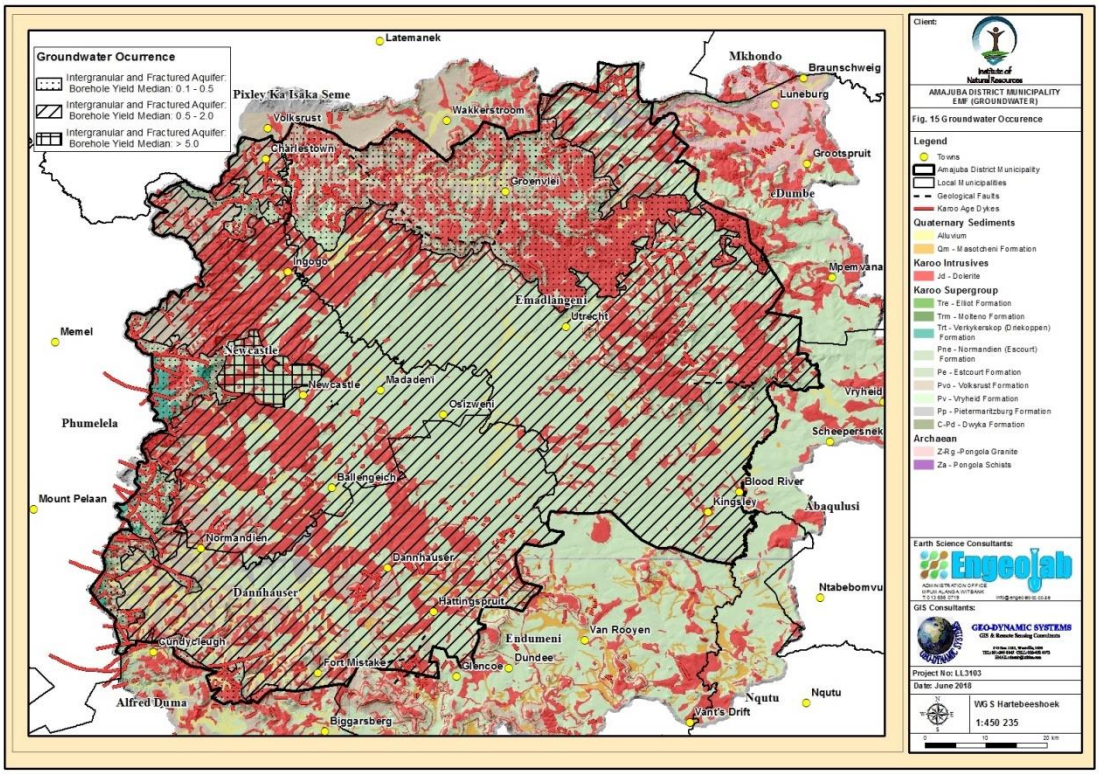


Figure 54: Groundwater occurrence across ADM

Information on borehole yields was obtained from some 800 boreholes scattered throughout the study area and recorded on the National Groundwater Data Base (NGDB). Statistics which define the yield of boreholes in ADM is presented by Table 20 below and illustrated by

Figure 55: Borehole yields across the ADM

.

Table 20: Summarised statistics of depth related borehole yield data

Lithological unit	Mean yield Data (l/s)	Mean yield Range	Maximum Yield Data(l/s)	Maximum Yield Range
Quaternary sediments	**0.9**	Moderate	4.8	High
Dolerite intrusions	**2.7**	Moderate	58	High
Karoo sediments	**1.2**	Moderate	19.8	High
Archaean rocks	**0.9**	Moderate	2.8	Moderate

Where Yield Ranges: - High >3l/s; Moderate >0.5 to 3l/s; Low > 0.1 to 0.5l/s; Very Low ≤0.1l/s

The success rate of boreholes was noted to vary considerably within an area and often within the same lithology. The following presents a generalised summary of the findings regarding borehole siting and drilling within the study area: -

- the highest borehole yields appear to be associated with fractures occurring along dolerite contact zones;
- fractured and weathered zones found in depth within sedimentary rocks are often strong aquifers;
- boreholes drilled into dolerite sills or dykes are not likely to yield water unless a fracture zone is intersected;
- significant water strikes appear to occur at depths greater than 30m but less than 60m;
- rotary air flush percussion drilling is the generally accepted drilling method required to drill through all hard rock formations with appropriate sleeving in top weathered sections;
- drilling through unconsolidated sediments require either symmetrix, odex or mud rotary drill methods.

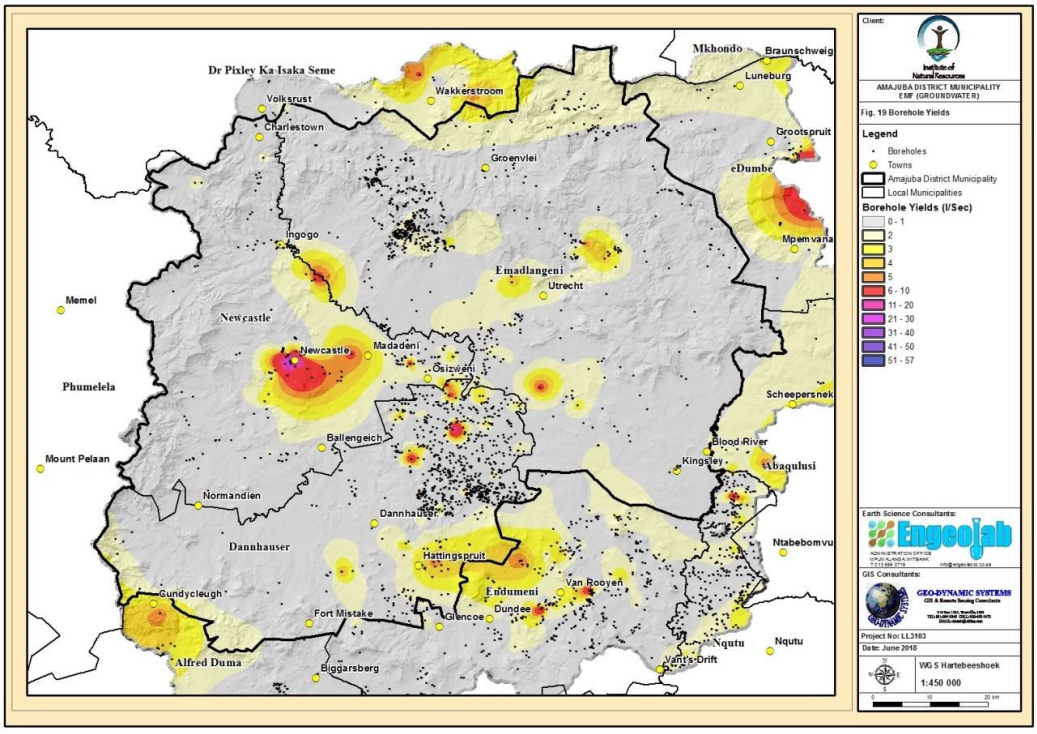


Figure 55: Borehole yields across the ADM

5.8.2 Recharge

5.8.2.1 Hydrochemistry

Unit 11, KZN Groundwater (1995) reports that 'In general, bicarbonate type groundwater appears to be dominant, followed by sulphate type groundwater and to a lesser extent groundwater of a chloride character. The presence of bicarbonate (HCO_3) as the dominant anion suggests that the groundwater regime generally presents a dynamic system regularly receiving recharge from rainfall. The groundwaters in the study area are not only predominantly bicarbonate but also support an electrical conductivity (EC) of <70mS/m with the central sections from Dannhauser to Newcastle and from Utrecht south- and south-westwards to Osizweni supporting more saline type waters with EC values ranging from 70 – 300 mS/m – refer to Figure 20, Groundwater Quality. These elevated conductivity levels are often associated with high levels of mineral salts in solution, such as sodium and chloride. Sodium-chloride (NaCl) type groundwaters do indeed occur in the central portion of the study area, indicating a correlation with water strike depths ranging from 35m to 70m'.

5.8.2.2 Groundwater Drainage, Transmissivity, Storativity and Recharge

Conceptual groundwater divides which define several groundwater basins are portrayed by Figure 21, Groundwater Drainage – refer to Unit 11, KZN Groundwater (1995). As reported, 'there is a remarkable confluence of groundwater basins in the Newcastle/Madadeni area which may be the contributing factor to the success of groundwater investigations in this area'.

The report comments that 'the groundwater regime of the northern portion of the Klip River coal field is seemingly isolated and the Newcastle-Hattingspruit sector which includes the Durnacol Colliery and the defunct Kilbarchan operation, drains in the direction of Newcastle/Madadeni area. This area is therefore at risk of receiving contaminated groundwater which might arise from coal mining operations'.

The report also comments that 'several studies had been conducted in the Wakkerstroom, Newcastle and Dannhauser areas to assess the transmissivity of bedrock types such as mudrock, sandstone and dolerite. It was found that the overall transmissivity within the regional groundwater regime is in the order of T= 3 -5m^2/day'.

Storativity values are in the order of 0.17% which are indicative of semi-confined conditions. Natural groundwater recharge occurs in the form of springs and seeps which seldom support a yield >0.1l/s.

According to the report (Unit 11, KZN Groundwater (1995)), 'the process of recharge is complex and dependant on a number of interdependent variables which include hydraulic parameters, precipitation, land-use, topography and current use. In view of the results of several studies conducted elsewhere on different lithologies, a mean recharge value of 3% of the annual rainfall was accepted for the study area. This value represents a net recharge value as losses due to evapotranspiration are accounted for. It is further perceived that the

large central basin that covers the study area promotes the conditions for widespread recharge of groundwater sources and as such is considered to be favourable'.

5.8.3 Groundwater Development Potential

Provision of potable water to rural communities, densely populated semi-urban areas and farming households presents the greatest demand on groundwater resources in the study area. Generally, these are low-demand applications satisfiable from single borehole installations with relatively minor stresses on groundwater resources. Provision of irrigation water does however have a much larger demand on the groundwater which should have a bigger impact on the resources.

According to the Unit 11 KZN Groundwater (1995) report, 'studies to determine the groundwater resource potential of the area indicated that the potential for groundwater resources to support a larger scale water supply function in the study area is promising. This is based a number of observations which include the following': -

*Positive recharge in the Karoo sediments and post-Karoo intrusions from rainfall;

*The ability of the groundwater resources to locally provide as much as 10,000m^3/month per borehole on average.

5.8.4 Groundwater quality

Groundwater quality is relatively poorly understood in the District largely due to limited data availability. Sources of contamination are varied and some have been discussed with reference to the vulnerability of shallow groundwater tables. Other key impacts include mining and industry. The Newcastle LM IDP (2018 review) states that the quality of groundwater is moderate to poor and that the most probable causes are:

5. Poor rates of recharge
6. Mining activities – particularly coal mining
7. Industry
8. Farming activities

A number of defunct and operational coal mines exist in the study area. Contamination of groundwater from the mining operations can occur as a result of seepage of polluted water from flooded workings – both from underground and opencast mining activities. Shallow contamination plumes are likely to develop down slope from surface waste facilities – i.e. slurry dams and discard stockpiles, affecting the deeper groundwater regime.

Higher-than-normal sulphate concentrations can be indicative of coal mining related groundwater pollution. The Unit 11, KZN Groundwater (1995) report comments that 'the coal deposits of the Hattingspruit - Newcastle coal sector in the Klip River coal field support total sulphur content ranging from 1.1 – 2.5% whilst those of the Utrecht coal field support sulphur values that fall in the range of 0.95 – 1.64%. From this data it appears that the potential for acid mine drainage in the Klip River coal field is higher than in the Utrecht coal field'. Sulphate and other dissolved salts result in higher electrical conductivity in water. High

dissolved salt concentrations result in high EC values. The distribution of high EC values from boreholes across ADM is shown in Figure 56.

Noxious industry is primarily situated within the Ngagane Catchment and the adjacent Buffalo River Catchment where it intersects with the NLM. The industry comprises of ore beneficiation, a power station, steel manufacturing and chemical manufacturing. The NLM's IDP 2017/2022 report states that 'Industrial land use is likely to have a significant impact on water quality – both surface - and groundwater resources in the region. The potential contaminants include:

- Heavy metals;
- Organic contaminants;
- Soluble salts;
- High turbidity;

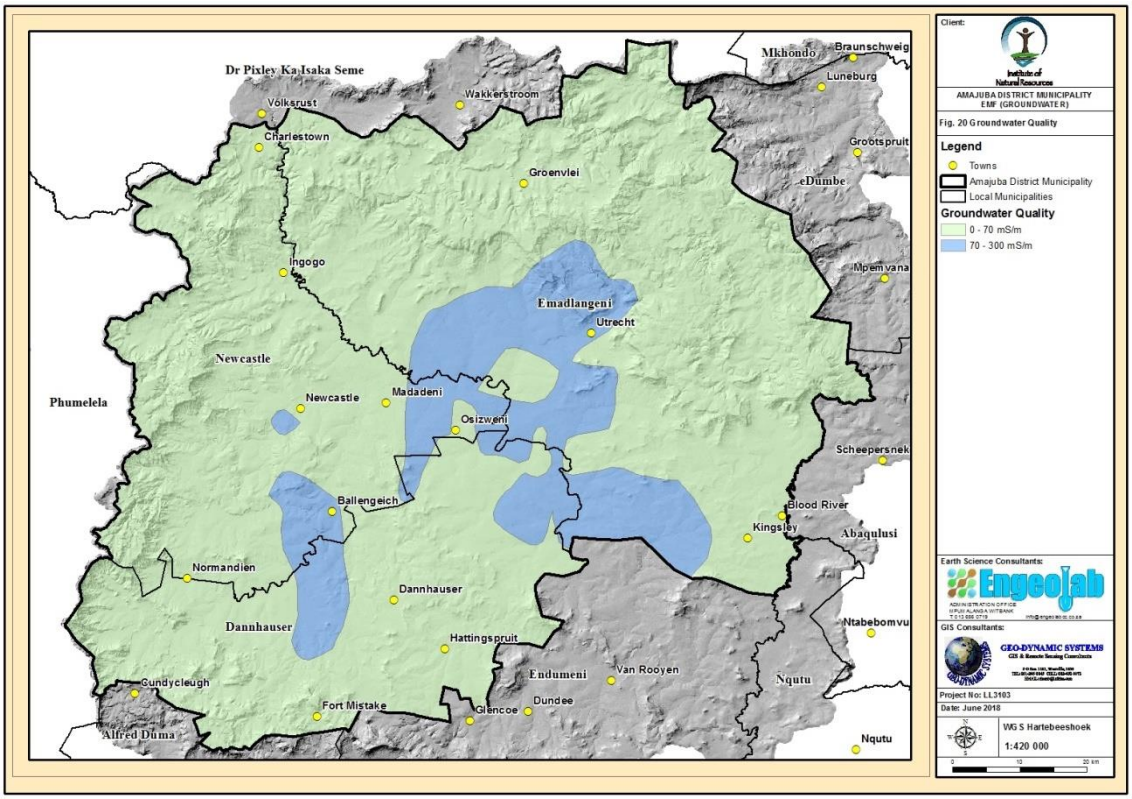


Figure 56: Electrical conductivity of groundwater

5.8.41 Pollution

Coal Mines

A number of defunct and operational coal mines exist in the study area. Contamination of groundwater from the mining operations can occur as a result of seepage of polluted water from flooded workings – both from underground and opencast mining activities. Shallow contamination plumes are likely to develop down slope from surface waste facilities – i.e. slurry dams and discard stockpiles, affecting the deeper groundwater regime.

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Industry

The land cover indicates that a large expanse of the Newcastle Local Municipality (NLM) is natural grassland with isolated thickets, natural forest, agriculture and forestry. Urban settlement is centred around the town of Newcastle, which is sited across the boundaries of the Buffalo-Ngagane and the Ngagane catchments. The residential land use comprises informal land use as well as well-established medium housing.

Noxious industry is primarily situated within the Ngagane Catchment and the adjacent Buffalo River Catchment where it intersects with the NLM. The industry comprises of ore beneficiation, a power station, steel manufacturing and chemical manufacturing. Mining is largely inactive in the area and isolated in the Ngagane - and Buffalo River catchments.

The potential contaminants associated with the non-point source land-use in NLM are limited given the extensive natural grassland. The isolated nature of agriculture practises, which could have impacts such as excessive nutrient loading and suspended particles, is not considered to be significant other than in the Buffalo River.

The NLM's IDP 2017/2022 report states that 'Industrial land use is likely to have a significant impact on water quality – both surface - and groundwater resources in the region.
The potential contaminants include': -

- Heavy metals;
- Organic contaminants;
- Soluble salts which translates into low oxygen levels;
- High turbidity;
- Increased levels of tropic sensitivity; and
- Elevated toxicity of water.

The NLM's IDP 2017/2022 reported further that 'the issue of acid mine drainage in the Ballengeigh area deserves the urgent intervention of authorities and a concerted effort involving relevant parties. This is noted as a possible source of both surface and ground water pollution both now and in years to come. The resultant impact is the applicability of water for agricultural, domestic and ecological use. Increase water treatment cost would also be realised to facilitate potable water'.

The DWA results within NLM indicate good water quality; however, the quality of the river water is impacted upon by poorly performing WWTW or urban run-off with high total coliforms and faecal coliforms. The NLM's IDP 2017/2022 report states that 'industrial impact is not evident and seems to manifest through fluctuating levels of chemicals such as Fe, Mn, TDS and Sulphate. This assessment of water quality is based on the current water quality data. However, following discussions with DWA and based on information pertaining

to the potential contaminant sources, it is suspected that the impact may be more pronounced should additional variables be analysed especially along reaches of the Ngagane River'.

The Ngagane River experiences the majority of the industrial impact with several noxious industries located within these catchments – refer to the NMLM's IDP 2017/2022 report. Monitoring data from DWA suggest that an impact is occurring immediately downstream of Silteck operations. This is evident from TDS values deviating from upstream results and is likely associated with increased sulphate (494mg/l) content of the river from the ash dump or colliery yard in that area. These levels decrease downstream to an average of 235mg/l downstream of Arcelor Mittal Steel. The sulphate and TDS levels increase again following the confluence with the Ncandu River suggesting an impact, from either the Ncandu River, or a point source on the Ngagane River in this area.

Cemeteries

A shallow perched water table was encountered in the Madadeni and Osizweni cemeteries – refer to NLM's IDP 2017/2022 report. These cemeteries were obviously developed without considering the potential risks to the local environment and the local community. Commonly they are established close to settlements because of religious and sociological reasons and cultural circumstances. As there is seepage of decay products that can easily mix with the groundwater, this can conceivably be a source of waterborne diseases where the groundwater is used for human consumption.

Other Sources

Unit 11, KZN Groundwater Supply (1995) reports that 'other potential sources of groundwater pollution are pit latrines which constitute the primary mode of ablution facilities in rural areas. In regard to bacteriological contamination, this would be confirmed by excessive nitrate concentrations'.

The ADM's Environmental Plan (2003) reports that the Department of Water Affairs and Forestry had initiated studies of the groundwater resources in KZN in 2001 and 'that these studies revealed growing evidence of the potential contamination of the groundwater from several sources (eg. human and animal sanitary contamination …)'. The report further states that 'several deviations from the Standards for Drinking Water (SABS 241, 1984) have been noted for bacterial contamination and nitrates. Recommendations for sustainable practices and management of the vital reserves include: -

*proper sanitary conditions in the construction of boreholes;

*preparation of groundwater vulnerability maps;

*development of regional groundwater levels to assess the effects of long term abstraction on these sources;

*proper construction and protection of springs is essential if rural communities are to have an assured supply of water from these sources'.

5.8.5 Groundwater vulnerability

7.3.1.1 Depth to groundwater

Depth to groundwater is an important consideration from two perspectives. Firstly, shallow ground water tables represent a constraint to development. Secondly, shallow groundwater tables are vulnerable to contamination from surface activities. This has the knock on impact of deteriorating human health as many households are dependent on groundwater for their domestic water supply.

In the ADM, large areas of the municipality are seen to have very shallow ground water levels (Figure 57). This is particularly relevant in the lower lying peri-urban areas surrounding Osizweni. Here, outside the formalised township areas, the vast majority of households utilize pit latrines, and numerous cases of outbreaks of bacteria related diseases including cholera have been linked to contaminated groundwater (P. Baytopp *pers com*). The ADM's Environmental Plan (2003) reports that the Department of Water Affairs and Forestry had initiated studies of the groundwater resources in KZN in 2001 and 'that these studies revealed growing evidence of the potential contamination of the groundwater from several sources (e.g. human and animal sanitary contamination …)'. The report further states that 'several deviations from the Standards for Drinking Water (SABS 241, 1984) have been noted for bacterial contamination and nitrates'.

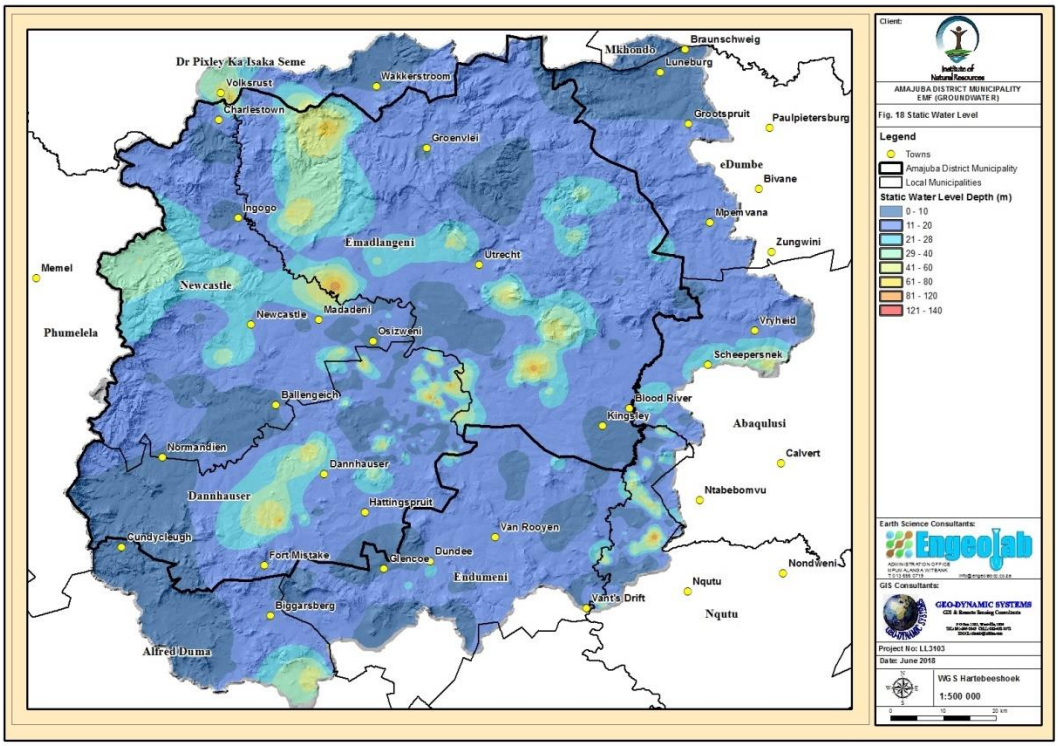


Figure 57: Static groundwater level across ADM.

Cemeteries also pose a threat to shallow groundwater tables. A shallow perched water table was encountered in the Madadeni and Osizweni cemeteries (NLM IDP 2017/2022). These cemeteries represent a risk to the local environment and the local community as the seepage of decay products can be a source of waterborne diseases.

5.8.6 Groundwater users

5.8.5.1 Groundwater Supply - Dannhauser Local Municipality

The Dannhauser IDP, 2017/2018 reported that the water treatment works at Dannhauser, Durnacol, Biggersberg and Ngagane supply 5.4Ml/day of potable water which is piped to 80% of the households within the municipality's area of jurisdiction. The balance of the population relies on natural water supplies and 98 boreholes scattered throughout the Buffalo Flats area. The intention is to continue using the boreholes as a backup supply, even after the Buffalo Flats Scheme is extended to supply the area.

5.8.5.2 Groundwater Supply - Emandlangeni Local Municipality

The town of Utrecht is supplied with potable water from its own WTW (1.11Ml/Day) and the Waterval Prison is supplied from the Ngagane WTW (1.3Ml/Day) via the Ngagane Scheme. With reference to the Emandlangeni IDP, 2017/2018, the rural areas are supplied by the following: -

- 78 boreholes of which 3 are without pumps, 3 are dry, 18 have submersible pumps, 2 have play pumps, 34 have hand pumps, 7 have windmills and 12 new boreholes equipped with pumps
- 21 springs
- 1 dam
- 2 streams
- Heavily settled semi-urban areas where 10 JOJO tanks are supplied by tankers
- 17 standpipes - these are reticulated from nearby boreholes/springs.

5.8.5.3 Groundwater Supply - Newcastle Local Municipality

The NLM's IDP, 2017/2022 reports that in terms of a resource potential, 'groundwater has the potential to service the whole of the NLM's basic water needs, and thus should be considered a valuable resource'. Furthermore, 'it is evident that there are instances of very significant groundwater supply potential when located in geohydrological favourable locations'.

A clearer indication of the groundwater resource potential in the study area of the overall yield capacity of boreholes located in Newcastle and on the Arcelor Mittal Steel grounds to supply emergency water supplies – refer to the Unit 11, KZN Groundwater (1995) report. It is reported that 'nine production boreholes in Newcastle yield 78,000m^3/month equating to 3,3l/s per borehole and another ten production boreholes with an average yield of 3,9l/s per borehole located on the Arcelor Mittal Steel grounds have a combined daily yield of 3,400m^3 translating to a sustainable yield of 124,100m^3per annum'.

5.8 WATER RESOURCES - DISCUSSION

The key challenge in water resources management is balancing the conservation value of water resources with the growing demand for them. The DWS's Resource Directed Measures (consisting of Water Resource Classification, Resource Quality Objectives and Ecological Reserve) are designed to identify and implement a balance between the use and the protection of water resources. The ADM falls into two primary catchments, the Thukela and the Pongola River Catchments. Importantly, there is currently no Water Resource Classification in place for the Thukela River catchment as is required by the National Water Act although an ecological reserve has been determined for this catchment, which was conducted in 2004. The Water Resource Classification of the Usutu to Mhlatuze WMA, which includes the Pongola River catchment is also outstanding though a reserve has been determined for this catchment. The lack of these instruments means that water resource management in the ADM is currently not systematic, not catchment based and thus not optimal.

A balance between socio-economic development and environmental protection needs to be accomplished. From a regulatory point of view the "business" of water quality management entails the ongoing process of planning, development, implementation and administration of water quality management policy, the authorisation of water uses that may have, or may potentially have, an impact on water quality, as well as the monitoring and auditing of the aforementioned.

The aquatic resources within the ADM are complex systems that are affected by a number of different factors. These factors result in changes in water quality, quantity and ecosystem health. Water quality within the ADM, especially of river systems within the Ngagane and Ncandu catchments, is affected by industrialisation, urbanisation, agriculture and mining. Effluent discharge, improper sanitation, sewerage contamination and litter also contribute to the deteriorated water quality within the ADM. Poor water quality results in added purification costs especially of potable water to meet specific health standards when providing drinking water.

According to DWS PES data, the Buffalo River is in a good ecological state and is largely natural with few modifications. The same data shows that the Ncandu River is in a poor state and is largely modified while the Ngagane River is in a moderately modified state. NFEPA data also indicates that the majority of the rivers in the District are important in terms of biodiversity conservation.

Rivers within the ADM are prone to flooding and have regularly burst their banks. Flood zone areas are important as a buffer against these flooding events and as a flood attenuation mechanism especially for downstream users. These areas are however highly transformed and under increasing pressure from urban and informal settlement expansion.

There are a number of wetland systems within the ADM which are not only important for their ecosystems services but for their tourism potential as well, especially in avi-tourism.

The ADM does have the potential to meet water quality and quantity needs of the district, however there are factors which work against this potential. Water yield is reduced by alien vegetation infestations and a lack of investment in water resources development means much of the potential is not realised. Water quality is affected by pollution, improper sanitation and sewerage and effluent dumping which further reduces the potential for efficient water use.

The sustainable development goals aim to provide clean water for all, that is accessible and affordable (IDP, 2017). One of the bigger overarching factors negatively influencing the potential for improved water quantity and quality of aquatic resources in the ADM is population growth in urban areas (as is demonstrated in Section 4 of this report) as with increased population there is increased development (planned and unplanned) and in turn more pollution of sensitive water resources. Costs of treating water to potable standards therefore increase. This presents a challenge in terms of water supply to the residents of ADM as an increase in population results in a greater demand for clean water. According to the IDP over 11 000 households have a piped water supply while 17% of households access water through communal stand pipes, over 7% of households rely on boreholes and springs however the quality of this water is unknown. Even though a large part of the ADM seem to have access to water, the fitness of the water for human consumption is unknown while others may have to walk long distances to get access to a standalone communal taps. Most of the piped water is found in the larger cities such as Newcastle indicating disparities around water supply and water supply infrastructure (IDP, 2017).

Population growth is however largely limited to the Newcastle/Madadeni/Osizweni area. Other factors affect water quality in the less urbanised areas. Contamination of water resources from mining activities such as coal mines and acid mine drainage are also a major problem.

There are important trade-offs that need to be made between development, job creation and the environment. This is especially evident in the ADM water resource demand graph (Figure 58). Even with short term interventions to meet the water resource demand such as the upgrading of pumping infrastructure there is still likely to be a major water deficit within the ADM in the near future.

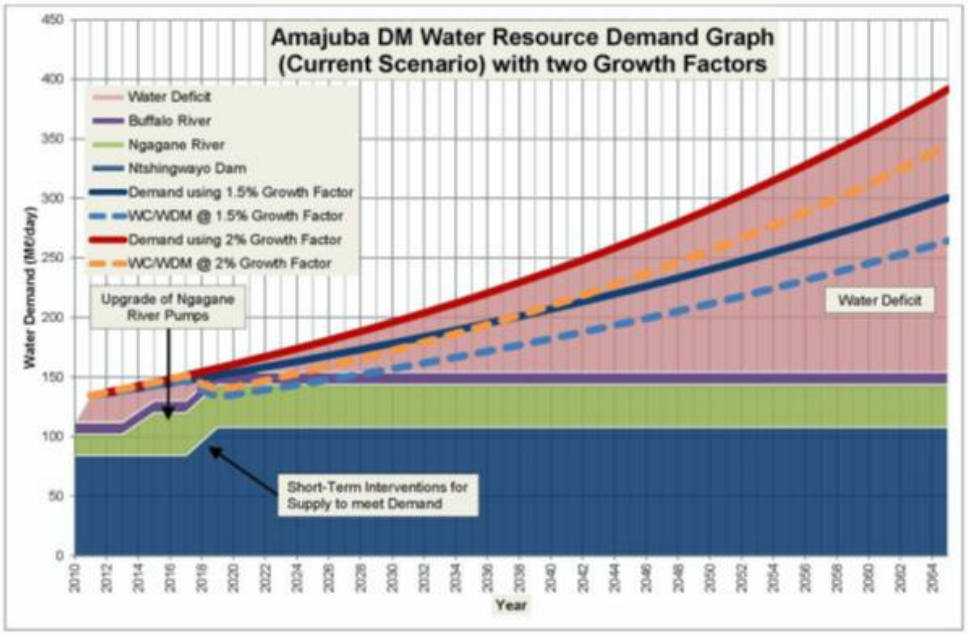


Figure 58: Amajuba District Municipality Water Resource Demand Graph (extracted from uThukela Water 2017 Annual Report)

The ADM five year development plan indicates the importance of this finite resource by making municipal infrastructure grants available to insure water quality monitoring and the improved public municipal services for the provision of this water (IDP 2017). Socio-economically water quality management is important and needs to be achieved through the cohesion and positive relationships between development and environmental protection.

6. TERRESTRIAL RESOURCES AND LAND DEGRADATION

6.1 OVERVIEW OF TERRESTRIAL BIODIVERSITY IN THE AMAJUBA DISTRICT MUNICIPALITY

6.1.1 Biomes and vegetation types

There are 4 biome types within the ADM (Forest, Savanna, Grasslands and wetlands) that contain 14 different vegetation types (Scott-Shaw and Escott 2011). Table 21 and Figure 59 list and map these vegetation types and show that the District is dominated by Grasslands and more specifically by Income Sandy Grassland, Wakkerstroom Montane Grassland, Northern KZN Moist Grassland and the KZN Highland Thornveld. Forests form a very small component of the vegetation in the District.

Table 21: Extent of original vegetation types within the Amajuba District (Scott-Shaw and Escott 2011).

KZN VEG TYPE NAME	Area (Ha)	Provincial Conservation Status
Alluvial Wetlands : Temperate Alluvial Vegetation	33900.7	Vulnerable
Alluvial Wetlands : Temperate Alluvial Vegetation : Midland Floodplain Grasslands	488.9	Least threatened
Amersfoort Highveld Clay Grassland	13078.1	Least threatened
Eastern Free State Sandy Grassland	189.1	Least threatened
Eastern Mistbelt Forests	5477.2	Endangered
Freshwater Wetlands : Eastern Temperate Wetlands	24488.1	Vulnerable
Income Sandy Grassland	149900.4	Vulnerable
KwaZulu-Natal Highland Thornveld	73206.1	Least threatened
Low Escarpment Moist Grassland	75319.5	Least threatened
Northern KwaZulu-Natal Moist Grassland	162370.7	Vulnerable
Northern Zululand Mistbelt Grassland	7007.7	Vulnerable
Paulpietersburg Moist Grassland	35547.9	Vulnerable
Thukela Thornveld	21.4	Least threatened
Wakkerstroom Montane Grassland	128280.7	Least threatened

Of these, Income Sandy Grassland, Northern KZN Moist Grassland, Paulpietersburg Moist Grassland and Northern Zululand Moist Grassland are considered vulnerable grassland vegetation types. Eastern Mistlbelt Forests are considered endangered, whilst Eastern Temperate Wetlands and Temperate Alluvial Vegetation are considered vulnerable wetland types.

Grasslands play an important role in water production and other ecosystem services. Good condition grasslands have the ability to reduce runoff in wet seasons and improve infiltration. This contributes to maintaining dry season baseflow and helps mitigate against the effects of drought. Grasslands can also decrease the destructive force of floods (flood attenuation).

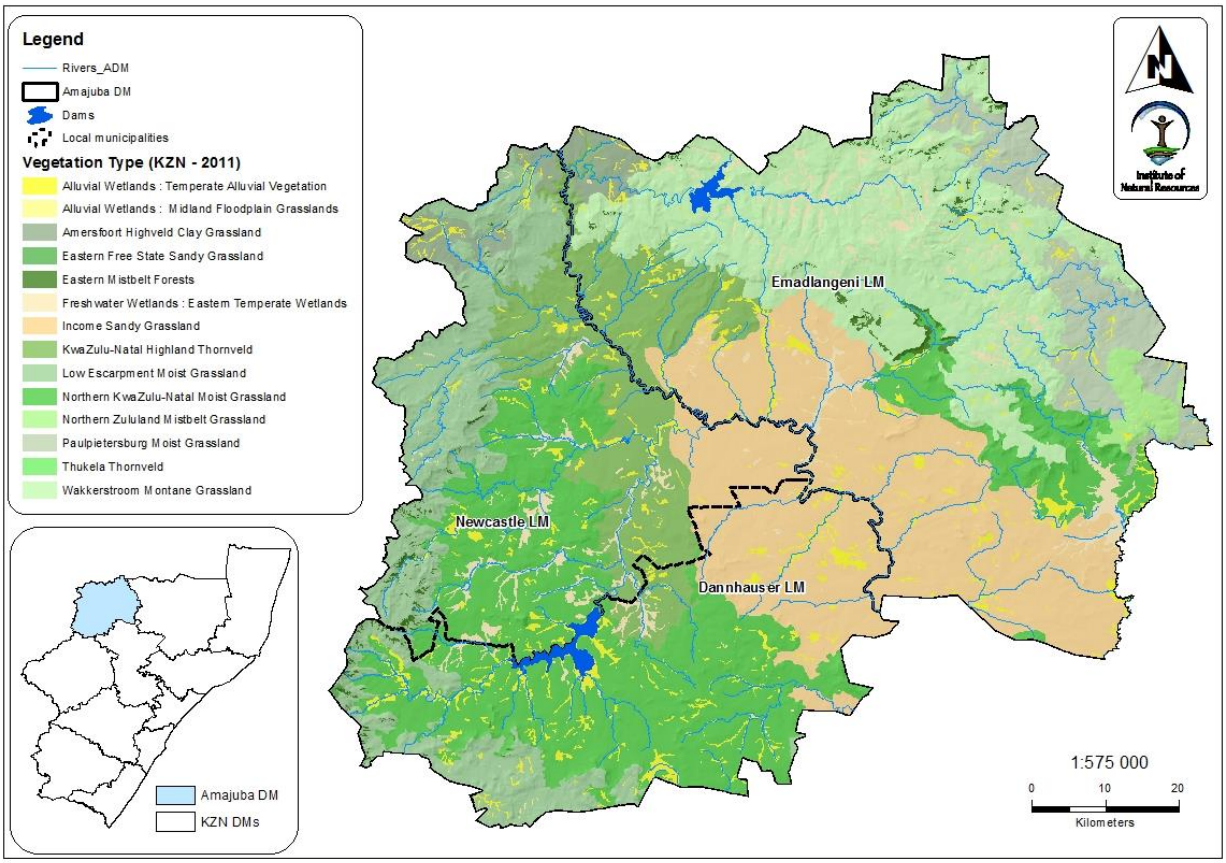


Figure 59: Spatial distribution of the vegetation types of the Amajuba District Municipality

The high lying grasslands of the ADM are located in a high rainfall/runoff region of the country, and have been included as National Strategic Water Source Areas. Some areas have an estimated mean annual rainfall of between 600-1000mm, which is significantly higher in comparison to the regional average of 450mm. Due to the relative inaccessibility of the area along the Drakensberg escarpment, these grasslands provide a reserve of relatively pristine natural resources. Minimal infrastructural development has occurred in the area, which has contributed to the continued supply of relatively good quality water. This is beneficial for users of the ADM from a water quantity and quality perspective (Snyman and Jewitt, 2010).

6.1.2 NEMBA Threatened Ecosystems

The National Environmental Management: Biodiversity Act (Act 10 of 2004) allows for the publication of provincial and national lists of ecosystems that are threatened[6] and in need of protection. NEMBA listed threatened terrestrial ecosystems that occur within the ADM include:

1. Bivane Montane Grassland (EN),
2. Wakkerstroom Grassland (EN),
3. Fort Metcalf Grassland (EN),
4. Low Escarpment Mistbelt Forest (VU),
5. Paulpietersburg Moist Grassland (VU),

[6] Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Near Threatened (NT)

6. Uyskop Valley (VU),
7. Chelmsford Grassland (VU),
8. Chelmsford North Grassland (VU),
9. Majuba Mistbelt Forest and Moist Grassland (VU) and
10. Nkunzi / Sundays River Grassland (VU).

The details regarding the fulfilment of criteria for listing each of the ecosystems can be found here: http://bgis.sanbi.org/Ecosystems/Home. (Figure 60).

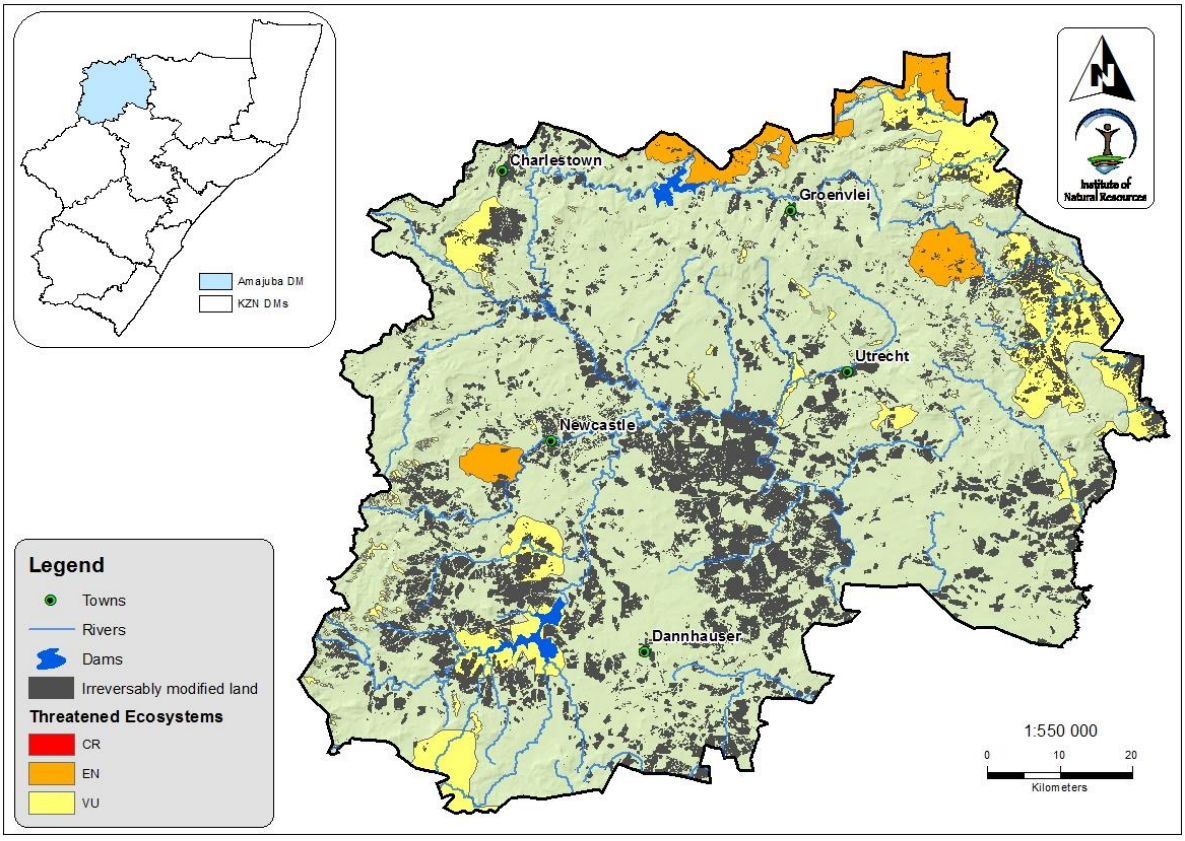


Figure 60: Threatened ecosystems within the Amajuba District Municipality

6.1.3 Threatened flora

Flora data for the ADM shows that the habitat supports 1 near threatened, 1 rare species and 5 vulnerable species e.g. *Nerine Platypetala* (Groenvlei Lily), which as the name suggests is found in the grasslands around the Groenvlei Wetland. The Groenvlei Lily, like other species in its class is threatened by habitat degradation and loss (Scott-Shaw, 2005; SANBI Red List).

6.1.4 Threatened fauna

Faunal data (amphibians, reptiles, birds, mammals, fish and invertebrates) has recorded 3 critically endangered species, 4 endangered and 5 vulnerable species. Of these, 3 critically endangered birds species are known to inhabit the area namely, *Bugeranus carunculatus* (Wattle crane), *Heteromirafra ruddi* (Rudd's Lark) and *Hirundo atrocaerulea* (Blue Swallow). While some species such as the Wattle Crane inhabit regions within the ADM more

permanently (i.e. wetlands), some species such as the Rudd's Lark and the Blue Swallow are are infrequently observed in the District. According to the South African Bird Atlas Project (Animal Demography Unit, UCT), a reporting rate of less than 5% has been recorded for Rudd's Lark in the Wakkerstroom / Groenvlei habitat, and 4% for Blue Swallow in the Newcastle area, with none being recorded in 2018 thus far.

The 2 endangered mammalian species found in the ADM are the *Mystromys albicaudatus* commonly known as the White-tailed mouse and the *Ourebia ourebi ourebi*, also known as the Oribi.

Rare invertebrate species include the *Aloeides swanepoeli* (Swanepoel's Copper) and the *Bowkeria Phosphor borealis* (Scarce Scarlet), while the *Doratogonus septentrionalis* (Northern black millipede) and the *Doratogonus minor* (Minor black millipede) are endangered species.

6.2 SPATIAL EXTENT OF IMPORTANT BIODIVERSITY FEATURES

6.2.1 Protected areas and Stewardship Sites

Formally protected areas are regions protected by law under the National Environmental Management: Protected Areas Act (Act 57 of 2003) such as nature reserves, national parks, and world heritage sites. Stewardship sites and protected environments also provide protection, however these occur on private land with various levels of stewardship.

The Chelmsford Nature Reserve and the Ncandu Forest Reserve and recently the Pongola Bush Protected Environment are the only 3 provincial nature reserves in the ADM. The Ncandu Forest is situated between KZN and the Free State along the rugged escarpment. The area is known for its birdlife, supporting Wattle Crane, Grey Crowned Crane, Blue Crane and the Denham's Bustard (EKZNW, 2009-2013). The Chelmsford Nature reserve is an important conservation feature for Oribi (EKZNW, 2009-2013). The Pongola Bush Protected Environment site constitutes many pristine forest and grassland species and is a known wattle crane breeding site (Stone *et al.*, 2011).

The BSP also lists the Normandien Farm as a Natural Heritage site, which consists largely of natural forest that boarders the Ncandu Nature Reserve (Thring *et al.,* 1999). Mkhothane is a community conservation area, in Charlestown, which includes pristine grassland and woodland along the Buffalo River (Figure 60).

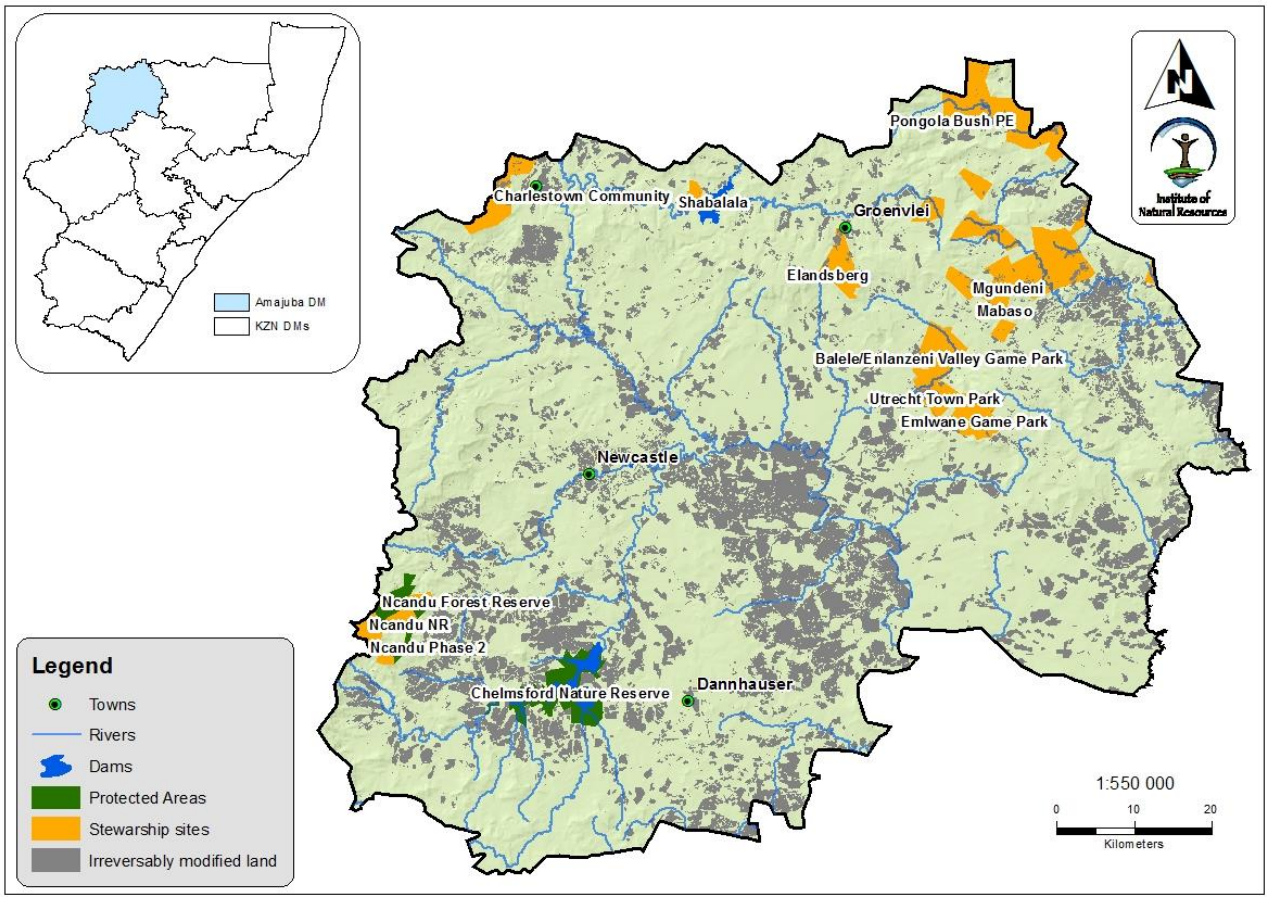


Figure 61: Protected areas and Stewardship sites within the Amajuba District

6.2.2 Critical Biodiversity Areas and Ecological Support Areas

A Critical Biodiversity Area (CBA) is a natural / pristine or semi-natural feature, habitat or landscape that stretches across the terrestrial, aquatic and marine environments that is considered critical for

- Meeting national and provincial biodiversity targets and thresholds
- Assists in safeguarding certain areas in the landscape that are required to ensure the persistence and functioning of species, ecosystems as well as the delivery of ecosystem goods and services
- Preserving habitats that are important for biodiversity or rare species.

CBAs can be further divided into two categories; CBA Irreplaceable and Optimal.

CBA Irreplaceable: these areas are considered critical for meeting biodiversity conservation targets. Irreplaceable areas are necessary for the persistence of species as well as the overall functionality of the environment.

CBA Optimal: these are areas that are considered an optimal solution for meeting biodiversity conservation targets and aims to avoid areas where the risk of losing biodiversity is high.

Conservation of CBAs is a priority as areas that are not well maintained in a natural or near natural state have limited carrying capacity for biodiversity and rare species, which in turns reduces the chances of meeting national/ provincial biodiversity conservation targets.

An ESA is a functional area, whilst not necessarily in a natural or in near-natural state, that is used to ensure the persistence and maintenance of biodiversity, species and environmental processes within a CBA. ESAs are made up of four categories, ESA, ESA corridors, ESA Expert Input and ESA Species Specific.

CBAs and ESAs are used in the development of district biodiversity sector plans which makes recommendations regarding appropriate land uses and provides guidelines regarding land management. The distribution of CBAs and ESAs across the ADM are shown in Figure 62

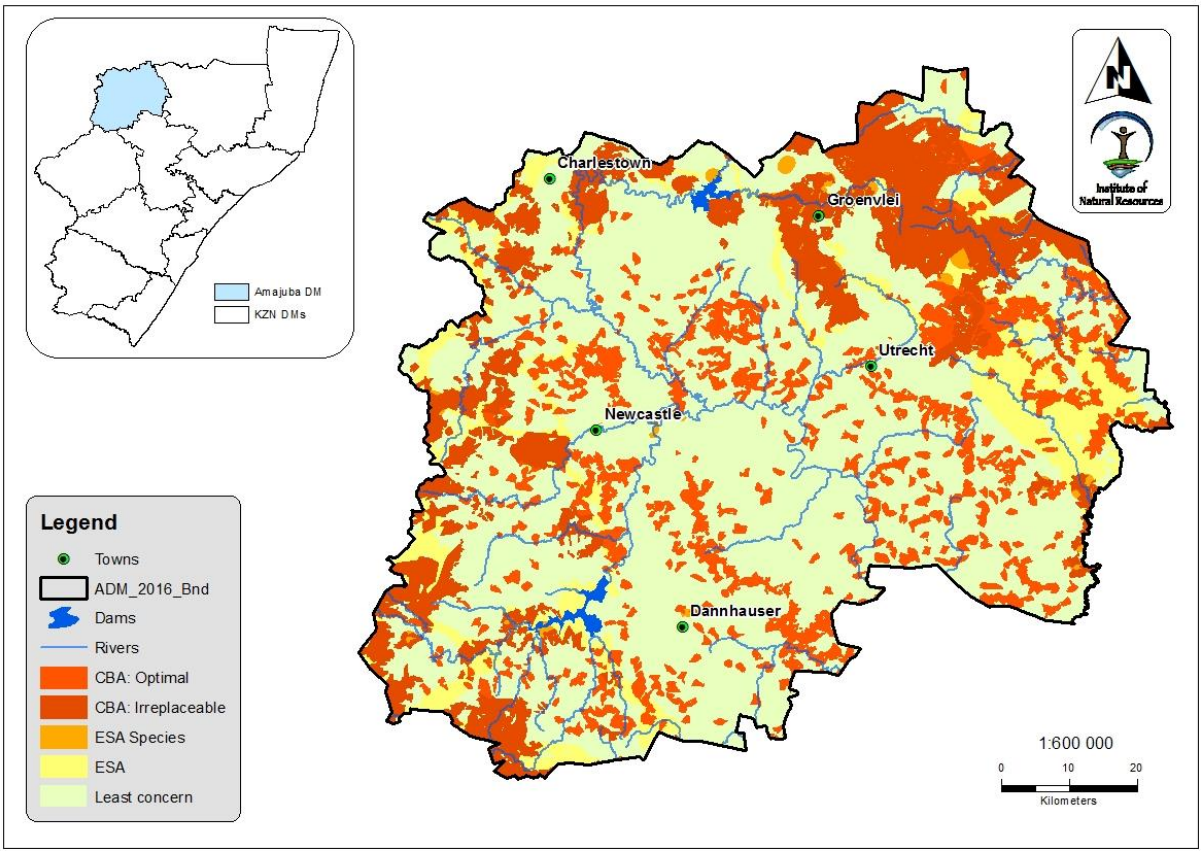


Figure 62: Distribution of CBAs and ESAs across ADM

6.2.3 Agrobiodiversity Zones

Agrobiodiversity zones are zones that aim to highlight the importance of sustainable agriculture and biodiversity conservation, because they represent areas that are deemed to have both a high to moderate agricultural potential and a high biodiversity value. Importantly, they exclude land which is considered high priority from a crop cultivation perspective as this would place biodiversity conservation objectives at odds with that of agriculture in these areas. An agrobiodiversity zone therefore promotes the co-existence of indigenous biodiversity with agricultural activities (Figure 63).

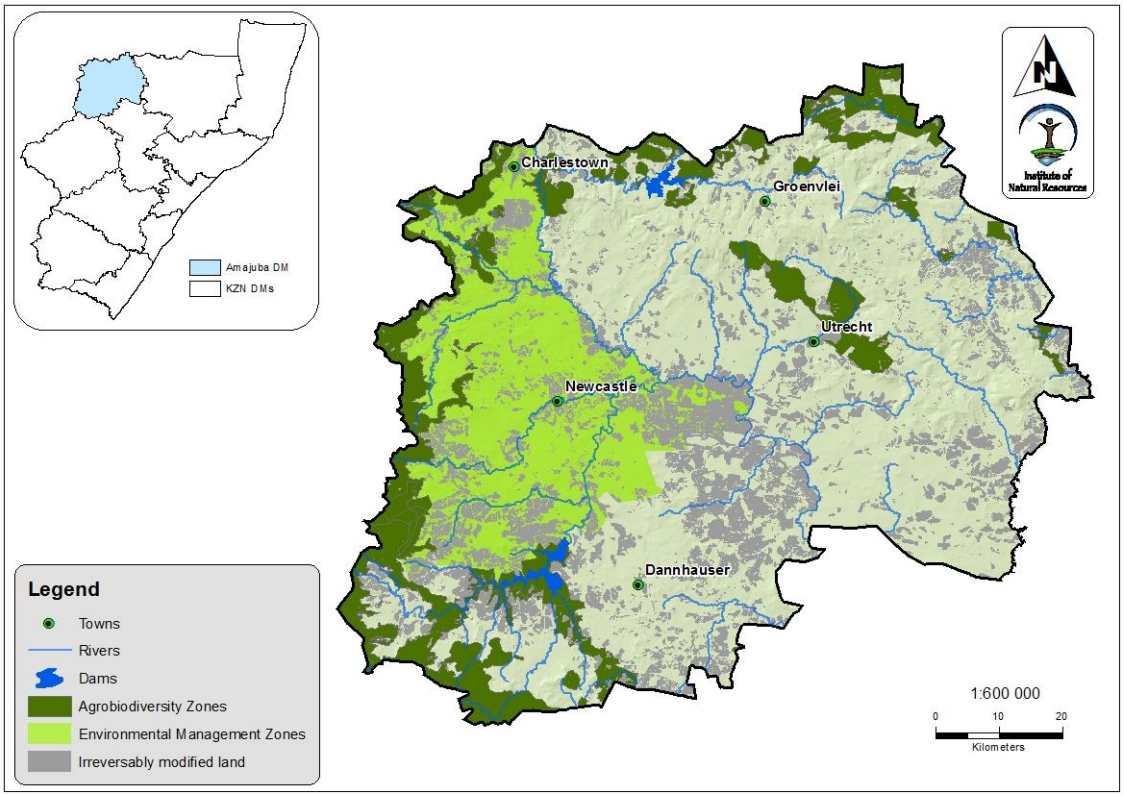


Figure 63: Agrobiodiversity zones within the Amajuba District

These zones are also linked through "corridors" with formal protected areas. To enable or maintain species interaction between populations, the use of rangelands can be used to link or provide viable habitats for species that are prone to isolation. This encourages protecting indigenous vegetation and maintaining it in a good state and/or re-establishing natural species, the removal of alien plant species and buffering wetlands and watercourses.

Agrobiodiversity zones promote appropriate management of pesticide, herbicide and fertiliser use. They also aim to control surface runoff and prevention of soil erosion and degradation (in accordance with CARA (Act 43, of 1983)). The cultivation/ ploughing of virgin land are not supported in these areas as they do not contribute towards the above aims. Often, grazing is offered as an alternative. Natural resource harvesting is permitted, at low levels provided it is on a sustainable basis.

6.2.4 Composite Biodiversity Map

By combining all important biodiversity features, a composite map can be compiled reflecting all important biodiversity features of the ADM. This is shown in Figure 64.

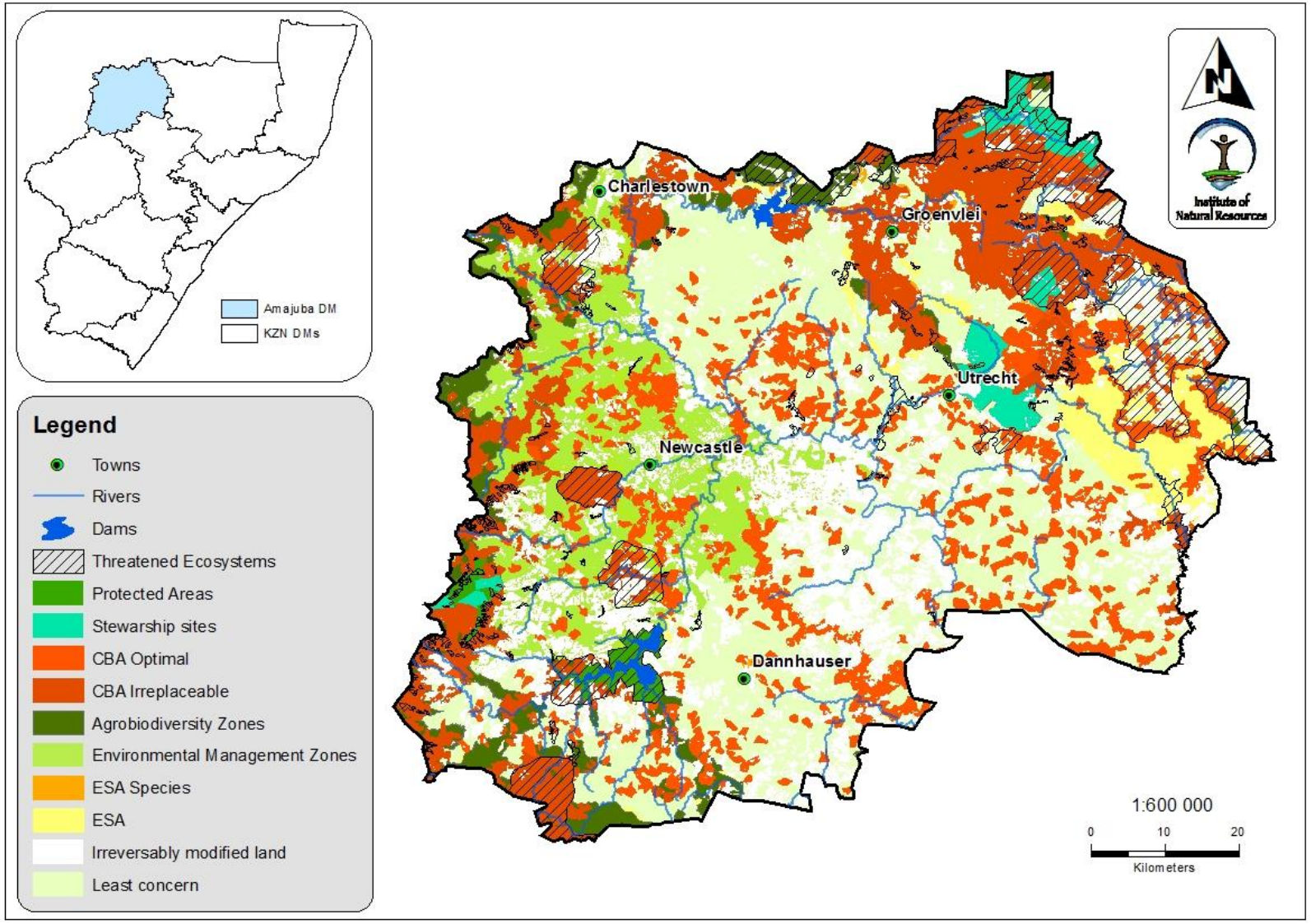


Figure 64: Composite map of important biodiversity features in ADM

6.3 CONSERVATION AND SOCIAL USE VALUE OF TERRESTRIAL ECOSYSTEMS

Biodiversity and the ecosystem services provided by the terrestrial environment underpin social and economic activities that form a central feature of socio-economic development in Amajuba District. Agriculture, tourism, livestock grazing and numerous environmental processes (nutrient cycling, soil stabilization, water purification etc.) are vital for the proper functioning of human life and economic growth in this region. Conservation and proper management of these biodiversity features is therefore essential.

The different grasslands of the ADM are perhaps the most important ecosystems in the District. They play a critical role in providing habitat for a range of biodiversity and perhaps more importantly they provide a range of services that are crucial for the persistence and growth of the local economy. Extensive animal production is directly reliant on grasslands for grazing, while industry, mining and any form of settlement is dependent on the water produced by grassland dominated catchments. The grasslands of the ADM are also key habitats for medicinal plants that are important from a socio-cultural perspective for many, especially for rural communities with limited access to healthcare facilities.

The District has identified intensive irrigation farming as an important mechanism to develop the regional economy (SDF, 2017). This however is dependent on the availability and supply of good quality water to areas with sufficiently arable land. The grassland ecosystems of the District are critical components of the hydrological cycle which results in the supply of water to the District. This demonstrates a critical link between development objectives in the District and the management of the terrestrial ecosystems providing water related services. Without well managed catchments, water stress (quality and/or quantity) will likely curtail any irrigation related development initiatives. Importantly, **all** the water used in the District is generated by catchments located entirely within the District. The District is therefore effectively soley responsible for the management of its water resources.

In most cases, these areas provide multiple benefits. Not only do they support economic growth through provision of water related services, but they additionally fulfil a critical role in supporting tourism. The ADM has identified tourism and its associated environmental resources as key areas in which to implement development initiatives (IDP, 2017). The Drakensberg escarpment offers tourism opportunities through hiking trials in the natural forests, scenic walks alongside waterfalls, trout fishing in clear mountain streams and bird watching in the numerous reserves, grasslands and wetlands. The large dams of the ADM and their surrounds are used as recreational areas for relaxation, fishing and sports such as the annual Chelmsford Challenge. These areas have been identified as important opportunities for tourism development (IDP, 2017).

The area surrounding Ntshingwayo dam i.e. Chelmsford Nature Reserve as well as other important catchment areas such as the Ncandu Nature Reserve and the Pongola Bush Protected Environment are also formally protected, which allows them to serve as sanctuaries for biodiversity. Close to 400 faunal and floral species associated with grasslands, bushveld, wetlands and mountainous habitats

have been recorded in the ADM, some of which have already been noted in this report. Bird life in the ADM is also a key drawcard for tourism and therefore must be regarded as a valuable resource. As with agriculture, the development of such tourism initiatives links heavily to water (fishing, wetlands, dams etc.) and will therefore largely depend on well managed terrestrial ecosystems, particularly in the higher lying catchment areas (Table 22).

Table 22: Bird species of tourism interest found in the ADM (Source: Amajuba Routes)

Blue crane	Bush Blackcap	Amur falcon
Rudd's Lark	Bald Ibis	Wattle cranes
Buffstreaked Chat	Blacknecked Grebe	Blue Korhaan
Palecrowned Cisticola	Grass Owl	Ground Woodpekcer
Yellowbreasted Pipit	Greywinged Francolin	Blue Swallow

Sensitive wetlands in the area assist in regulating and filtering water that moves through the landscape. Taking into consideration the number of industrial and mining operations in the area which contribute to an array of water and air quality impacts, and considering the complete reliance of the District on its own catchments, it is essential to highlight the role wetlands play in the local economy through the sequestration of contaminants and the regulation of base flow during dry periods. Sound management of the terrestrial ecosystems in these key catchment areas is thus critical for the sustainable development of the District.

6.4 THREATS TO TERRESTRIAL BIODIVERSITY AND DRIVERS OF CHANGE

6.4.1 Habitat Loss

It is widely accepted that globally, habitat loss is the single greatest threat to biodiversity. In the Amajuba District, grasslands such as Income sandy grassland, Paulpietersburg moist grassland, Northern KZN moist grassland and Amersfoort Highveld Clay grassland have been negatively impacted by land use change showing a decline in spatial coverage of between 20-35% from their original extent, giving these vegetation types a conservation status of 'vulnerable'. Grasslands are not the only vegetation type that has been adversely affected, alluvial wetland vegetation has also been readily converted. These losses and various others can be attributed to a number of anthropogenic activities or processes.

Table 23 gives an indication of the level (in percent) of modification that natural vegetation has undergone in the ADM. According to this summary, the Income Sandy Grassland, Northern KZN Moist Grassland and the Paulpietersburg Moist Grassland have been the most threatened vegetation types in the ADM, aligning well with their KZN vulnerable status. The conversion of natural grasslands to commercial agriculture and plantations are the leading cause of their vulnerability. Sparse rural settlements and associated subsistence agriculture have also lead to the degradation of natural ecosystems, particularly the Income Sandy Grassland. Irreversible modification of grasslands limits the ecosystem services that these ecosystems supply such as flood

attenuation, sediment control, groundwater recharge and filtration, thus increasing the vulnerability of downstream users both within and outside of the District.

Table 23: Land cover classes associated with vegetation type distributions

	Natural Unimpacted	Wetlands	Unimpacted habitat sum	Natural Degraded	Dams and Rivers	Plantations	Dryland Commercial Agriculture	Irrigated Commercial Agriculture	Subsistence Agriculture	Sparse Settlement	Urban Open Space	Urban Residential	Urban commercial	Urban industrial	Mines and Quarries
Amersfoort Highveld Clay Grassland	74.5	3.3	77.8	0.2	0.1	1.6	14.9	0.8	1.8	2.8	0.0	0.0	-	-	0.1
Eastern Free State Sandy Grassland	100.0	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-
Eastern Temperate Freshwater Wetlands	70.4	21.9	92.3	1.0	2.2	0.2	3.0	1.0	0.3	0.0	-	-	-	-	-
Income Sandy Grassland	63.1	1.9	65.0	2.6	0.3	0.3	11.1	1.6	8.5	7.5	0.1	2.6	0.1	0.0	0.3
KwaZulu-Natal Highland Thornveld	80.3	3.4	83.7	1.5	0.2	0.5	6.3	1.9	1.1	1.4	0.2	1.5	0.4	0.5	0.9
Low Escarpment Moist Grassland	89.5	1.7	91.2	0.3	0.1	5.4	2.4	0.3	0.1	0.3	-	-	-	-	0.0
Northern Afrotemperate Forest	93.1	0.7	93.7	1.5	0.0	4.4	0.1	-	-	0.3	-	-	-	-	-
Northern KwaZulu-Natal Moist Grassland	64.7	5.5	70.2	0.3	2.4	5.2	16.8	2.3	0.6	0.8	0.0	0.8	0.1	0.0	0.4
Northern KwaZulu-Natal Shrubland	93.2	2.1	95.3	0.1	0.0	0.8	1.7	-	-	0.1	0.3	1.4	0.0	0.1	0.1
Paulpietersburg Moist Grassland	63.3	7.1	70.4	0.2	0.1	15.9	8.7	0.2	3.0	1.5	-	-	-	-	0.0
Thukela Thornveld	100.0	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-
Wakkerstroom Montane Grassland	88.7	2.8	91.5	0.6	0.9	2.4	3.5	0.1	0.9	0.2	-	-	-	-	0.0

** Red highlights the biggest impact, orange the second largest and yellow the third largest*

Importantly Table 23 does not indicate the extent to which grasslands have been altered to other 'Unimpacted' land cover classes. An analysis has been undertaken of land cover change over the period of 1990 to 2014 using the national land cover data sets from these two points in time. The results of this analysis clearly indicate the extent to which grasslands are under threat. Over this time period, roughly 94 000 Ha of grassland has been altered to another land cover type (Table 24). This represents 18 percent of the grassland that was present in 1990.

Table 24: Area of ecosystem change in ADM 1990 - 2014

Habitat	Area change (Ha)	Total area (1990)	Percent of total habitat
Grassland	93696.1	500912.3	18.7
Thicket / Dense bush	8180.4	17405.9	47.0
Woodland / Open bush	6122.9	7115.5	86.1
Low shrubland	4307.0	4630.9	93.0
Ind. Forest	480.6	3502.0	13.7

6.4.2 Invasive Alien Plant Species

Further analysis of land cover change data (1994 – 2014) indicates that over the last 20 years, the primary driver of the conversion of grassland is the change from grassland to woody vegetation. Interrogation of this change shows clearly that the primary factor driving this change is the spread of alien *Acacia dealbata* and *A. mearnsii*. It is a significant concern from a biodiversity as well as agricultural and water resource management perspective that 40 000 Ha of valuable grassland has been lost to this process in the space of 20 years (Table 25) (Figure 65).

Table 25: Area of Grassland lost to different land cover categories 1990 - 2014 (and summary table)

Grassland chages to:	Area (Ha)
Thicket / Dense bush	26506.04
Woodland / Open bush	12450.94
Cultivated comm fields (med)	9675.31
Plantations / Woodlots mature	8480.71
Cultivated comm fields (low)	5430.58
Cultivated subsistence (med)	4066.24
Urban village (low veg / grass)	3707.77
Erosion (donga)	3644.13
Wetlands	3618.63
Plantation / Woodlots clearfelle	2926.51
Low shrubland	2359.80
Indigenous Forest	2011.47
Cultivated subsistence (low)	1155.21
Cultivated comm pivots (low)	781.98
Plantation / Woodlots young	765.31
Bare none vegetated	764.90
Urban township (low veg / grass)	649.01
Urban informal (low veg / grass)	606.88
Water permanent	570.05
Cultivated subsistence (high)	521.16

Driver group	Area
Woody vegetation	41316.78
Comm Cultivation	15887.86
Forestry	12172.53
Subs Cultivation	5742.61
Human settlements	4963.65
Other	13612.65
Total	**93696.08**

Figure 65: Alien wattle trees blanketing the grasslands of Majuba Hill.

Invasive alien plant species pose a major threat to the integrity of terrestrial ecosystems. In the ADM, this is particularly true of grasslands. Alien plants and wattle species in particular can establish themselves in areas where grasslands are heavily utilized / poorly managed and in poor condition. Once established, they are able to expand into more pristine areas using rivers as seed dispersal agents along riparian corridors and through a 'mushrooming' process whereby localized seed dispersal results in a progressive enlargement of an existing stand in a circular pattern (Figure 66). In this way they slowly erode the area of natural and productive grassland, limiting ecosystem service provision such as grazing and water and biodiversity related services.

Figure 66: Upper catchment grasslands and riparian areas invaded by wattle trees showing seed dispersal through river transport and localised 'mushrooming'.

Exotic species utilize more water than indigenous species, meaning they release more water into the atmosphere through transpiration as a result of them accessing ground water (Calder and Dye, 2012). A decrease in both ground water and overland flow limits the amount of water available for humans and their associated daily activities.

Large portions of grasslands in the upper reaches of the ADM and the riparian areas of important water courses have been invaded by alien invasive species i.e. silver wattle (*Acacia Dealbata*), black wattle (*Acacia Mearnsii*), gum (Eucalyptus sps.) and white poplars (Populas Alba)(Angus Burns pers. comm.). The impacts of this alter the water production potential of these areas as indigenous species are outcompeted and the water source is over utilized. This is particularly important where major supply dams / abstraction points occur downstream.

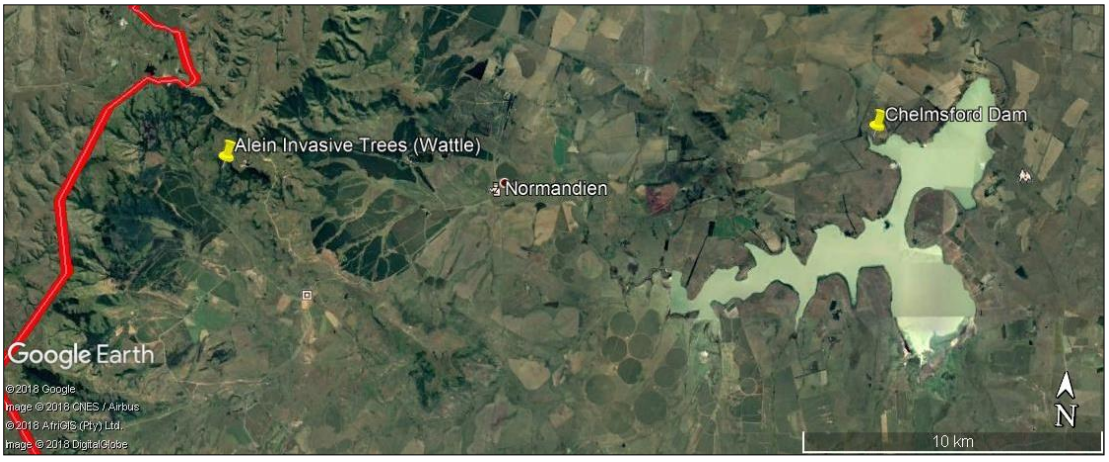


Figure 67: Alien trees in critical catchments are a threat to water security

The loss of grassland regions to alien species also results in bare ground exposure (lack of cover under the canopies and undergrowth) which is a leading cause of soil erosion (though wind and water). This results in a loss of fertile topsoil which limits nutrient cycling and decreases the chances of supporting biodiversity. This impact is felt further in terms of reduced livestock grazing areas for farmers, impacting livelihoods. This process additionally threatens water resources through enhancing sedimentation of water courses and impoundments.

The Enkangala grassland project encouraged farmers to clear alien species by providing them with an incentive in the form of herbicide. This resulted in a 95% success rate in terms of removal, which highlights the effectiveness of stewardship programmes, and similar initiatives which involve the land owners in alien clearing activities.

The large areas invaded by wattle interestingly also present an economic opportunity. A positive social outcome of the Enkangala grassland alien clearing work was job creation. There additionally exist opportunities for the utilisation of the biomass in power generation, charcoaling, wood sales etc.

6.4.3 Agricultural impacts

Agriculture can pose a significant threat to terrestrial biodiversity, particularly the cultivation of virgin land, which transforms large areas of natural vegetation and habitat. Intensive farming practices, over utilization of harmful chemical such as pesticides, fertilizers, herbicides etc. can also however have a detrimental impact on biodiversity. In Amajuba District, heavy grazing is a major concern and one of the biggest pressures (Angus Burns WWF. *Pers. comm*). Intense over-grazing and frequent burning of the grassland decreases biodiversity, allows alien invasive infestation and decreases grassland vigour/health. Grasslands are put at risk by poor burning management, where grasslands are burnt too frequently, in-frequently or burnt in the wrong season (C. Botha – KZN DARD *Pers. comm*).

Poor land management practices also leads to loss of vegetation cover and soil loss. There has been an observed decline in overall grassland health due to intense grazing pressure and frequent burning, including in grasslands within protected areas (Angus Burns pers. comm).

Biodiversity on private farm land is also affected by illegal hunting and poaching. Hunting with dogs has become more popular, which affects antelope utilizing the grassland such as Southern Reedbuck and flagship species such as Oribi (Angus Burns pers. comm).

Agriculture can however co-exist with biodiversity, particularly where grazing areas are well managed and where intensive farming is responsibly practiced, leaving appropriate corridors and buffers for habitats to persist. This is the foundational principle behind Agrobiodiversity Zones. As an example of this, the WWF has implemented stewardship programmes which promote land reform and food security. The Mndeni community were the beneficiaries of a successful land claim. Working with WWF, they took on the responsibility of improving land management and biodiversity and successfully declared their land as a protected environment. Furthermore, through funding provided by the UNDP, the community was provided with mentorship and training on management of their

grasslands, and effective farming practices. The Mndeni community have successfully lowered the mortality rates and raised the overall condition of their herd, whilst simultaneously conserving biodiversity. They recently entered the commercial livestock market, sending their first 70 oxen to market (WWF).

6.4.4 Expansion of Settlement and Infrastructural Development

Unplanned, inappropriate and ill managed development i.e. for tourism, formal and informal, urban and rural developments are extremely destructive to biodiversity. Built-up towns and settlements generally represent irreversible modification / loss of habitat – leaving little to no ability to support biodiversity, as opposed to agricultural land uses which often still have the ability to provide a degree of biodiversity value.

Clearing natural landscapes for informal settlements and / or subsistence agriculture (Figure 12) is less destructive than hardened urban environments, but none-the-less eliminates or degrades large areas of habitat and this type of activity is very often unregulated and difficult to control. It is evident from aerial photographs that large portions of grassland in the ADM have been converted to small scale or subsistence agriculture (Figure 68), particularly in the southern low lying areas of the Buffalo River basin. This can have further implications than the loss of natural landscapes e.g. increased destructive power of floods (more compact, bare surface which reduces infiltration) and ultimately loss of life and livelihoods.

Figure 68: Irreversibly modified grassland consisting of sparse settlements and subsistence agriculture in the Amajuba District

6.4.5 Mining

Mining is in most cases incompatible with biodiversity conservation priorities and open cast mining in particular is land hungry and destructive and poses a major threat to terrestrial (and aquatic for that matter) biodiversity. Underground mining is less 'land hungry', but is none-the-less considered a threat through secondary impacts such as the construction of required infrastructure, the large

volumes of waste that are generated (and often poorly managed, particularly after mine closure) and water quality degradation.

The areas of Newcastle, Durnacol, Dundee and Glencoe have a long history of coal and metal ore mining, which played a big role in the development of the local economy. Over recent decades however, the weakening of this sector is noticeable in the decline in the surrounding towns' populations and in the closure and abandonment of mines. A large number of coal mines have been abandoned within the Newcastle and Emadlangeni municipalities. From a biodiversity perspective, several old mine sites require rehabilitation and despite their closure, still pose a threat to the environment through water and air pollution. The most active mining town remains Dannhauser (Dannhauser IDP, 2014) with the main mining outputs being coal and clay. Only 1 significant commercial coal mine remains in Newcastle.

According to WWF, mining activities continue to pose a major threat to grasslands in Amajuba (Angus Burns, pers comm). Mining not only threatens grasslands in the form of direct disturbance related habitat loss, but it also can result in groundwater contamination which can ultimately result in damage to terrestrial ecosystems and crops. Acid mine drainage from defunct mines has reportedly degraded farmers water resources in the area and is known to have detrimentally impacted the water quality of important water resources. Very little information is however available regarding acid mine drainage as monitoring data is limited. Furthermore, effluent dams built within close proximity to water courses results in effluent leaching into the ground and surface water, decreasing water quality and biodiversity in aquatic ecosystems (Amajuba Park).

Fracking applications by applicants Rhino and Sungusungu have been received in the Amajuba district, and one exploration license has been granted. It is widely believed that fracking will lead to ground water contamination and surface water quality decline, while grassland habitat will undoubtedly be destroyed by fracking infrastructure.

6.4.6 Climate Change

Climate change impacts from a terrestrial biodiversity perspective are likely to be considerable, with the loss of ecosystem goods and services. The change in rainfall patterns and temperature will have an effect on the geographical ranges of sensitive species, which ultimately affects ecosystem species composition, populations and communities. Over time, species and even biomes may shift towards more desirable conditions in efforts to persist. The future existence and distribution of sensitive species will depend on the ability of species to migrate. Altitudinal corridors and ESAs therefore play an important role in facilitating the migration of species. Fragmented habitats hinder plant migration as they do not offer suitable areas for successful colonization.

The loss of grasslands through land conversion and alien invasion in the District can also exacerbate the effects of climate change. Grasslands and vegetation cover are known to act as carbon sinks, removing large amounts of carbon dioxide from the atmosphere and storing it in the soil. Grassland degradation and modification elevates the carbon levels in the atmosphere increasing the effects of climate change (increased temperatures / seasonal changes / elevated annual rainfall).

6.5 AGRICULTURAL RESOURCES

6.5.1 Overview

Amajuba District Municipality is among the most fertile regions within KwaZulu-Natal. Despite this advantage, the agricultural sector only accounts for roughly 2.2% of total GVA in the Amajuba District (though agri-processing is not fully accounted for in this figure), while the contribution of this sector to total formal employment is also low at 2% (LED review 2011). The importance of agricultural development and sustainability in the Province has however been prioritized recently in many of the provincial and national policies and strategies. Locally, The Amajuba District Growth and Development Plan (ADGDP) stresses the need for good potential agricultural land to be kept productive and lower potential land to be well managed in order to conserve existing limited production potential. The limited realization of potential in the District is noteworthy and should be addressed in association with other governance, socio-economic and environmental variables which influence agricultural production.

6.5.2 Spatial Extent of Resources

6.5.2.1 Current agricultural activities

The 2014 National Land Cover database and the KZN DARD cultivated fields data set has been used to identify the distribution and nature of existing agricultural activities. Extensive livestock production is practised in the vast majority of the grasslands across the District. It has therefore been assumed that all grassland areas are utilised for grazing purposes to varying degrees. These areas have therefore been included in the map of agricultural activities. The results of this assessment are shown in Figure 69.

Annual crop production is focused in three key areas:

5. The area in the South west of the District around Normandien and the Ntshingwayo Dam, and extending up the catchments of the Horn River, the Ncandu River upstream of Newcastle and the Ngagane River. This is primarily large scale commercial agriculture with a large area under irrigation.
6. Along the Buffalo River and lower Ncandu River, and Ngagane River in the vicinity of Madadeni and Osizweni. The banks of the Buffalo River are heavily utilised for commercial irrigated agriculture while the area around Madadeni and Osizweni is heavily utilised by small scale farmers, very little of which is irrigated.
7. The far southern area of the District, around Hattingspruit where large scale commercial dryland agriculture dominates production.
8. The south eastern corner of the District, along the Blood River and R34 which includes a mixture of irrigated and dryland commercial agriculture.

Timber production is clustered in three areas:

1. A small area along the Majuba Pass near Charlestown (though this area is dramatically bigger when unmanaged wattle jungle is taken into account)
2. the eastern high lying areas in the Bivane River catchment and
3. the foothills of the Drakensberg escarpment in the west near Normandien and in the upper Ncandu catchment

KZN DARD agricultural development projects are mainly located in Newcastle (2) and Dannhauser (5), with a single project being located in Emadlangeni.

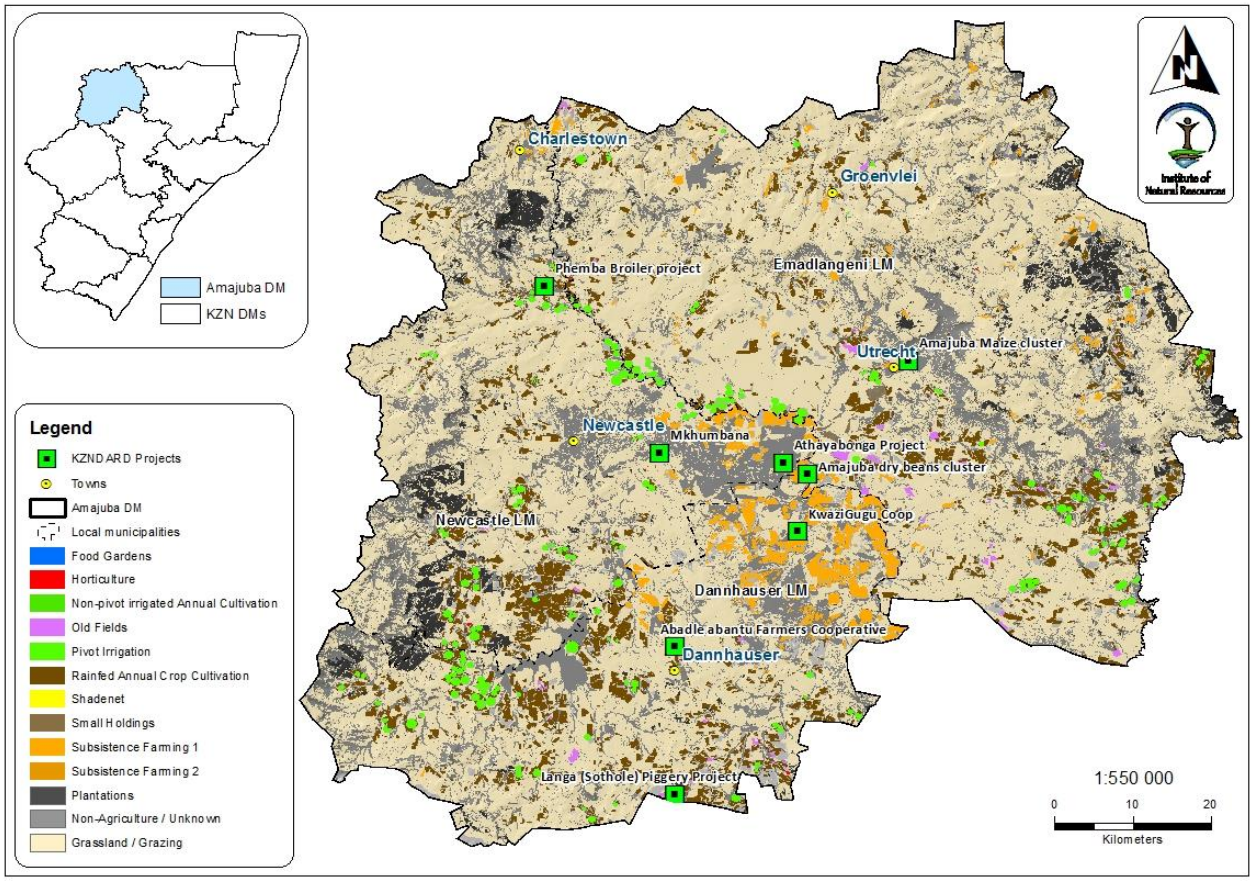


Figure 69: Distribution of agricultural activities in ADM (KZN DARD and DEA Land cover 2014)

6.5.2.2 Land potential

Identification of high potential agricultural land in KwaZulu Natal has evolved over the last two decades. Various physiographic factors were combined to establish Bioresource Groups (Camp 1999). Amajuba is divided into six Bioresource Groups (BRG's) namely 8, 9, 11, 12, 13 and 14 (Figure 70). Table 26 shows the areas of the various BRG's in Amajuba.

Table 26: Bioresource group areas for the ADM

BRG No	Amajuba (Ha's)	Total (Ha's)	Percentage of total BRU in ADM
8	40430.2	879379.9	4.6
9	27422.1	375311.6	7.3
11	54314.5	772487.9	7
12	16023.6	416295	3.8
13	30751.6	478034	6.4
14	15820.1	519301.7	3

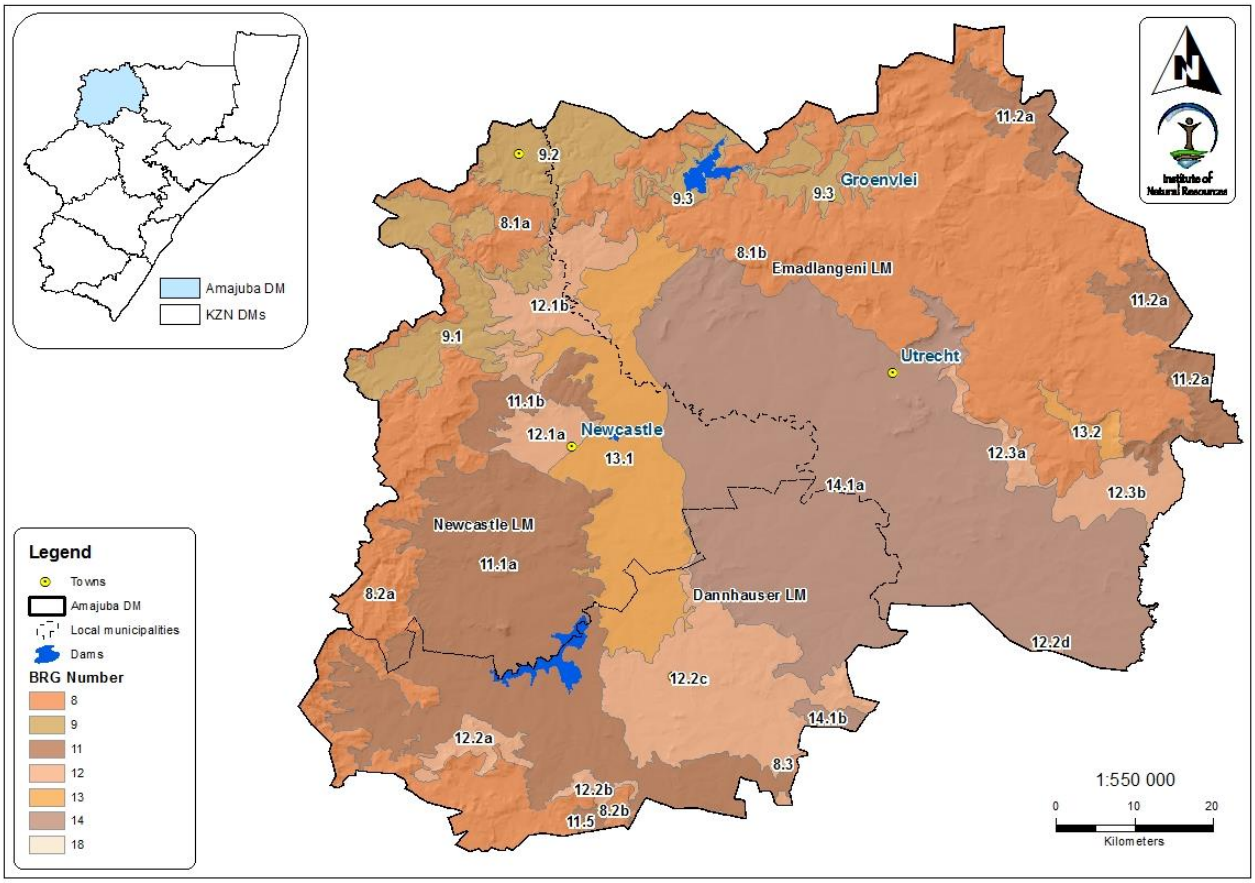


Figure 70: Bioresource Groups of ADM

BRG 8 Moist Highland Sourveld : The mean annual rainfall varies from 800 mm to 1 265 mm and the temperature is between 11.5oC and 16.6oC. The rainfall is reasonably reliable. Summers are cool and winters cold, with severe to very severe frost. Snow is experienced occasionally, more frequently on the high-lying areas. The growing season is short, hail is a hazard and hot "Berg" winds increase the risk of serious fires.

BRG 9 Dry Highland Sourveld: Droughts are quite frequent occurrences and the mean annual rainfall varies from 620 mm to 816 mm, with the lower extremes in the Newcastle area. Snow is infrequent. The mean annual temperature varies from 12.9oC to 15.6oC.

BRG 11 Moist Transitional Tall Grassveld (Transitional Tall Grassveld): The mean annual rainfall is from 800 mm to 1 116 mm. Mists are a frequent occurrence. The mean annual temperature varies from 15.0oC to 18.7oC. Frosts are generally moderate, but occasional severe frosts do occur.

BRG 12 Moist Tall Grassveld: The mean annual rainfall varies from 712 mm to 805 mm. There are 3 to 4 ecologically dry months. The mean annual temperature varies from 15.3oC to 18.9oC. Occasional drought periods occur during the summer, frosts are moderate to severe, and hailstorms are experienced.

BRG 13 Dry Tall Grassveld: The mean annual rainfall varies from 666 mm to 745 mm and there are 4 to 5 ecologically dry months. The rainfall is not reliable and is poorly distributed. The mean annual temperature varies from 15.6oC to 19.0oC and frost is moderate to severe.

BRG 14 Sour Sandveld: The Sour Sandveld has sandier soils than the Dry Tall Grassveld but the climate can be regarded as being similar to the climate of that BRG. The mean annual rainfall varies from 645 mm to 737 mm, and the mean annual temperature is between 14.7oC and 17.3oC.
KZN DARD has more recently undertaken a mapping exercise incorporating a range of spatially referenced agricultural data (including the BRU data) aimed at categorising and mapping land potential for the province. The distribution of these five categories across the ADM is shown in Figure 71. The categories themselves are described in Table 27. More detailed descriptions of each of these categories are contained in Annexure 2.

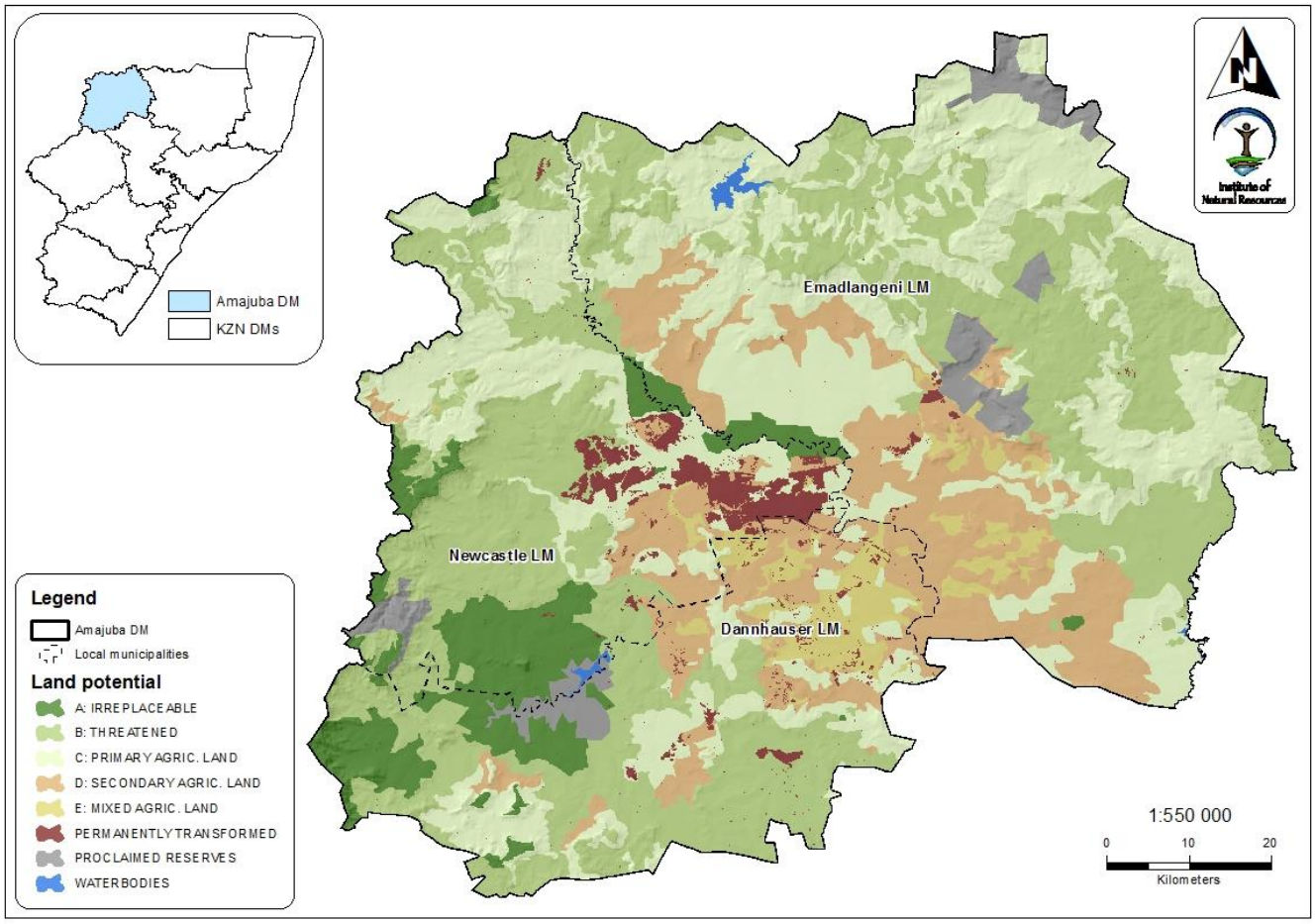


Figure 71: Distribution of land potential categories across the ADM

Table 27: Land potential categories according to KZNDARD

Category	Description	Allowed land uses	Requirements for subdivision / rezoning
Category A: Irreplaceable (Includes 'unique agricultural land').	Regarded as very high potential agricultural land that should be retained exclusively for agricultural use	Land use restricted to those that support primary agricultural production only (e.g. silos, sheds, reservoirs), which should all be preferably located on the lowest potential areas within the category.	Detailed agricultural impact assessment by SACNASP registered scientist that has sufficient motivation for a change of land use (e.g. where available zoning data is
Category B: Threatened	Regarded as high potential land and efforts should be focussed on retaining this land for predominantly agricultural use.	No major change of land use within this category. Limited changes of land use will be supported only if in direct support of primary agricultural production.	
Category C: Primary	Regarded as land with moderate agricultural	Land use within this category may include those mentioned in A&B	

Category	Description	Allowed land uses	Requirements for subdivision / rezoning
agricultural land use	potential. Arable areas may be restricted and scattered through the landscape – may be more suited to fodder crops and extensive grazing in support of livestock production. Category C areas may also be retained as a buffer to protect Category A & B areas.	but could also include: • Storage and processing facilities for farm products • Limited footprint agri-tourism, small education and research structures supporting scientific awareness (preferably in lower potential areas)	broad, and a down grading of the category is justified where site-specific studies show that land potential should be downgraded)
Category D: Secondary agricultural land use	Regarded as land with restricted to low agricultural potential. Change of land use may be supported as long as it does not conflict with the surrounding agricultural activity. Change should also not interfere with existing agricultural activities.	Land use within this category may include those mentioned in A,B&C but could also include: • Intensive farming (e.g. poultry, piggeries) • Packhouses and processing plants • Recreation facilities • Small wedding / conference venues and renewable energy farms	
Category E: Mixed land use	Regarded as land with very restricted to very low potential for agricultural production in terms of both arability and grazing.	Should there be a reason to retain a land parcel within this Category for agricultural purposes, DAFF and KZN DARD must offer supporting documentation as to why the application should be denied. A proposed change of land use within this category will therefore most likely be supported.	Basic / semi-detailed natural resources survey could be requested should there be a reason to retain this land for agricultural use.

While this data shows that some areas may have very low potential, the scale of such a mapping exercise does not consider site specific circumstances such as:

- Localised soil potential – there are many areas that have good soils in what are mapped as low potential areas and many areas that have poor soils in high potential areas.
- Input climatic data is relatively course and microclimates can vary, creating suitable conditions for various forms of agriculture (potentially in areas identified as low potential).
- Access to irrigation is not considered in the analysis – irrigation can significantly improve productivity by mitigating the climatic restriction of rainfall. This is potentially relevant in the central and southern areas of the district.

- Slope: Slopes are mapped at the resolution of the best available topographic data and can over or under estimate the limitations imposed by slope on cultivation. Slopes greater than 12% should not be used for annual cultivation

6.5.3 Conservation and Social use Value of Resources

6.5.3.1 National importance

Agriculture is seen as a key component of the development of the South African, Kwazulu-Natal and Amajuba economies. Nationally, its importance for economic growth and job creation is explicitly included in the National Development Plan which lays out the following related objectives:

- An additional 643 000 direct jobs and 326 000 indirect jobs in the agriculture, agro-processing and related sectors by 2030.
- Increased investment in new agricultural technologies, research and the development of adaptation strategies for the protection of rural livelihoods and expansion of commercial agriculture.

The medium term strategic framework endorses this and includes "Revitalisation of the Agriculture and Agro-processing value-chain" as a key driver of economic growth and job creation. It focuses on improved food and nutrition security, smallholder farmer development and agricultural competitiveness with the intention to transform the rural economic landscape. To achieve the 1 million agriculture jobs by 2030 as per the NDP, Outcome 7 advocates for several interventions that include:

- Increase the percentage of productive land owned by previously disadvantaged individuals from 11.5% in 2013 to 20%.
- Ensure that, by 2019, 7.2 million hectares of land in total will have been transferred to previously disadvantaged individuals and is being used productively (as compared to 4 million hectares by 2013).
- Reduce the percentage of households who are vulnerable to hunger from 11.4% in 2013 to less than 9.5%.

6.5.3.2 District level importance

Given the prioritisation of Agriculture at a National and Provincial level, agriculture is accordingly also a key sector for economic growth in the Amajuba District. The 2011 review of the District's local Economic Development strategy identifies that ADM is considered as among the most fertile regions in the province and that decline of the other economic sectors have determined increasing focus on agriculture, in the interest of increased production value and employment creation. The review also identifies that while ADM is a fertile region, it only contributes 2.2% of the total Gross Value Add (GVA) and only 2% to formal employment in the District. The contribution of the agricultural sector to the District GVA had declined between 2005 and 2009, with an average growth rate of -6.7%. According to the LED review, the decline in agricultural production in the region can be attributed to a number of factors including:

- Uncertainty about the large number of pending land claims (70% of agricultural land is under claim in the Emadlangeni municipality);
- Lack of support for small-scale and informal farming operations;
- Lack of relevant skills and training programmes;
- Access to markets;
- Access to funding for investment into new machinery and equipment;
- Increasing input costs and competition;
- Poor institutional support and assistance in the region.

6.5.3.3 Produce and Markets

According to the Amajuba Agricultural Development Plan (2008), the main commercial crops that are produced in Amajuba are maize, soybeans, peanuts, wheat, drybeans, potatoes, cabbage and barely. The most important crop in the area is maize along with soybeans and this has been planted for many decades in Amajuba region. The list of local markets identified by the plan is given in Table 28. Whilst it is acknowledged that this data is relatively old, the list still provides a valuable insight into the nature of the agricultural value chain in the Amajuba District. The agricultural plan goes on to note that the majority of the markets are traditional silos, mills and abattoirs.

The plan also identifies potential markets that are not locally based including large corporate entities such as South African Breweries (SAB) and Tiger Brands which are under increasing pressure to procure agricultural raw materials from Previously Disadvantaged producers, processors that require soybeans for the animal feed industry and large scale vegetable retailers who are willing to work with emerging farmers. All of these offer emerging farmers an opportunity to enjoy access to large scale, reliable, mainstream commercial markets for their produce.

This process has now been extended to include livestock production and has the backing of certain large commercial feedlots and national auctioneers who will ensure that emerging farmers enjoy the benefit of commercial prices.

Table 28: Agricultural Produce markets identified by the ADM agricultural plan (2005)

Town	Company name	Location of business	Activities	Existing input/output	Spare capacity	Planned future input capacity
Dannhauser	Waterfall Poultry	On Normandien side of the Ladysmith on the Dundee/Ladysmith road near Ridgegate park.	Produce eggs	Output of 1200 dozen eggs/day	Nil	Nil
Dannhauser	Dannhauser Malt	Industrial area	Malt factory	Sorghum: 6000 to 7000 ton/year from Mpumalanga: Maize (yellow) : 500 ton/year from Amajuba	Nil	Nil
Dannhauser	Roadside Abattoir	55km from Newcastle on Newcastle/Ladysmith road. At Sunset rest, on N11.	Abattoir - Class B	1800 cattle/month, 5 sheep/month, 0 pig/month, 0 chicken/month maximum of 100 cattle/day = ± 2000/month	Nil	Nil
Dannhauser	Leicester Mill	On Crossroads of Newcastle/Ladysmith/ Dannhauser road.	Mill	66 to 75 ton maize/month	1600 tons/month	Nil
Dundee	Bhubesi maize products	23 McKenzie street	Mill	600 ton maize from silo's (Dannhauser, Dundee, etc.)	600 ton/year	Continuously expanding
Dundee	National Sorghum Breweries	Industrial area	Brewery	Malt from Mandeni	Nil	Nil
Dundee	Farmers Brewery	Hattingspruit - between Dundee and Dannhauser	Beer brewery	Ingredients from Austria	Nil	Nil
Dundee	CCC Feedlots	Farm Maybole. On Vryheid/Dundee road. ± 2km outside Dundee	Feedlot	±14600 cattle/3 months	Nil	Nil
Glencoe	Glencoe Abattoir	On Ladysmith road at Glencoe	Abattoir	100 sheep and cattle/day	Nil	Nil
Glencoe	5 Star Milling	Industrial area	Mill, maize, corn, bakery	Confidential	Yes, didn't want to specify	Every 2 years
Ladysmith	Natal Agri(Bergville)	Bergville, 45 Voortrekker street	Silo	Confidential	Nil	Nil
Ladysmith	The SA Breweries	Industrial area	Only a dry depot	Stock from Durban and Johannesburg. Couldn't say how much.	Nil	Nil
Ladysmith	Ladysmith Abattoir	Will not supply information				
Ladysmith	Intando Milling	Damskraal	Mill	± 200 tons maize/month from Bronkhorstspruit.	Nil	Nil
Newcastle	Newcastle Abattoirs / NN Abattoirs	46 Marconi street Industrial area	Abattoir	1500 cattle/month, 3000 sheep/month max: 125 units per day, from Memel, Dundee, Vrystaat, Mpumalanga, Glencoe, etc.)	Nil	Nil

Town	Company name	Location of business	Activities	Existing input/output	Spare capacity	Planned future input capacity
Newcastle	Matandu Chicken Abattoir	5 km from Newcastle on the Vrede road	Abattoir	Is licensed to slaughter 1 000 chickens per day	Nil	Is busy expanding at the moment
Newcastle	The Fruit Basket	Will not supply information				
Newcastle	Newcastle Mills	Will not supply information				
Paulpietersburg	Dumbe Fruit	Kings building, Hoog street	Fruit and vegetable market	± R5 000 fruit and vegetables/week. Gets fruit and vegetables from local people and market.	Nil	Nil
Paulpietersburg	Dumbe grain	4 Geelhout Ave	Silo/Mill	60 - 80 ton maize/month	100 ton/month	Nil
Utrecht	Utrecht mills	On Newcastle road, ± 9 km, turn left	Mill	130 ton maize/month	1000 ton/year	Nil
Vryheid	Big 5 Milling	On Vryheid/Dundee road. 10 km from Vryheid	Mill and feedlot	500 tons maize/month from own production and other	500 tons/month	Busy upgrading at the moment
Vryheid	Meadow meats	27 Bloekom street	Abattoir	2500 cattle/month 130 sheep/month 40 pigs/month	500 cattle	Nil
Vryheid	KZN Fruit & Vegetable Wholesalers	265 Utrecht street	Fruit and vegetables	3 300 bags of Potatoes/week 3 000 bags onions/week 50 bags cabbage/week	Nil	Nil
Vryheid	Sondaleni Farm produce	Utrecht street	Fruit and vegetables market	Fruit from Cape town Vegetables : tomatoes, cabbage from local farmers, onions from market or Cape town. ± 50 bags cabbage/day ± 25 crates tomatoes/day	Nil	Nil
Vryheid	Stilwaters Poultry Farm	10 km west of Vryheid	Produce eggs	22 000 chickens/year from Parys. 1 400 dozen eggs/day	Nil	Nil
Vryheid	Vryheid Groothandel Slagtery	249 Boeren street	Butchery	7 cattle/week, 10-15 sheep/week 10-15 pig/week	Nil	Nil

6.5.4 Condition of Resource and Drivers of Change

Amajuba District Municipality contains a large area of potentially highly productive land. The vast majority of this is primarily important from a grazing perspective (KZN DARD). Grazing resources are however particularly sensitive to different management practices and can easily be degraded by over utilisation and inappropriate burning practices. The ADM area is predominantly highland sourveld with a moderate carrying capacity.

Veld condition assessments in the highland areas around Groenvlei showed an average condition score of 55 and the poor scores in this area are attributable to long term inappropriate burning practices with respect to timing and frequency (C. Botha KZN DARD pers comm). The area has a history of burning large areas of land (as opposed to block burns) in spring or early summer as opposed to in July. Conflict is also evident with respect to burning times in the drive for late burns by the fire protection associations, largely to protect the timber industry. This conflicts with KZN DARD's and the Conservation of Agricultural Resources Act's recommendations for July burning (C. Botha pers comm).

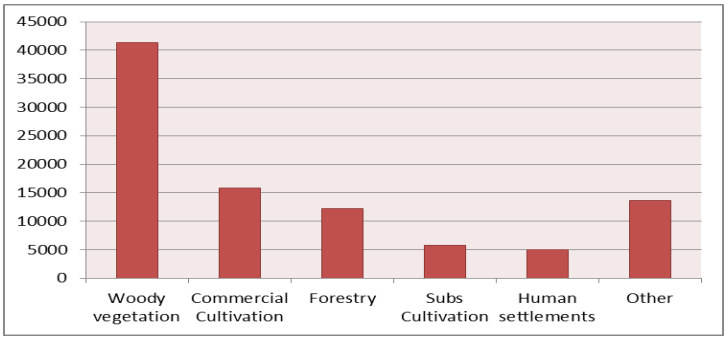
Areas without adequate fencing are unable to control the utilisation of the veld by livestock and communal grazing areas are particularly heavily utilised. Commercial farming areas are however also subject to heavy grazing, particularly when economic conditions push farmers to extract as much as possible from the land (F. Mitchell KZN DARD pers comm).

6.5.4.1 Modification and loss of agricultural land

A key driver of change in the potential of agricultural resources in the ADM is the loss of agricultural land and grasslands in particular to a range of land uses and land covers. Given the importance of grasslands in the agricultural economy of the District, it is important that this loss be closely analysed. Table 29 shows the area of grassland lost to different land cover categories between 1994 and 2014.

Table 29: Area of grassland lost between 1994 and 2014

Driver group	*Area (Ha)*
Woody vegetation	41316.78
Commercial Cultivation	15887.86
Forestry	12172.53
Subs Cultivation	5742.61
Human settlements	4963.65
Other	13612.65
Total	**93696.08**



The loss of grassland to woody vegetation encroachment is dramatically more than to any other land use category. Further analysis of the encroached areas indicates that the vast majority of this area is in fact lost to invasive alien trees, predominantly black (*Acacia mearnsii)* and silver wattle (*Acacia dealbata)*. Alien plants are a significant threat to the productivity of the land given their aggressive encroachment into important grazing areas.

Figure 72: Alien woody plants - *Acacia dealbata* and *A. mearnsii* are invading grasslands and reducing available grazing.

6.5.4.2 Governance

According to numerous stakeholders, the lack of coordination between organs of state with a mandate and/or interest in agriculture results in duplication of efforts and hampers effective agricultural development in the area (INR 2011). A good example of such a disjunction is the apparent differences in approach to strategic planning between the Department of Water and Sanitation and the KZN DARD. According to KZN DARD, DWS requires that project plans be drafted prior to water availability for such projects being assessed, whilst KZN DARD would prefer to base their plans on water availability in the first instance (F. Mitchell KZN DARD Pers. Comm).

The lack of strategic planning and coordinated agricultural management / leadership in communal areas is also a concern to stakeholders who have highlighted the informal allocation of land for housing on land with agricultural potential, and the existence of conflict between cattle owners and crop farmers (INR 2011). This is in many respects related to a lack of fencing and the destruction of crops by livestock.

6.5.4.3 Land restitution process

Land restitution / redistribution is a highly complex issue and it is continually being debated across all levels of government and across the socio-political arena. It is also a highly contentious issue and one with a vast number of stakeholders. In Amajuba District, numerous documents point to this process as being a major stumbling block to agricultural development in the District. In particular, the delays associated with transfer of land, the lack of support for beneficiaries and the uncertainty created amongst existing farmers are all cited as key factors.

The Amajuba District Area-Based Plan (2007) states that demand for agricultural land is tied up in a number of unresolved land claims which have yet to be properly processed and resolved and maintains that once this is completed then the real demand for agricultural land will be clarified.

According to the Dannhauser Local Municipality IDP 2017, Dannhauser Municipality is also characterised by large and complex land tenure reform challenges, which include 24 - Farm dwellers that are established within commercial farms but are no longer providing labour to the farm.

Approximately 70% of agricultural land in the Emadlangeni Municipality is under claim. There are 130 claims on farms in the Newcastle area, totalling 53,000ha. Of this total, 34 claims have been settled, making up 12,700ha. Charlestown, which involves dairy farming, timber plantations, crop production and livestock farming, has been resolved successfully with the community obtaining access to more than 10000ha of good agricultural land (Dannhauser Local Municipality IDP, 2013/2014).

According to Mr Masuku of the Amajuba Livestock Farmers Association (*Pers comm* – interviewed telephonically), the majority of people who reside in the townships, are unemployed and desire to venture into farming are constrained due to the lack of farming land.

Mr Smith of Ingogo Farmers Association (*Pers comm* – interviewed telephonically) argues that land that is available that is often provided by the government is tied up in title deeds that are still in the possession of previous land owners. Land is often given to groups of people who generally do not want to farm and the individuals who do want to farm do not get support from their communities and government. He also expressed his frustration with the land tenure process stating that redistribution of land did not always occur in a manner benefiting those who wished to farm but rather those who were politically connected.

Although the process towards the resolution of the other land claims such as Ingogo is progressing slowly, Mr Smith (*Ibid*) maintains that illegal land claims on farms is one of the main challenges faced by the district where farmers have to refute the claims on their farms. He argues that government often funds the land claims while commercial farmers have to fund their own claims and foot the bill for the legal costs which are generally high. In some cases this has resulted in farmers losing their farms due to high legal costs.

The pressure to expand the existing settlement in order to accommodate future increase of local population should not and must not risk the loss of agricultural land within the commercial farms (Amajuba District Municipality SDF 2017/2018). However some of the common scenarios that have characterized the negative outcomes of a land reform programme are 1) the misuse of agricultural productive land or 2) it's transformation into settlements and 3) the emergence of small isolated settlements in the middle of commercial agricultural land**.** The outcome of the land reform process can therefore have serious spatial implications for the conservation of agricultural resources.

7. GEOTECHNICAL COMPONENTS

7.1 OVERVIEW

The portion of the report is a condensed version of geohydrological investigations, geotechnical assessments and integrated development planning reports for the district. DWAF reports on the Groundwater Resources (1995), Mintek's Assessment of KZN Coal Reserves (2007), ADM's Growth and Development Plan (Vision 2030) as well as the 2017/2018 IDP's for the three local municipalities are acknowledged as the principal sources of information.

5.8.2 Spatial extent of geotechnical features

5.8.1.1 Geology and Lithostratigraphy

The lithologies represented in the study area are described in Table 30 and their distribution portrayed in Figure 73. The latter represents a simplification of the more detailed geological map. The lithologies span a discontinuous geological time period of more than 3000 million years (Ma) subdivided by SACS (1981) as follows: -

- The Phanerozoic Erathem (<570 Ma), incorporating the Karoo Supergroup and younger chronostratigraphic units.
- The Swazian Erathem (>2620 Ma), which forms part of the Archaean, and is represented primarily by as yet unnamed granitic rocks and, to a much lesser degree, by extremely limited and isolated outcrops of the Baberton Sequence (amphibolite and schist).

A detailed lithological description of the rocks associated with each lithological unit is presented in Table 31.

The Quaternary sediments include fossil subsoils. Limited alluvial deposits generally occur along and in the channels of the larger streams and rivers where these traverse more level ground. In some instances, marshy vleis and wetlands have developed locally on the floor of shallow valleys.

The ubiquitous and extensive dolerite sheets found in the study area – see red colouring on Figure 73, represents an important structural element of the geological regime. The greater resistance which these rocks offer to weathering and erosion provides protection for the sedimentary lithologies, into which these rocks have intruded, against these forces. This is strikingly evident in the steep and often precipitous krantzes which characterize the eastern slopes of the Drakensberg and the upper slopes of the Balelesberg.

The Karoo Supergroup is represented almost exclusively by the Ecca and the Beaufort Groups. Of these, the Ecca Group is by far the best represented, in particular by the Vryheid Formation. The sediments of the Beaufort Group, viz, the predominantly sandstone of the **Estcourt Formation** (Adelaide Subgroup) occur at elevations above approximately 1800m amsl and represent the younger lithostratigraphic units of the Karoo Supergroup in the study area.

Table 30: Chronostratigraphic and lithostratigraphic subdivision of relevant rock type

Erathem (Age span in million years)	Period (Age span in million years)	Supergroup or Sequence	Group	Formation (Fm) or Subgroup (SGp)	Lithology
Phanerozoic (present – 570Ma)	Quaternary (present– 18Ma)				Alluvial clay, silt, sand, gravel
					Clay, gravel beds, laterite, silcrete, soil
	Jurassic (141–200 Ma)				Dolerite
	Permian (230–208 Ma)	Karoo Supergroup	Beaufort	Tarkastad (SGp)	Fine- to coarse-grained feldspathic sandstone, subordinate siltstone
				Adelaide (SGp)	Fine- to coarse-grained sandstone, grey shale
			ECCA	Volksrust (Fm)	Bluish-grey or dark-grey mudstone and shale, subordinate siltstone
				Vryheid (Fm)	Sandstone, dark-grey mudstone and shale, coal beds in places
				Pietermartizburg (Fm)	Bluish-black shale
	Carboniferous (280- 345 Ma)			Dwyka Tillite (Fm)	Tillite, diamictite
Swazian (>2870 Ma)	Archaean (Granite)				Medium- to coarse-grained biotite granite, porphyritic biotite granite, coarse-grained hornblende granite
		Baberton Sequence			Amphibolite, talc-carbonate schist, serpentine-bearing schist

Source: SACS, 1980 and published 1:250 000 geological map sheet 2728 Frankfort & 2730 Vryheid

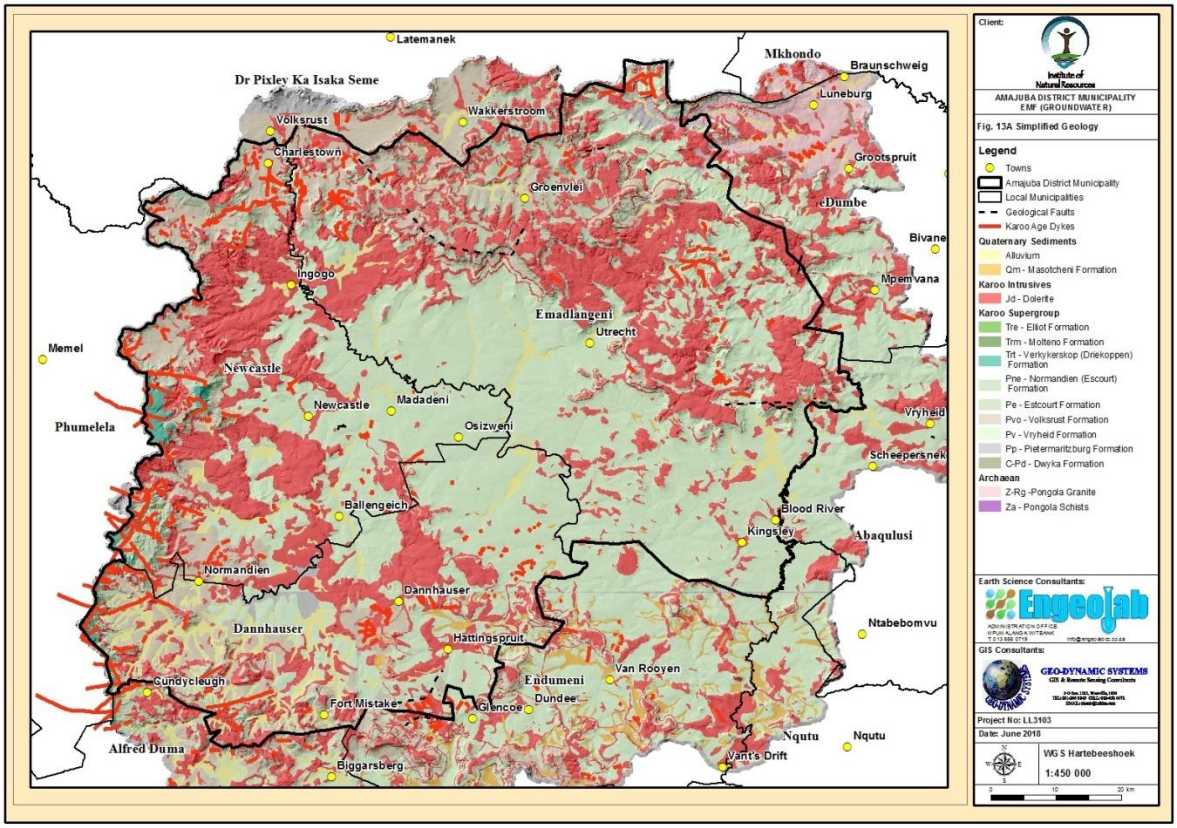


Figure 73: Simplified geology of the ADM

Table 31: Description of lithologies associated with ADM stratigraphy

Stratigraphy	Lithologies
Alluvium	Alluvium
Qm - Masotcheni Formation	Semi - consolidated sand, clay, gravel beds, laterite, silcrete, soil, partly consolidated fine - grained sediments with silcrete nodules, Basal boulder bed, yellow - brown sandy clay
Jd - Dolerite	Dolerite
Tre - Elliot Formation	Maroon, red, purple, green and blue - grey mudstone, fine - to medium - grained yellowish - white and red sandstone, interbedded yellow to grey siltstone
Trm - Molteno Formation	*Course grained glittering sandstone with thin grit beds, green, grey and blue mudstone and shale with occasional coal seams, carbon - rich beds, Course - to fine - grained buff sandston
Trt - Verkykerskop (Driekoppen) Formation	Medium - to fine - grained yellow and grey sandstone, red, purple and blue - green mudstone
Pne - Normandien (Escourt) Formation	Fine - to course - grained sandstone, grey shale (Escourt Fm.), olive - green and grey mudstone, subordinate sandstone (Normandien Fm.)
Pe - Estcourt Formation	Dark blue - grey shale, carbonaceous in places, grey, green and brownish - red mudstone, yellow and grey fine - to coarse - grained sandstone, siltstone, subordinate thin conglomerate
Pvo - Volksrust Formation	Thin sandstone beds, blue - grey to dark - grey shale and mudstone, subordinate siltstone
Pv - Vryheid Formation	Medium - grained buff sandstone, medium - to course - grained feldspathic sandstone, micaceous shale, coal, siltstone, shale and grit with coal and oil - shale beds, dark - grey mudstone and shale
Pp - Pietermaritzburg Formation	Dark - grey shale, siltstone, subordinate sandstone, carbonaceous shale
C-Pd - Dwyka Formation	Tillite, minor shale, varved shale and sandstone
Z-Rg - Pongola Granite	Medium - to course - grained biotite granite, porphyritic biotite granite, course - grained hornblende granite
Za - Pongola Schists	Amphibolite. talc - carbonate schist, serpentine - bearing schist

5.8.1.2 Soil

The soil types and characteristics are primarily determined by the mode of weathering of the underlying rock types – that is, on a macro scale – fertile clayey soils over dolerite and low fertile sandy loam over sandstone (Figure 74).

The association of soil characteristics with weathering of the relevant underlying rock types with estimated percentage of surface area coverage (Unit 11, KZN Groundwater (1995)), is as follows:

- Dolerite – 31,5% : red, deep clayey fertile soil where well drained; black clayey fertile where drainage is restricted
- Shale ~ 32,5%: light-brown deep fertile clayey soil
- Sandstone ~ 32,5%: light grey sandy loam soil of low fertility
- Granite – 3,5%: grey, gritty, moderately fertile

Generally, the soils in the study area vary from sandy loam over the Vryheid Formation to clayey loam on shale or mudstone. Areas underlain by dolerite are characterised by red to brown or black clayey soils. Good arable soils are defined as soils on a slope of less than 12% with a texture of over 15% clay which have a depth of >500mm and includes humic, well drained, alluvial and moderately drained plinthic soil forms (ADM Agricultural Development Plan, 2006). The typical soil problems that are found in ADM area are the following:

- Higher rainfall areas, highly leached soils occur which usually have a high acid saturation;
- Areas underlain by sandstone – on a macro scale that will include most of the area covered by the Vryheid Formation – leaching of nutrients is prevalent due to its low clay content;
- The soils that have a plinthic origin and are shallow, tend to be susceptible to erosion especially if on a slope and water logging if found on the lower mid-slope and foot slope positions.

5.8.1.3 Slope

There are large areas of the District characterized by mountainous terrain and steep slopes. These areas have significant implications for potential land uses. The District's terrain has been classified according to slope in Figure 75.

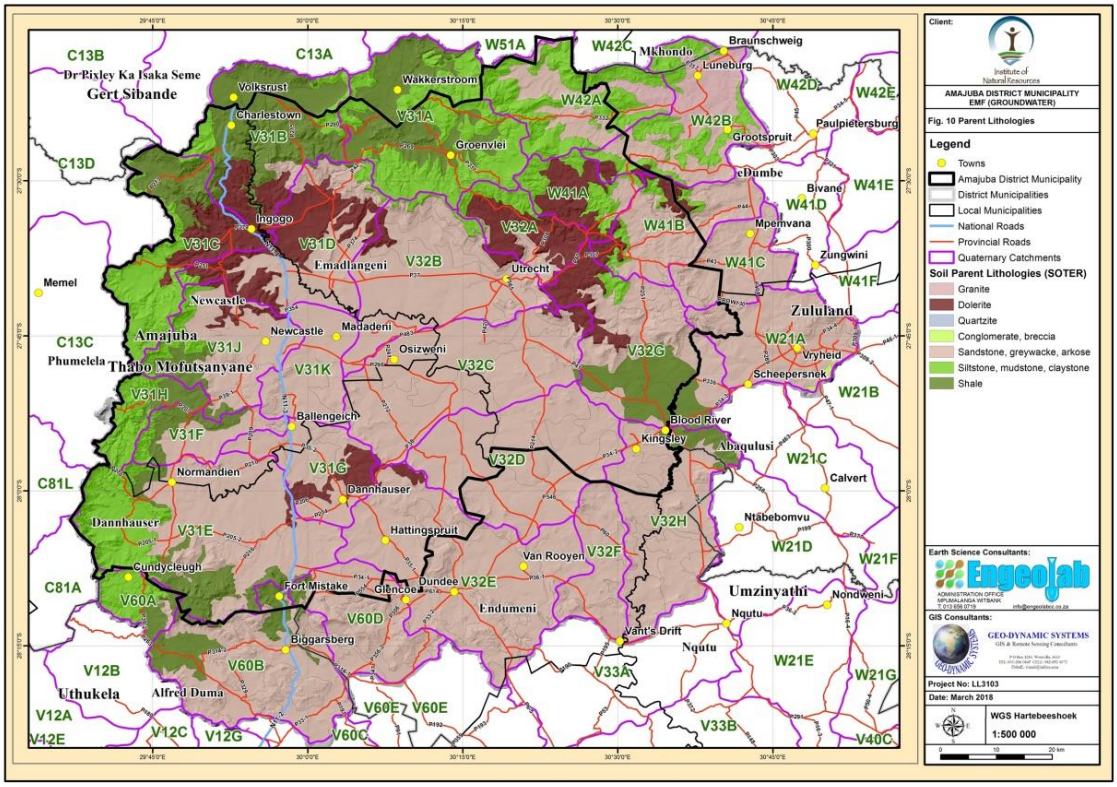


Figure 74: Soil parent lithologies across the ADM

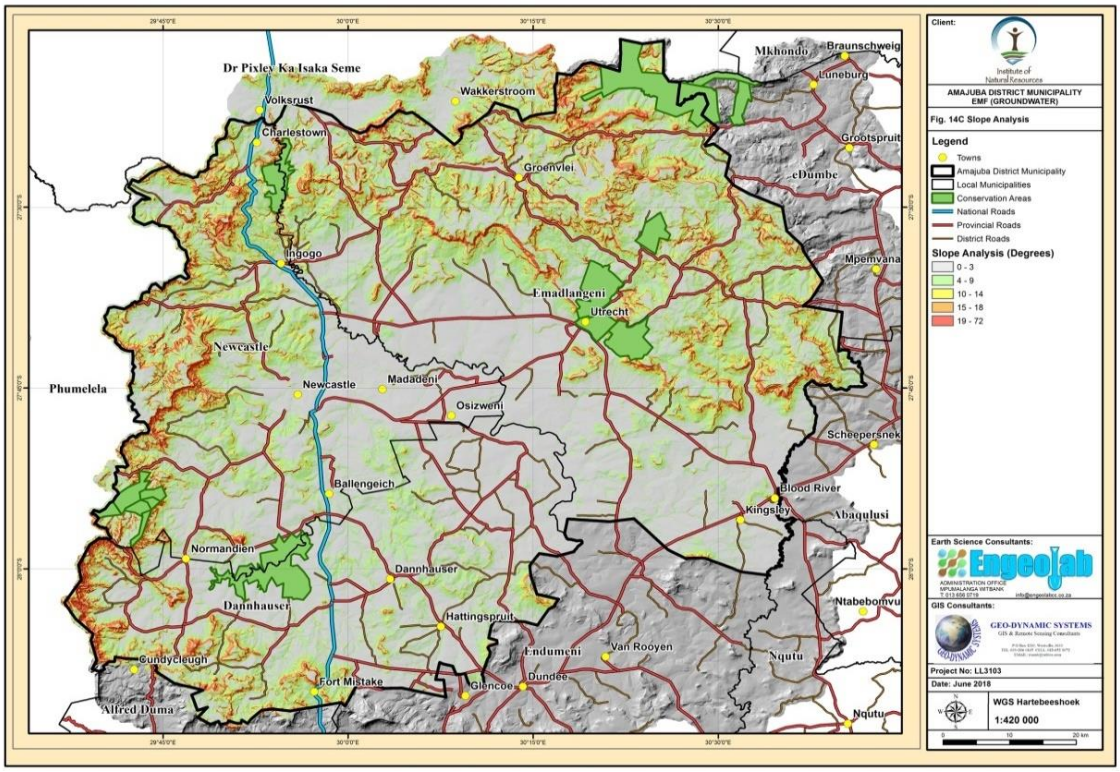


Figure 75: Slope classification for the ADM

7.3 KEY CONSIDERATIONS FOR THE ADM EMF

7.3.1 Geotechnical zoning

The National Home Builders Registration Council's (NHBRC) requirements relating to geotechnical investigations for foundations and structures are used to ultimately produce a land use classification plan. Residential site class designations for single storey residential buildings of masonry construction designed and constructed in accordance with the NHBRC's site class requirements are given in Table 32.

Table 32: Residential site class designations

TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING MATERIAL	EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)	ASSUMED DIFFERENTIAL MOVEMENT (mm)	SITE CLASS
Rocks	Stable	Negligible	-	R
Fine grained soils with moderate to very high plasticity (clays, silts and sand-clay mixes)	Expansive soils	<7.5 8.2– 15 15 – 30 >30	50%	H H1 H2 H3
Silty sands, sands, sandy and gravelly soils	Compressible and potentially collapsible soils	<5 5 – 10 >10	75%	C C1 C2
Fine grained soils sands, sandy and gravelly soils	Compressible soils	<7.5 7.5– 15 >15	50%	S S1 S2
Contaminated soils, Controlled fill, Landfill, landslip, Marshy areas Mine subsidence, Reclaimed areas, Uncontrolled fill, Very soft silts and clays	Variable	Variable	-	P

For the purpose of this desktop study, the simplified geology, slope analyses, drainage courses and mine areas were used as baseline information and five zones were established. In order to delineate areas where geomorphic or geological conditions could impose geotechnical constraints or have serious cost implications on future developments, the study area has been broadly demarcated into the 'least favourable' to the 'most favourable' under the 'Development Constraint Class' (Figure 76). Additional detail regarding the classification is provided in an expanded legend format in Table 33. Note that the land use plan excludes quarries, landfill sites, cemeteries, sanitary sites and borrow pits.

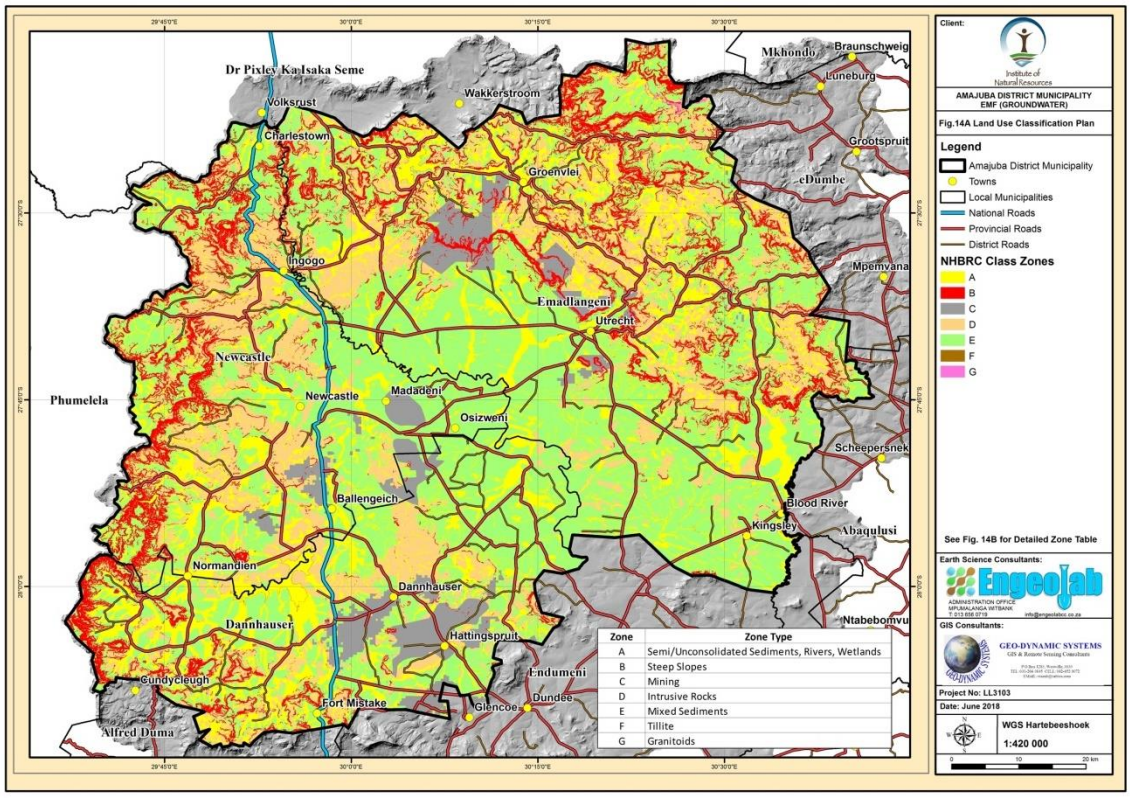


Figure 76: Landscape classification

Table 33: Expanded landscape classification legend

Zone	Legende Code & Type		Simplified Stratigraphy	Lithology	Geotechnical Constraint	NHBRC Site Class	Structural Solution	Development Constraint Class
A	Wetland		-	-	Susceptible to Seasonal Flooding	P	No development or non-standardized development	4
	Water Bodies							
	River Buffers (32m							
	Floodplain	Quaternary	Alluvium	unconsolidated sand clay boulders				
	Scree		Masotsheni	unconsolidated sand clay boulders				
B	Steep Slopes	-	-	-	Susceptible to slope failure	P	No development	
C	Mining	-	-	Mining	Susceptible to Ground collapse	P	No development or non-standardized development	
D	JD	Karoo Intrusives	Dolerite	Boulders, active clays, sugary textured sand, fractured bedrock	Boulder excavation active clay	H^1 H^2 $H^2 + H^3$	Modified normal construction Split construction Stiffened raft, cellular raft, piled construction	1
E	Tre	Karoo Supergroup	Elliot Formation	Shale, mudstone, Sandstone, loose cover soils, clayey residuum, Tillite	Outcrops, hard excavation,	R, C, H, S	Strip footing and slab-on-the-ground	
	Trm		Molteno Formation					
	Trt		Verkykerskop Formation		clayey residuum,	$H^1 - H^3$	see above H^1, H^2, H^3	
	Pne		Normandien Formation					
	Pe		Estcourt Formation		loose cover soils	C^1 & S^1	Modified normal	
	Pvo		Volksrust Formation			C^2 & S^2	Stiffened raft footings; stiffened	
	Pv		Vryheid Formation			C^3 & C^3	Cellular raft	
	Pp		Pietermartizburg Formation					
F	CPd		Dwyka Formation	Tillite, Minor Shale	Boulder excavation	H^1-H^3	see above H^1, H^2, H^3	
G	Ƶ - Rg	Archaean Rocks	Pongola Granite	Biotite granite	Boulder excavation collapsible soils	S^1	Modified normal construction	
						S^2	Stiffened raft footings, stiffened raft, piled found data, pre-compaction	

Where:
- R = Rock
- H_1H^1 - H^3 = Expansive Soils
- C^1-C^2 = compressible and potentially collapsible soils
- S, S^1-S^2 = Compressible soils
- P = marshy areas, areas susceptible to flooding, open cast mine, Steep Slopes

Note:
- NHBRC Site Classes to be verified on Site.
- Development Constraints Class: 1 - Least Constrained/Most Favourable; 4 - Highest Constraints/Least Favourable

8. AIR QUALITY

8.1 OVERVIEW

The existing air quality in the ADM area is affected by the presence of the industrial activities within the ADM industrial zone (criteria pollutants and nuisance dust), waste facilities (dust), off-site agriculture (dust, herbicides and pesticides) and transport routes (criteria pollutants and dust where unpaved).

Topographical features as well as meteorological factors play a role in the distribution of pollutants in the local area. The air mass from upslope moves downslope under katabatic flow on winter nights to fill the valley floor with cold, dense air creating an inversion that does not allow for the escape of pollutants. The air mass moving downslope (like water) will carry with it all the pollutants it contains and gathers en route to accumulate and concentrate in the lower lying areas under the inversion layer. These lower lying areas include commercial, residential and industrial land uses.

8.1.1 Historical data

Smoke and sulphur dioxide concentration trends were taken from the Air Quality Specialist section of the KwaZulu-Natal State of the Environment Report 2004 (amended and published 2010); however, the available historical data from the old National Survey of Smoke and Sulphur Dioxide only extends until 1997 (See Section 4.4).

The Newcastle continuous air quality monitoring station located at the entrance to Amcor Caravan Park in the neighbouring open field was built in direct line of sight of industries, and commissioned in 2006. Whilst it recorded data from mid-2006, 2007 and 2008, the station experienced some technical problems with all monitoring instruments as well and with the air conditioners which maintain a cool operating temperature inside the monitoring station. No data was recorded in 2009 and for much of 2010. The continuous monitoring instruments were sent for calibration and repairs during the down time. Subsequently, the station continued monitoring from June 2010. This single station data was previously reported in the 2011 Newcastle EMF AQ Specialist Study, but there have been many gaps in the data since, so passive sampling conducted by the Provincial Dept. (EDTEA) is considered to be more representative of recent compliance and has a far better spatial coverage for the current study area that has been extended to the entire Amajuba District (three Local Authorities).

8.1.1.1Historical smoke & sulphur dioxide concentrations

Historical smoke and sulphur dioxide concentration trends were taken from the Air Quality Specialist section of the KwaZulu-Natal State of the Environment Report 2004 (published 2010). The available data only extends until 1997.

Figure 77 shows a steady increase of smoke concentration from 1993 to 1996. The annual average guideline value suggested by the Department of Environmental Affairs was 100 micrograms per cubic meter (µg/m3), which equates to a Soiling Index of approximately 20 S/m3. The Soiling Index figures between 1987 and 1996 for the city of Newcastle did not exceed the recommended guideline of the day, but standards have become much more stringent with regulations under NEMAQA.

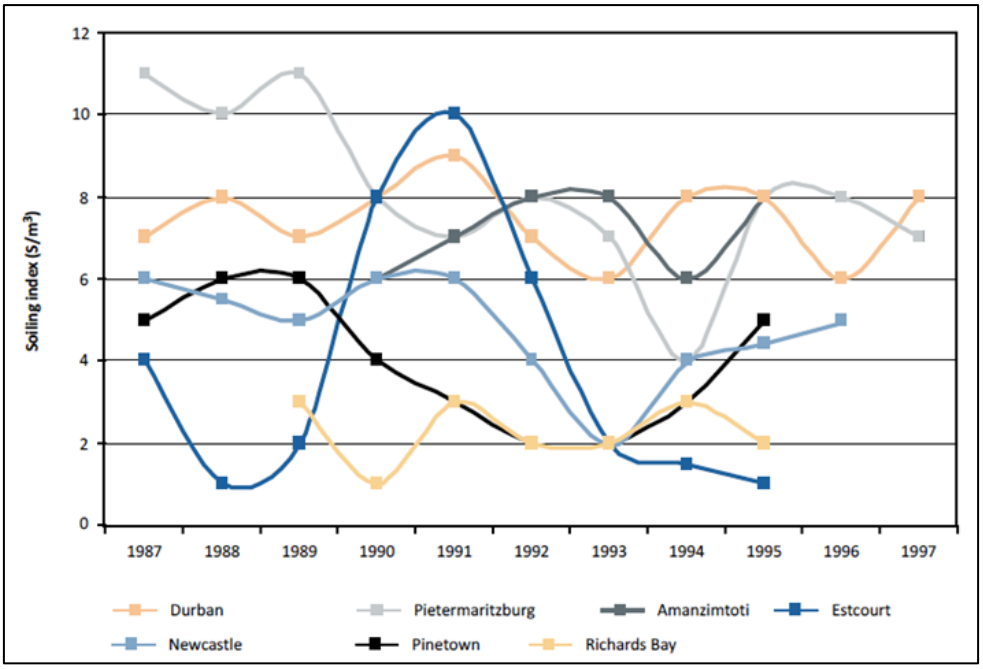


Figure 77: Comparison of smoke concentration for towns and cities in KwaZulu-Natal between 1987 and 1997. Some interpolation of missing data points was required to show trends (data collated from CSIR).

Figure 78 displays a notable increase in sulphur dioxide concentrations in 1994. This is most likely due to an increase in industrial activities in the Newcastle area. The annual average standard value for sulphur dioxide as promulgated by NEMAQA (Act No. 39 of 2004) is 50 micrograms per cubic meter (µg/m3). Annual average sulphur dioxide concentrations did not exceed the NEMAQA annual average between 1987 and 1997 and are believed to have reduced since the 1990s owing to various government interventions; most notably the declaration of Listed Activities and associated Minimum Emissions Standards since promulgation of the Air Quality Act. The most recent passive sampling campaign data presented below (Section 4.6.1, courtesy of EDTEA) confirms that sulphur dioxide concentrations are now greatly reduced through improved industrial controls.

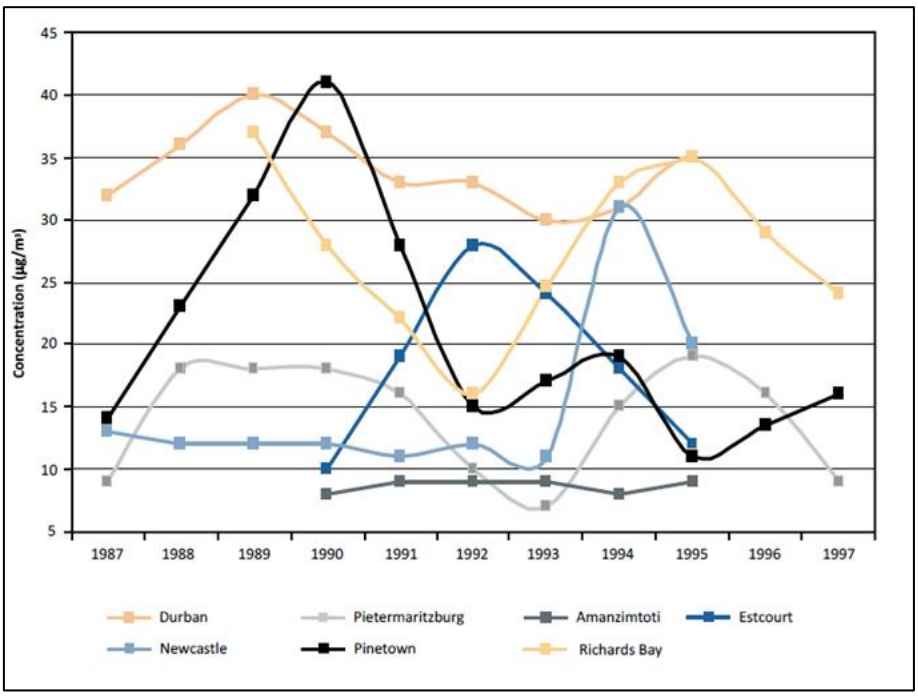


Figure 78: Comparison of sulphur dioxide concentration for towns and cities in KwaZulu-Natal between 1987 and 1997. Some interpolation of missing data points was required to show trends (data collated from CSIR).

8.2 AIR QUALITY SPATIAL EXTENT

8.2.1 Recent dust fallout monitoring

The Provincial Department of Economic Development, Tourism and Environmental Affairs (EDTEA) sampled and reported monthly dust fallout rates between February 2017 and January 2018 at twelve (12) sites across the Amajuba District Municipality. These sampling sites are mapped across the entire Amajuba District in Figure 1 and shown at a larger Local Authority scale in Figures Figure 79, Figure 80 and Figure 81(below).

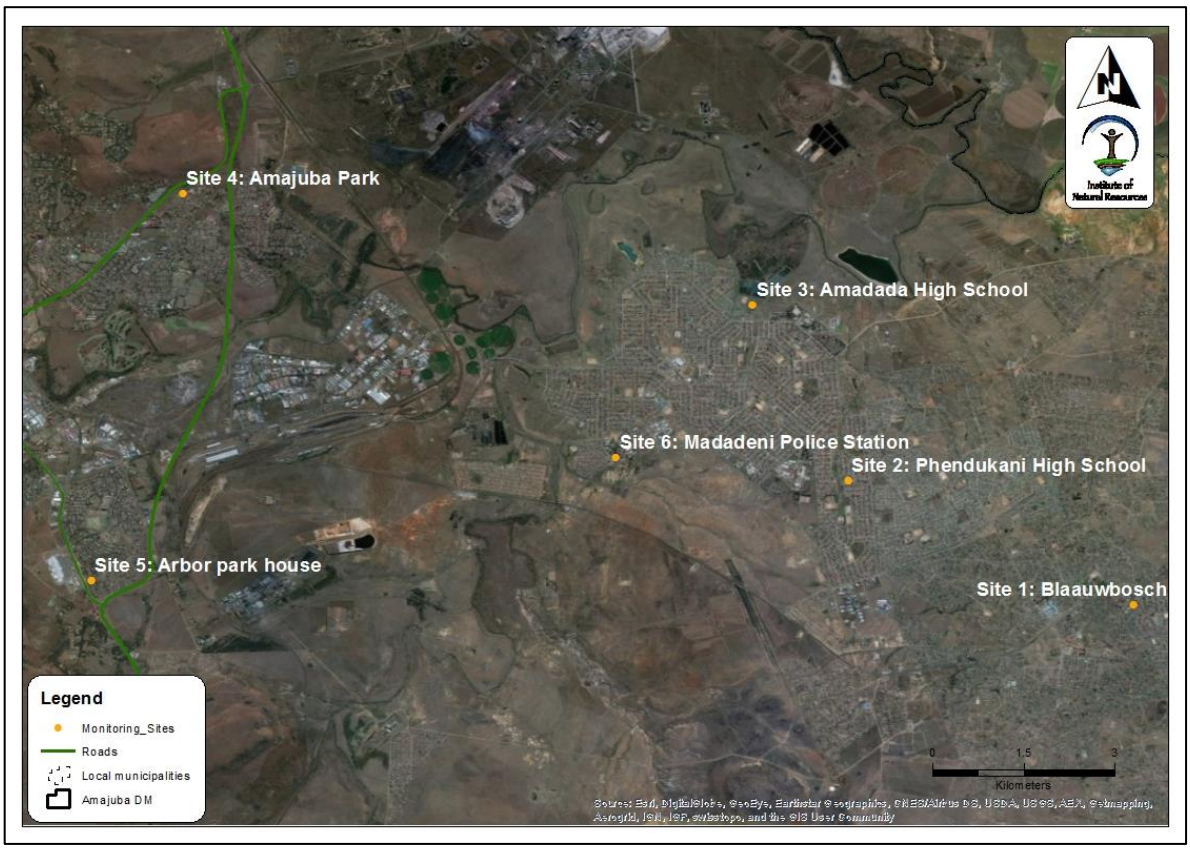


Figure 79: Location of ambient air quality monitoring (dust fallout) sites in the Newcastle District Municipality.

Figure 80: Location of ambient air quality monitoring (dust fallout) sites in the Dannhauser District Municipality.

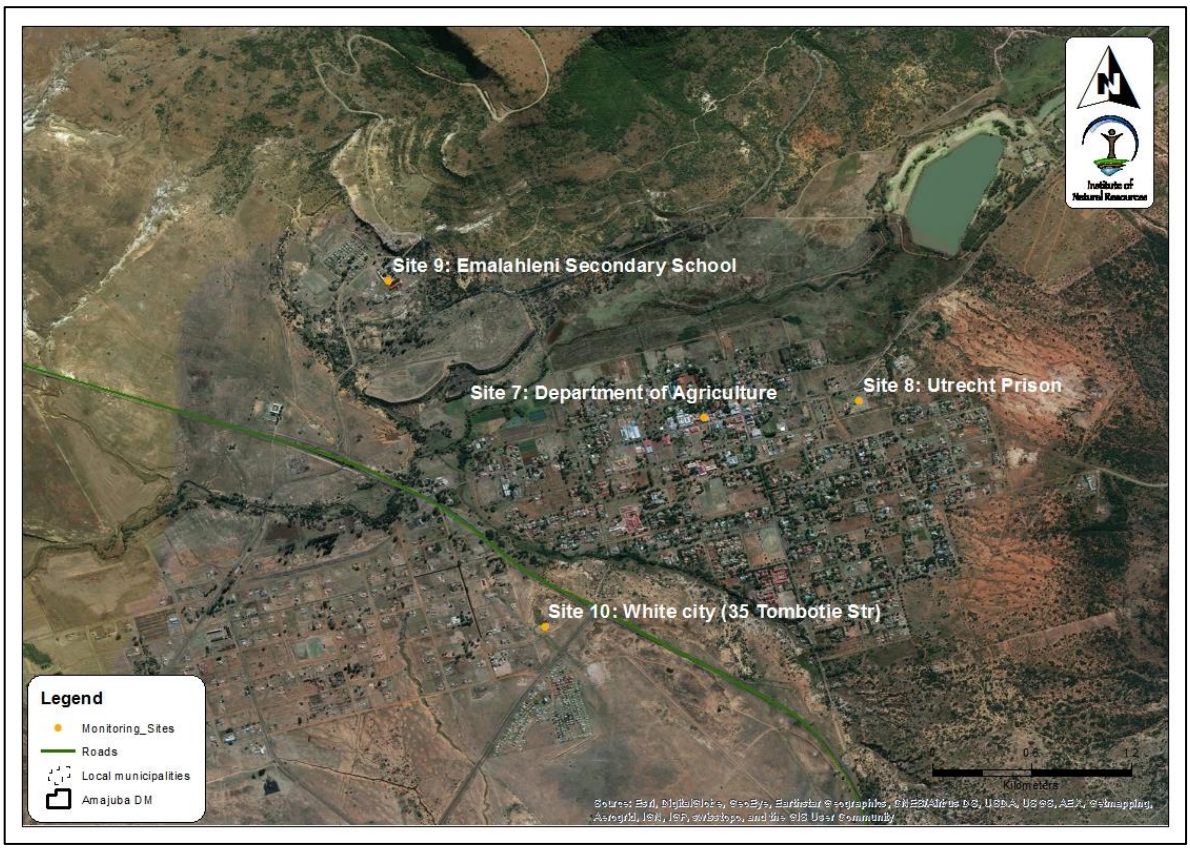


Figure 81: Location of ambient air quality monitoring (DFO) sites in the Emadlangeni District Municipality.

The maximum dust fallout rates recorded for each month are presented in Table 34. The only month in which dust fallout was not compliant with the regulations (Residential limit: 600 mg/m2/day) was in October 2017.

Table 34: Monthly dust fallout rates for the Amajuba District Municipality (source: EDTEA Annual Air Quality Report – March 2018).

Month of 2017	Site Number	Classification as per NDCR	Maximum Monthly Means	Compliance
February	Site 2: Phendukani High School	Residential	242	Yes
March	Site 3: Amadada High School	Residential	166	Yes
April	Site 4: Amajuba Park	Residential	214	Yes
May	Site 2: Phendukani High School	Residential	276	Yes
June	Site 8: Utrecht Prison	Residential	268	Yes
July	Site 3: Amadada High School	Residential	315	Yes
August	Site 11: Church Street and Link Street	Residential	329	Yes
September	Site 2: Phendukani High School	Residential	489	Yes
October	Site 2: Phendukani High School	Residential	729	**No**
November	Site 5: Arbor Park House	Residential	395	Yes
December	Site 1: Blaauwbosch	Residential	244	Yes

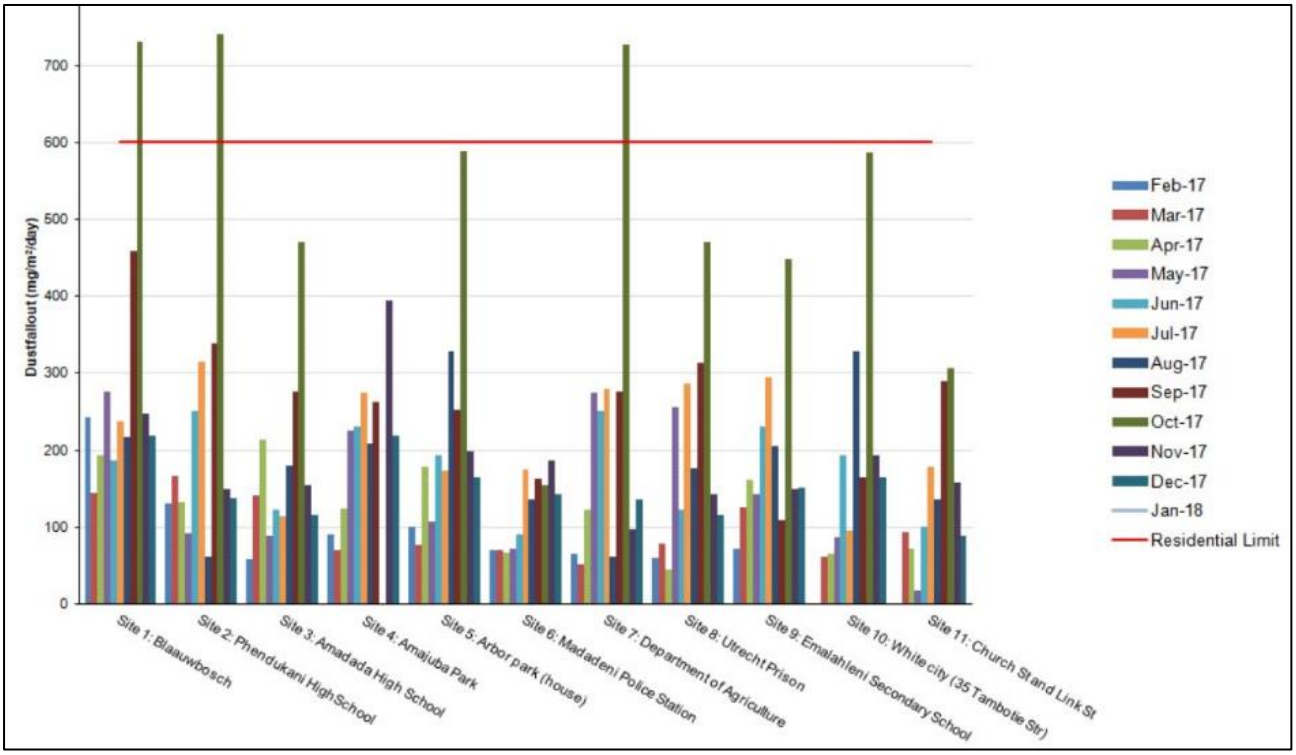


Figure 82: Monthly comparison of dust fallout per site in the Amajuba District Municipality (source: EDTEA Annual Air Quality Report – March 2018).

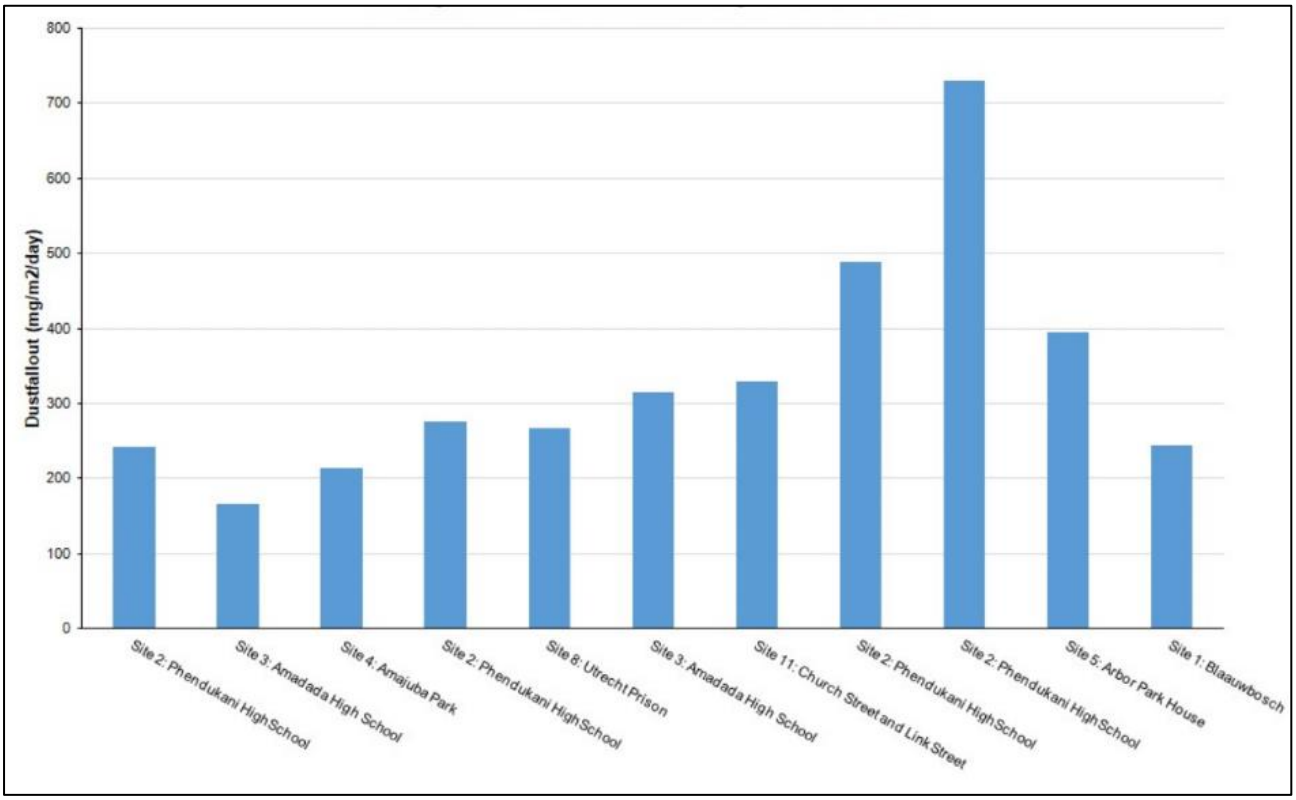


Figure 83: Comparison of highest dust fallout site for each month in the ADM (source: EDTEA Annual Air Quality Report – March 2018).

EDTEA noted three exceedances of the Residential limit (Residential limit: 600 mg/m2/day) at the Amajuba District Municipality between February 2017 and January 2018. The exceedances were observed in October 2017. In fact, the highest dust fallout for each site was highest in October 2017. This may be attributed to the dry and windy October month experienced in the Amajuba District Municipality, which may have been further exacerbated by local sources such as vehicular traffic over unpaved roads.

Whilst dust fallout is a useful screening tool for spatial distribution of particulate pollution, it is considered only as a nuisance factor, since no clearly defined health effects have been established for this coarse particulate fraction. There is little to observe in the way of spatial distribution across the sites as plotted. Temporally, dust does tend to peak in the late winter through to spring (before the onset summer rains) as the ground dries out, vegetation dies off and winds pickup in spring, enabling wind-blown entrainment from fallow agricultural lands, unpaved roads and exposed stockpiles at mines.

Overall, the finding of comfortable compliance (on average) with the Residential guideline throughout all sites and all months, with the exception of three sites during October 2017 only, suggests that dust nuisance is not a major issue across the Amajuba District Municipality. Sources of dust are quite varied, not being exclusive to either industrial or mining activities. However, mechanical entrainment from vehicles on unpaved roads is typically a major source of dust nuisance; which ties in with finings for other pollutants as described below.

8.2.2 Recent passive sampling

Passive samplers were also deployed at selected sites by EDTEA from February 2017 to January 2018 to measure sulphur dioxide (SO2), nitrogen dioxide (NO2), and the BTEX parameters (benzene, toluene, ethylbenzene and xylene). In addition, some measurements were conducted for hydrogen sulphide (H2S) concentrations.

8.2.2.1 Sulphur Dioxide and Nitrogen Dioxide

The measured annual mean sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) concentrations measured in the Amajuba District Municipality are presented in Table 35. The highest annual mean SO_2 concentration (5.3 µg/m3) was measured at Site 11 and the highest annual mean NO_2 concentration (12.7 µg/m3) was measured at Site 12, surprisingly both in Dannhauser (Table 35). It is important to note that all SO2 and NO2 concentrations are well-below the National Ambient Air Quality Standards (NAAQS) of 50 µg/m3 and 40 µg/m3 for SO2 and NO2 respectively and are thus comfortably compliant.

Since the SO2 ambient measurements are low and well-below NAAQS across the District, whilst NO2 concentrations remains compliant but are relatively high compared with SO2 and when expressed as a percentage of the NAAQS for NO2, these results suggest that road traffic rather than industry is the main contributor of gaseous air pollution of the Amajuba District Municipality. The ratio of SO2 to NO2 is typically a good indicator of industrial versus vehicular pollution, since industries produce both SO2 and NO2, whilst road traffic produces

much more NO2 than SO2. Nitrogen oxides are product of any combustion, but only nominal amounts of sulphur are released with regulated low sulphur diesel-fuelled vehicles. Meanwhile, petrol-fuelled vehicles emit largely NO2 and VOCs in measurable quantities, as petrol contains negligible sulphur.

Thus, the signature of relatively high NO2 with much lower SO2 across the entire District, regardless of the proximity to industry suggests that industrial air quality impacts are quite localised or well dispersed by ground-level and not significant in the context of widespread vehicular pollution along arterial routes and throughout even small urban areas such as Dannhauser. This finding will be explored further in the GIS analysis which follows.

Table 35: Amajuba District Municipality annual SO2 and NO2 concentration means (µg/m3) (source: EDTEA Annual Air Quality Report – March 2018)

Site name	SO_2	NO_2
Site 3: Amadada High School	0,8	9,5
Site 6: Madadeni Police Station	3,9	8,8
Site 8: Utrecht Prison	0,3	8,4
Site 9: Emalahleni Secondary School	1,3	4,2
Site 11: Church St and Link St	5,3	11,0
Site 12: Shri Avenue	1,0	12,7

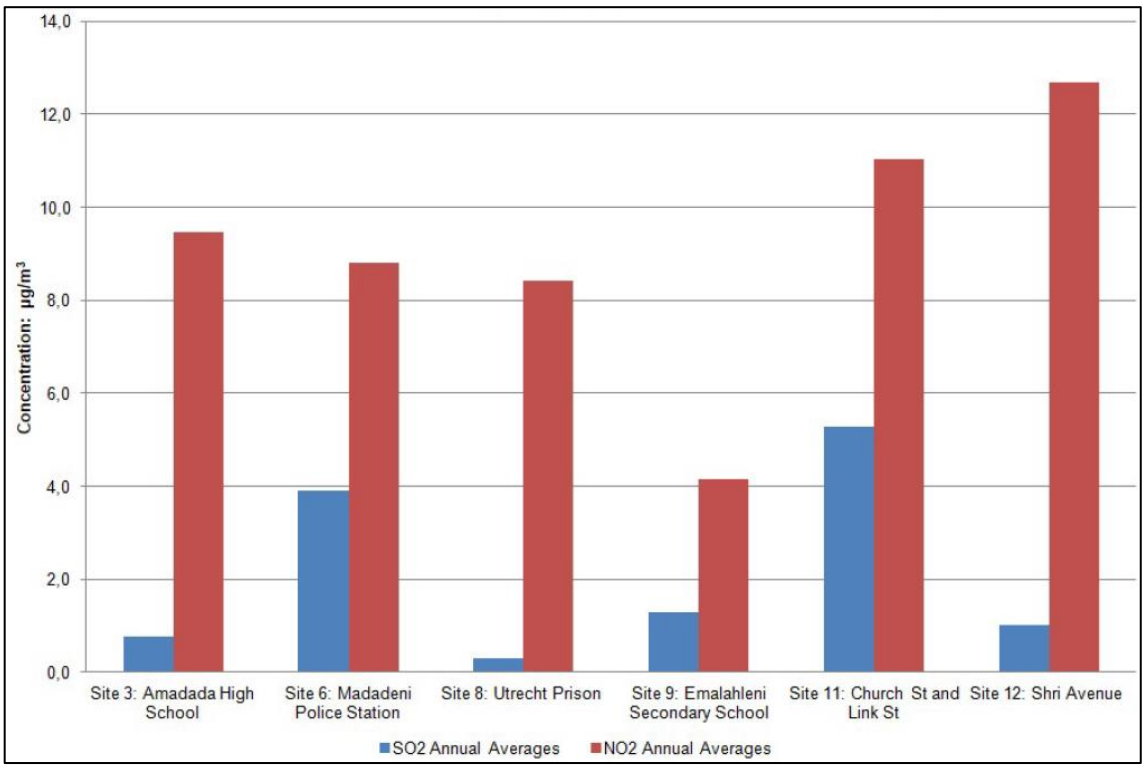


Figure 84: Annual mean concentrations of SO2 vs NO2 in the Amajuba District Municipality (source: EDTEA Annual Air Quality Report – March 2018).

8.2.2.2 Benzene, Toluene, Ethylbenzene and Xylene (BTEX)

The BTEX suite of hydrocarbons was measured at four (4) sites and the resulting measurements are presented in Table 15. Benzene is the only parameter in the BTEX suite currently regulated in the South African NAAQS. The NAAQS for annual concentrations of benzene (5 µg/m3) which was not exceeded during the duration of this study. The maximum benzene concentration of 2.5 µg/m3 and was measured at Site 4 and Site 1 (Table 36).

Whilst other BTEX gases are not regulated in South Africa, toluene typically showed the highest concentrations within the BTEX suite. The highest overall BTEX concentrations were measured in Blaauwbosch. This may be attributed to the fact that BTEX samplers measure emissions that are within close range of the emission source. If these samplers are in close vicinity of the road, their measurements will be higher than under normal conditions. Thus, the measured emissions depend on the micro-siting of the BTEX samplers.

VOCs quickly react in the presence of sunlight and moisture, so highest levels are typically measured where samplers are in close proximity to a source; e.g. kerbside monitoring locations or fencelines of a tanks farms or refineries. Since neither Amajuba Park nor Blaauwbosch are close to refineries or tank farms, road traffic emissions are again suspected as the major source of volatiles.

Table 36: Amajuba District Municipality annual BTEX concentration means (µg/m3) (source: EDTEA Annual Air Quality Report – March 2018)

Site Name	Benzene	Toluene	Ethyl benzene	Xylene
Site 3: Amadada High School	1,6	3,1	2,3	3,0
Site 4: Amajuba Park	2,5	3,7	3,1	3,7
Site 6: Madadeni Police Station	2,0	3,4	2,7	3,4
Site 1: Blaauwbosch	2,5	7,5	1,2	5,5

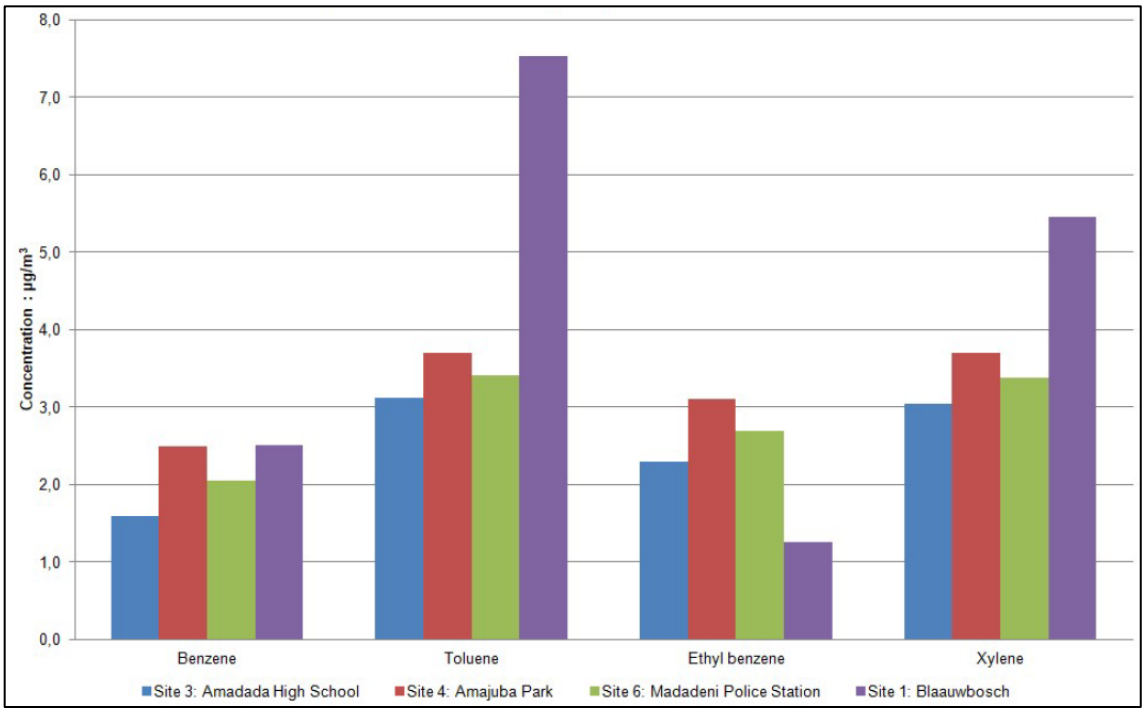


Figure 85: Annual mean concentrations of BTEX parameters in the Amajuba District Municipality (source: EDTEA Annual Air Quality Report – March 2018).

8.2.2.3 Hydrogen Sulphide

Hydrogen sulphide concentrations were also measured at four (4) sites, but are only assessed briefly in this report since there are no South African health-based standards for H2S. When compared with the WHO standard of 5 ppb over a 30-minute period, there were no apparent exceedances although it is observed that concentrations of this malodorous gas peak in late winter and early spring, and were highest in the Newcastle area. This pollutant is typically a results of specific industrial processes and or effluent treatment plants (both domestic or industrial).

8.2.3 Spatial Representation

In order to maximise the strategic value of available data and to offer a spatial planning tool that can be integrated with other environmental aspects of the Environmental Management Framework to develop areas of impact (sensitivity) with respect to the air quality component, some basic dispersion modelling (SCREEN3) and GIS techniques (ArcGIS) have been employed. Since any modelling logic relies on assumptions to simplify reality, the preliminary assumptions upon which the following spatial modelling has been conducted are listed below.

1. Proximity to source is the key determinant of air pollution concentration from industrial sources, and can be conservatively modelled using the US EPA SCREEN3 model;
2. In the absence of a comprehensive emissions inventory, strategic dispersion modelling for this level of study is still possible using a theoretical large stack based on cumulative emissions from a representative industry.
3. Road traffic emissions travel less distance from source than industrial emissions, but are also less diluted at ground level and remain close to multiple points of emission that can be simulated by road buffers.
4. Whilst traffic counts are not available for every road in the district, it can be assumed that the higher volumes of traffic on arterial routes are offset by the lower speeds and higher congestion of traffic on lower grade roads.
5. Overlaying areas of high industrial air quality impacts with areas of high road traffic air quality impacts for gases that are commonly emitted by both (indicator species) will yield a useful analysis of cumulative risk zones.
6. Cumulative risk zones, the highest category of which are peak impact zones, can be overlaid onto demographic data to ascertain the likely numbers of sensitive receptors (population) that may potentially be affected by air quality issues; such findings will offer environmentally conservative planning guidance for framework purposes.

8.2.3.1 SCREEN Dispersion Modelling

Since the response rate from Listed Activities was limited to 33% at time of writing, and the NAEIS data was not made available (being 'closed' for analysis by National DEA at present), data were extracted from a complete stack test report on several stacks belonging to one industry located in the key Newcastle industrial area. The emission rates for a common pollutant (NOX) were summed and modelled through a single large stack source, based on the largest stack in this industrial cluster. The model output was graphed (Figure 86) to depict ground-level plume concentrations in a downwind direction under a neutral (mid-range) stability class. This produced the classic Gaussian plume centreline output showing that impacts from this type and scale of stack peak within approximately 1 km and then

dilute and decay to nominal concentrations within 10 km along the curve as depicted in Figure 86. It is acknowledged that this curve will vary under different stability conditions and with different physical stack characteristics, but it is considered reasonably representative of the larger industrial emissions in this area for strategic guidance.

It should be noted that whilst concentrations may be higher or lower for different pollutants for different industries, the results of any SCREEN model are inherently conservative, being hourly downwind plume centreline concentrations. It is proposed that this environmentally conservative approach will at least offset the non-cumulative nature of such models, since winds do not always blow emissions towards one direction (or receptor); i.e. more advanced Tier 2 and 3 models will always show lower concentrations at a given receptor point than predicted by a Tier 1 model (i.e. SCREEN3).

Finally in this spatial modelling approach (which is not intended as an AQIA), it is important to note that the actual concentration is not critical for strategic level modelling. The downwind dilution from high to low impacts across an 10 km unidirectional modelling domain is sufficient for non-regulatory planning guidance using spatial relationships - a strategic level for impact classification (high → moderate → low at 2 km intervals is all that need be taken from the dispersion curve).

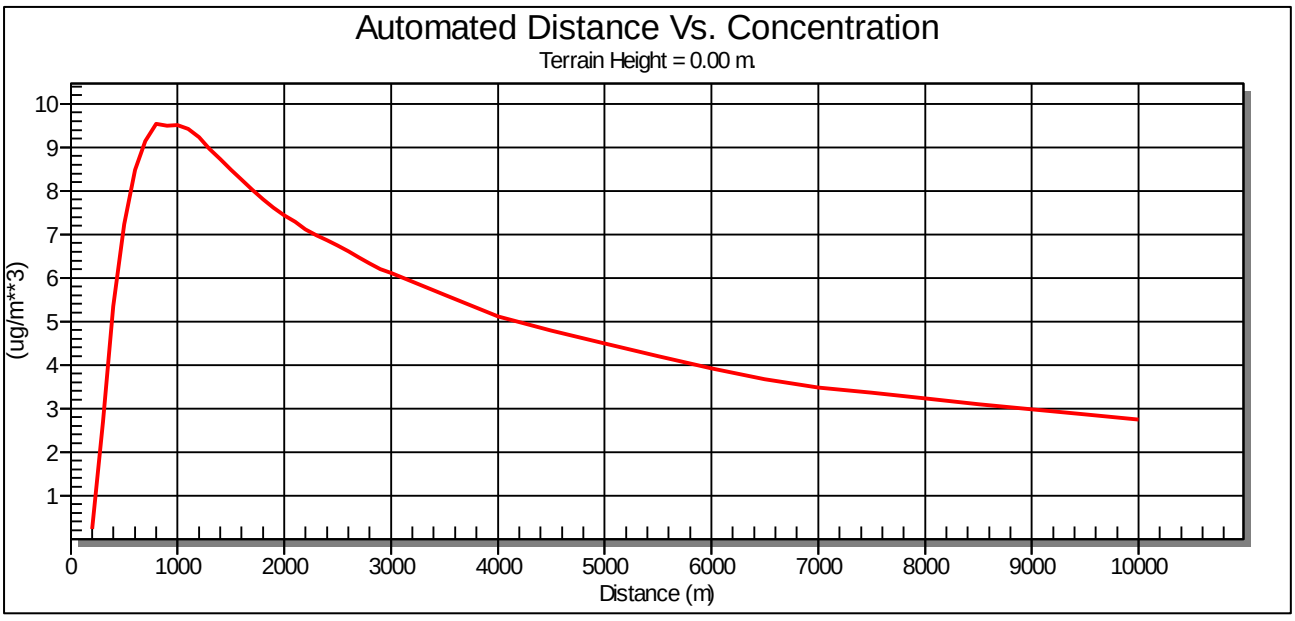


Figure 86: SCREEN3 dispersion model output for large 'representative stack', extracted from actual emissions data as worst-case impact scenario for a Listed Activity in Newcastle.

8.2.3.2 GIS Spatial Modelling

Once the typical dispersion pattern is established, the GIS base layers are considered towards basic spatial modelling of air quality impacts. First, to build confidence in the model approach, the ambient air quality monitoring sites are depicted on a District map (Figure 87). This includes a classification of the pollutants measured at each site; giving Type 1, 2 and 3

monitoring stations. In addition, locations of the largest industries and the arterial roads are depicted since another assumption of this model is that industries and road traffic are the major contributors to the indicator species (NOX7 in this study).

It is important to note that only a few of the EDTEA monitoring sites measured 'All Parameters' (i.e. dust fallout, NO2, SO2 and BTEX). These sites were logically located in Madadeni to the east of the Newcastle industrial areas, which would tend to receive industrial emissions under the worst dispersion conditions. It is however, noted that no annual exceedances of the NAAQS for any gaseous pollutants were recorded as reported earlier in this report.

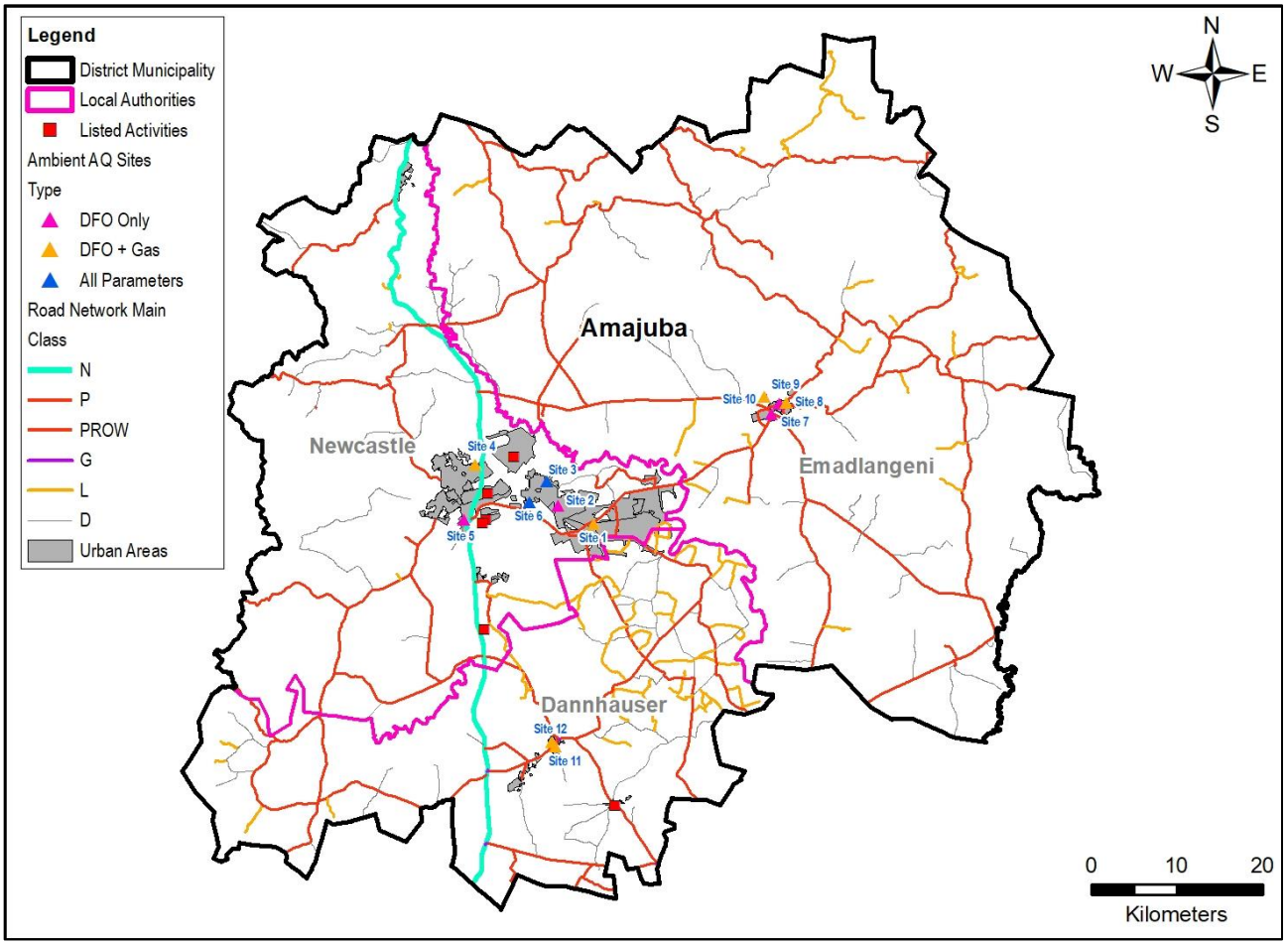


Figure 87: Map of Amajuba District Municipality base layers including classified monitoring sites, large industrial sites, main road network and urban areas.

The next map to be developed in ArcGIS is that of 'typical' industrial impact zones based on 2 km buffering over a range of 0 to 10 km from the coordinates of five large (possibly the largest) Listed Activities, all subject to Atmospheric Emission Licenses. The representative plume depicts buffered zones of high to low impact in five classes based on the SCREEN3

[7] NO_X is produced by all forms of combustion, making it a useful comparative pollutant. It is assumed to convert entirely to NO_2 for the purposes of this model.

model (Figure 88). The exact concentrations and plume shapes would need to be established in Tier 3 cumulative dispersion model, which is beyond the scope of work required or afforded by an EMF overview, constrained by current data availability and limited budget. However, the concentric buffered circle technique shown in Figure 16 offers a useful estimation of 'impact class', if not the exact quantum (although SCREEN3 models used with GIS can be remarkably accurate).

It is immediately clear from Figure 16 that the probable area of impact from major industrial emissions in Amajuba is relatively small and spatially limited to the eastern portion of Newcastle and part of Dannhauser, compared with the overall extent of the Amajuba District Municipality. The total area covered by all classes of industrial impact equates to 1038 km2, which is only 15% of the total area of Amajuba at 6912 km2. Whilst it can be argued that there are ten more industries not captured in this model owing to poor response, most of these do fall into the existing buffered impact areas, these being by far the largest industrial nodes in Amajuba.

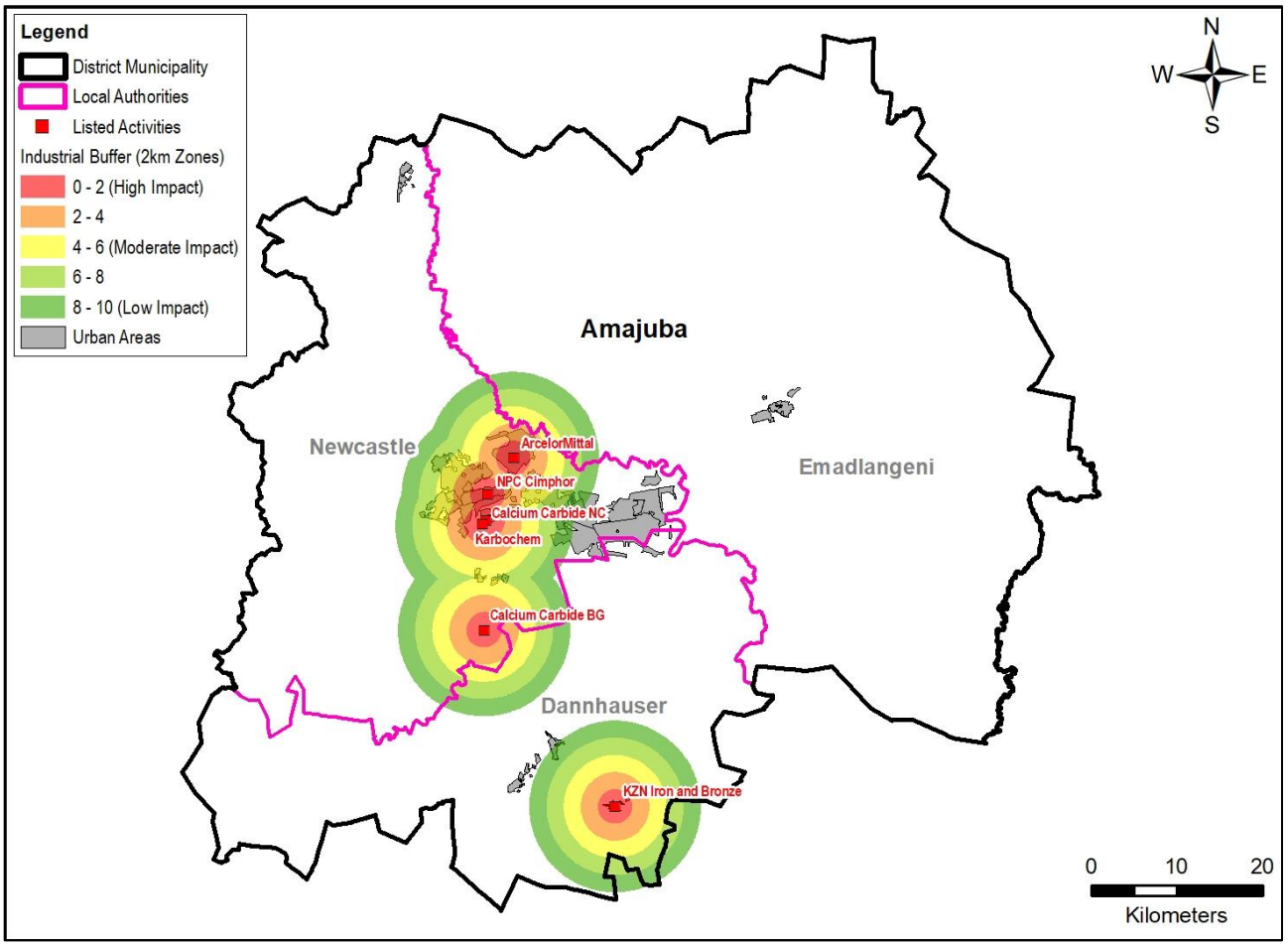


Figure 88: Map of Amajuba District Municipality industrial pollution impact zones developed using 2 km radius concentric buffers based on representative SCREEN3 model.

If it is assumed that agriculture, quarries and mines produce largely particulate pollution (also in the dust fraction rather than fine particulate matter and gases), then the next logical

contribution to gaseous air pollution must be road traffic. It is argued by the World Health Organisation that road traffic combustion emissions may now be contributing up to 50% of air pollution globally and up to 75% of gaseous pollution in urban environments. As such, the road network base layer was buffered uniformly by 200 m to represent kerbside air pollution; again, the exact quantum is not critical to this model, but just the fact that air quality impacts will be experienced along all linear routes in the District can be modelled for strategic assessment.

The impact of high density of road networks across the District is commonly underestimated. When this is buffered to a relatively narrow margin on either side, the impact zone covers a vast portion of the District. Not only are vehicle emissions ubiquitous, but they are emitted at low-level where dispersion is poor and they occur within commercial and residential areas where their impact on sensitive receptors is insidious, immediate and semi-constant.

Kerbside measurement stations have to be specially classified in urban ambient air quality monitoring networks and almost always yield the highest concentrations of NOX and VOCs (BTEX). The area covered by this buffered road network calculates to 3755 km2, which constitutes 54% of the total area of Amajuba District at 6912 km2. Hence, the coverage of industrial impacts is only 28% that of road impacts on fairly conservative environmental assumptions that industries at 10km are impacting the same as roads at 200 m; i.e. the actual impacts of industrial emissions at 10 km will vary, but may also be much lower than those from roads at 200m.

8.3 SOCIAL IMPORTANCE

To better understand the social impact of these air pollution ‘hot spots’ that have now been identified, a larger scale map was created (Figure 18) in which the peak impact zones are overlaid on demographic data. It is interesting to note that whilst the hot spots are in urban areas, they are largely confined to lowly populated industrial zones (white or yellow coloured cadastre) with lower grades of air quality impact extending over residential areas (with higher population marked in orange and red). This is perhaps a result of reasonable land use planning, as industrial zones in Newcastle are quite well separated from residential areas; somewhat more so than in other urban areas of KZN where industrial and residential zones share common boundaries and hence air pollution issues are more acute.

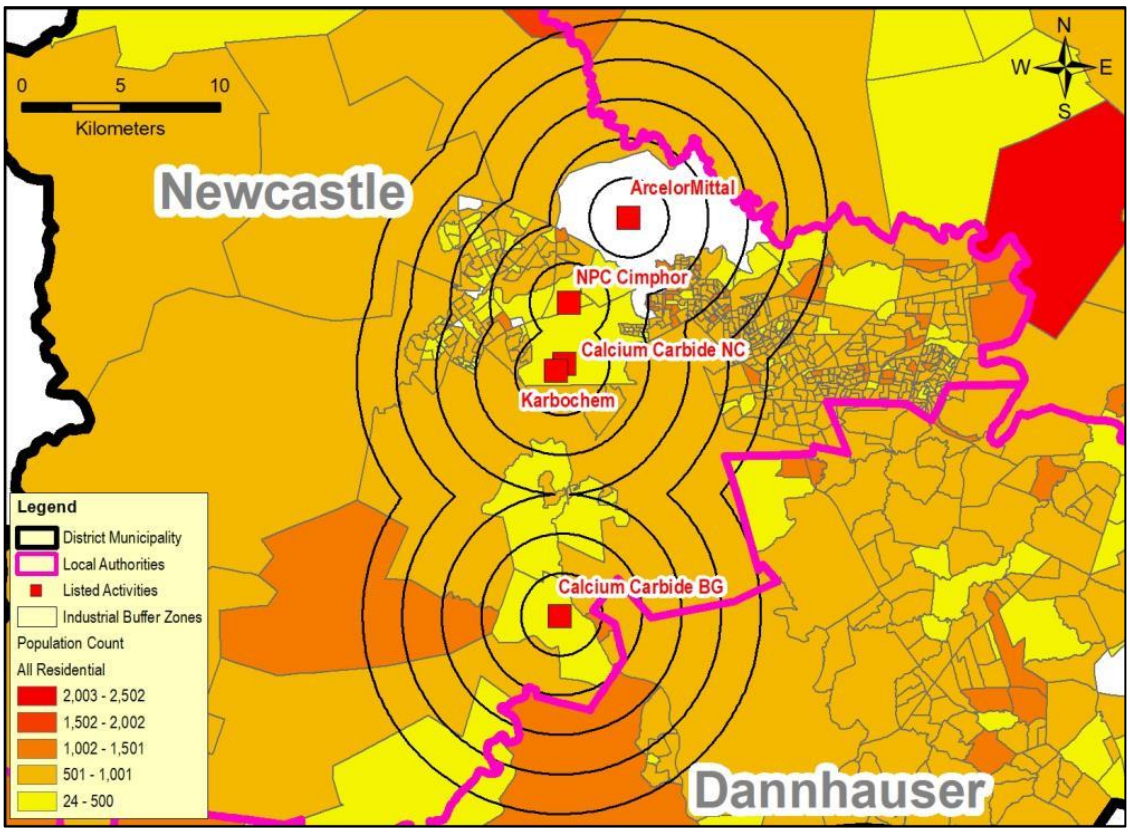


Figure 89: Large scale map focusing on industrial impact zones in Newcastle Municipality to show how peak air pollution 'hot spots' coincide with demographic data (population count).

It should be considered when viewing these maps that in order to offer any overview, some detail has been sacrificed by using annual averages that do not account for short-term pollution episodes. However, the likelihood of episodic pollution will also bear a reasonable correlation with long-term exposure; episodic pollution remains far more complex to model. Most human health effects are based on chronic exposure to pollutants in the ambient environment rather than acute exposure; and these chronic health risk statistics are also better established. Thus, the approach taken is perhaps limited by using average impacts, but is still defensible and useful to guide the planning of development at the lower social cost of poor health caused by poor air quality.

8.4 CROSS CUTTING ISSUES AND DRIVERS OF CHANGE

Whilst there is a clear perception from stakeholders that air quality in ADM is under pressure and that residents feel that air quality has been severely compromised, particularly in the Newcastle area, insufficient monitoring data is available to adequately quantify this. A full dispersion model has also not been developed for this area. This is indicative of a broader cross-cutting issue of lack of municipal financial and human capacity which is also evident in the limited monitoring data available for surface water resources across the District. It is also reflected in documents describing the state of waste water treatment plants in the District which are described as being under capacitated.

Two key drivers of change in air quality are the demand for economic growth in the ADM which results in the growth of industry, mining and other activities which impact air quality and the growth in urban population which brings an increase in the volume of road traffic and associated air quality impacts. Whilst the highly visible industrial emitters are foremost in the minds of stakeholders, growth in this sector over the last decade has been limited. Road traffic volumes have however increased as the urban population has increased and available monitoring data for the District show that traffic related emissions are a significant contribution to overall air quality impacts

An important driver of change in the air quality arena is the implementation of SAAQIS and associated regulation of emissions. Large emitters are registered, monitored and regulated and this contributes to the better management of air quality in the District.

9. HERITAGE RESOURCES

9.1 OVERVIEW

The Amajuba District has played a significant role in the history of South Africa and is rich in heritage resources. Despite this richness, relatively little systematic heritage survey work has taken place in this region, and even less has been systematically documented on SAHRIS. This hampers efforts at determining the heritage character of the area from existing work. While it is known that some academic research has taken place across the district, the results of this work are not publicly accessible.

Available resource data have been thoroughly researched through reviews of existing heritage resources databases (SAHRIS, KZN Museum Database), literature and expert knowledge. Categories of heritage identified in the region include:

9.1.1 Archaeological sites

In summary, no area–wide systematic Stone or Iron Age archaeological surveys have been undertaken for the District Municipality. Known sites are consequently the result of specific research projects and, more often, the findings of HIAs conducted prior to the inception of developments. However, recorded sites attest to a great historical depth of human interaction across the landscape from the Early Stone Age (ESA) (1.5m years ago) to the Late Iron Age (LIA) (150 years ago) and latterly, colonial interaction and into the modern era.

9.1.2 Military history

The Amajuba District was of enormous strategic importance in several phases of South African history, and this is attested to by the presence of several battlefields, military cemeteries, monuments and memorials in the region.

9.1.3 Buildings and Structures

It is self-evident that numerous buildings and structures with historical, aesthetic, architectural and/or social values occur within Amajuba District. However, no systematic, area-wide survey of such heritage resources has been undertaken, hence their locations, condition and management requirements are unknown.

All buildings and structures older than sixty years are afforded general protection in terms of Section 33 of the KZNHA Act 4 of 2008 (see Annexure 1). Accordingly, no such structure may be demolished, altered or added to without the prior written approval of the Amafa aKwaZulu-Natali Council having been obtained on written application to the Council.

9.1.4 Monuments and memorials

The majority of monuments and memorials in the region are related to the history of

military action in the area during the Zulu and Anglo-Boer Wars, in the form of commemorative installations at battlefields and cemeteries.

9.1.5 Burial Grounds and Graves

No person may damage, alter, exhume, or remove from its original position any grave, as defined in Annexure 1, without permission from the relevant authority. All human remains have high heritage significance at all levels for their spiritual, social and cultural values and may not be altered in any way without the permission of Amafa and the next-of-kin (see Annexure 1).

Given the distribution of rural settlements across the District, it is likely that numerous traditional burial places are located outside formal cemeteries. Such burial places are usually located within homestead precincts and are known to and managed by the next-of-kin.

However, people may abandon homesteads or become alienated from traditional burial places through social processes such as forced removals. Accordingly, it should be recognised that informal, traditional burials are likely across this area.

9.1.6 Living Heritage/Sacred Sites

Given the nature of the historical environment and modern land uses it is highly likely that numerous places associated with oral traditions or living heritage are present within Amajuba District.

9.1.7 Conservation Areas, Cultural Landscapes, Natural Sites and Places

This heritage resource category includes sites, areas or reserves protected in terms of environmental legislation, including conservancies and nature reserves.

Cultural Landscapes are not defined in the NHRA (Act 25 of 1999), but “landscapes and natural features of cultural significance;” are included as heritage resources listed as part of the National Estate (S3 (2) d). Cultural landscapes reflect the interplay between people and the landscape through time. The effect of people on their landscape, and the restrictions and possibilities the landscape exerts on people results in a unique combination of tangible and intangible characteristics that give each location its particular visual heritage character and sense of place.

9.2 SPATIAL EXTENT

9.2.1 Amajuba Cultural Heritage Sites

There are over 300 identified heritage resources within the Amajuba District Municipality (Figure 90). These sites predominantly comprise historic buildings within the towns. There are 20 Grade II Provincial Heritage Sites, of which six are located within Newcastle, and a further four in the Newcastle area, and ten in Utrecht. In addition to this are four sites on the Amafa Heritage Register, comprising two in Newcastle and two in Charlestown. The Amafa database also records 158 buildings that are of heritage significance, none of which is graded or accurately mapped. These structures can be assumed to carry at least a Grade IIIc grading but, without accurate co-ordinates, are of limited use for the purposes of this report and have not been mapped.

The remaining sites mapped on SAHRIS comprise sites encountered during heritage survey work conducted in advance of development (Figure 90to Figure 94). There are likely to be more sites than those mapped, but these are only identified within reports uploaded to the system and have not been individually mapped as of yet.

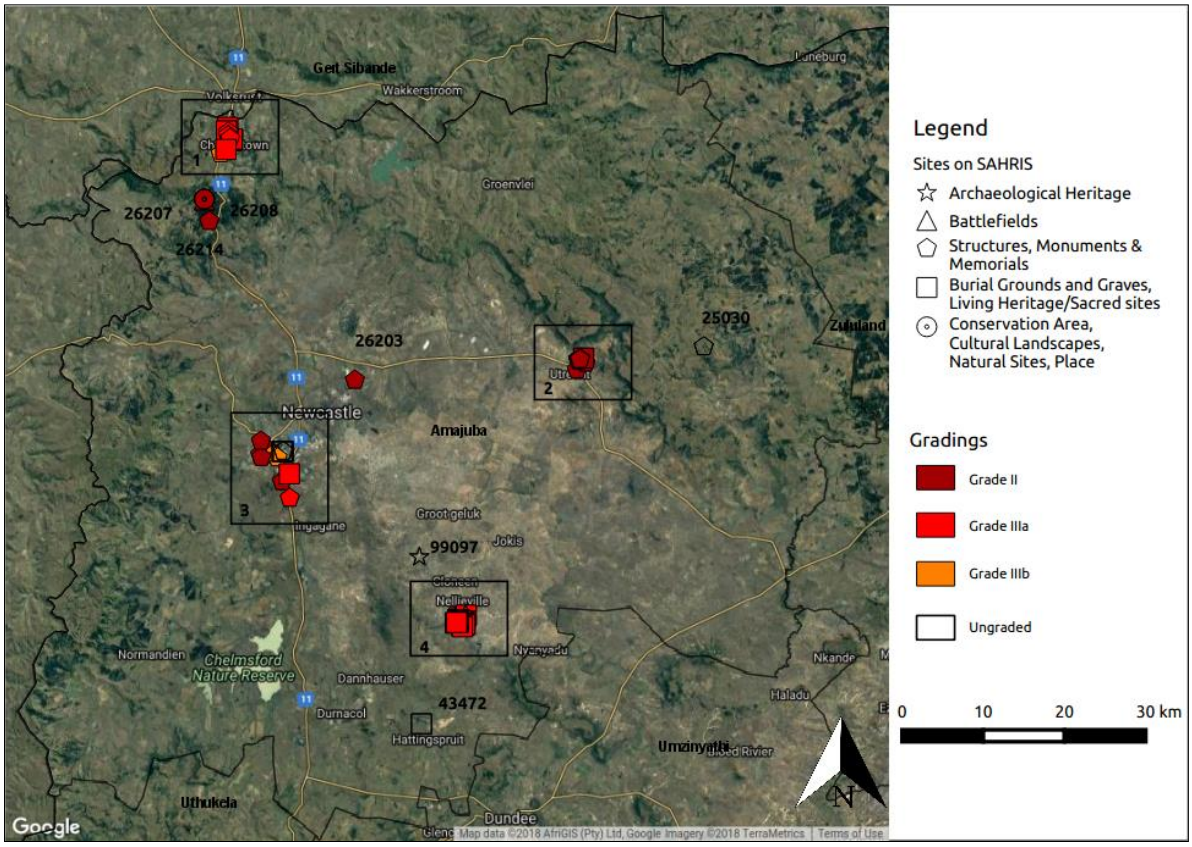


Figure 90: all sites recorded on SAHRIS. SAHRIS site ids indicated.

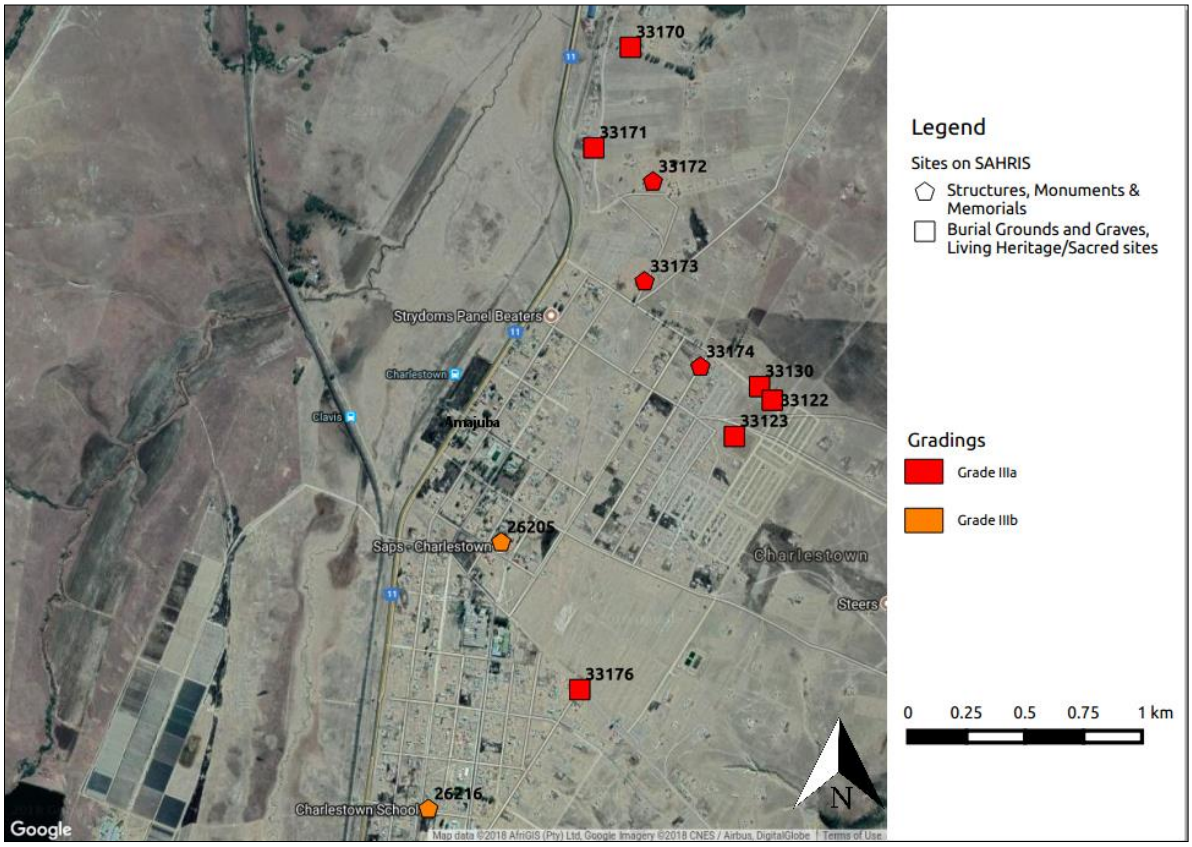


Figure 91: Charlestown inset map

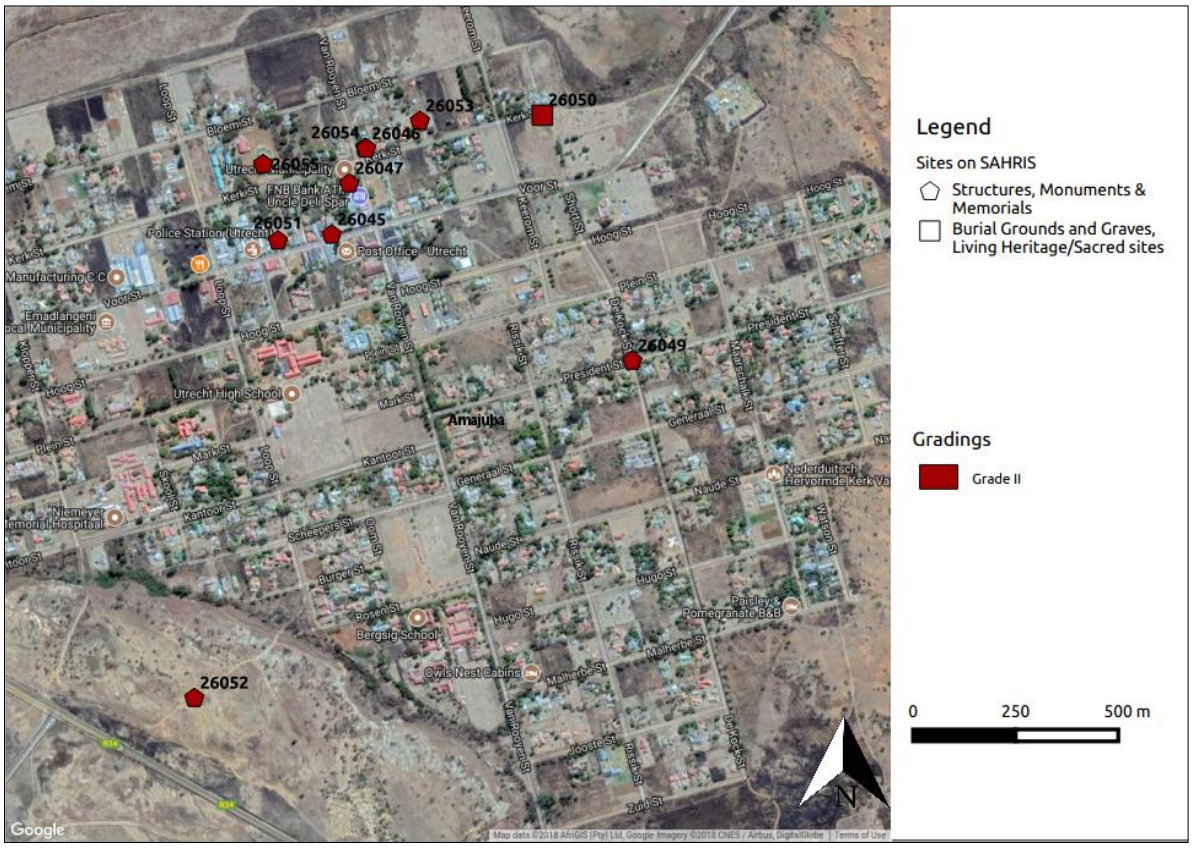


Figure 92: Utrecht inset map

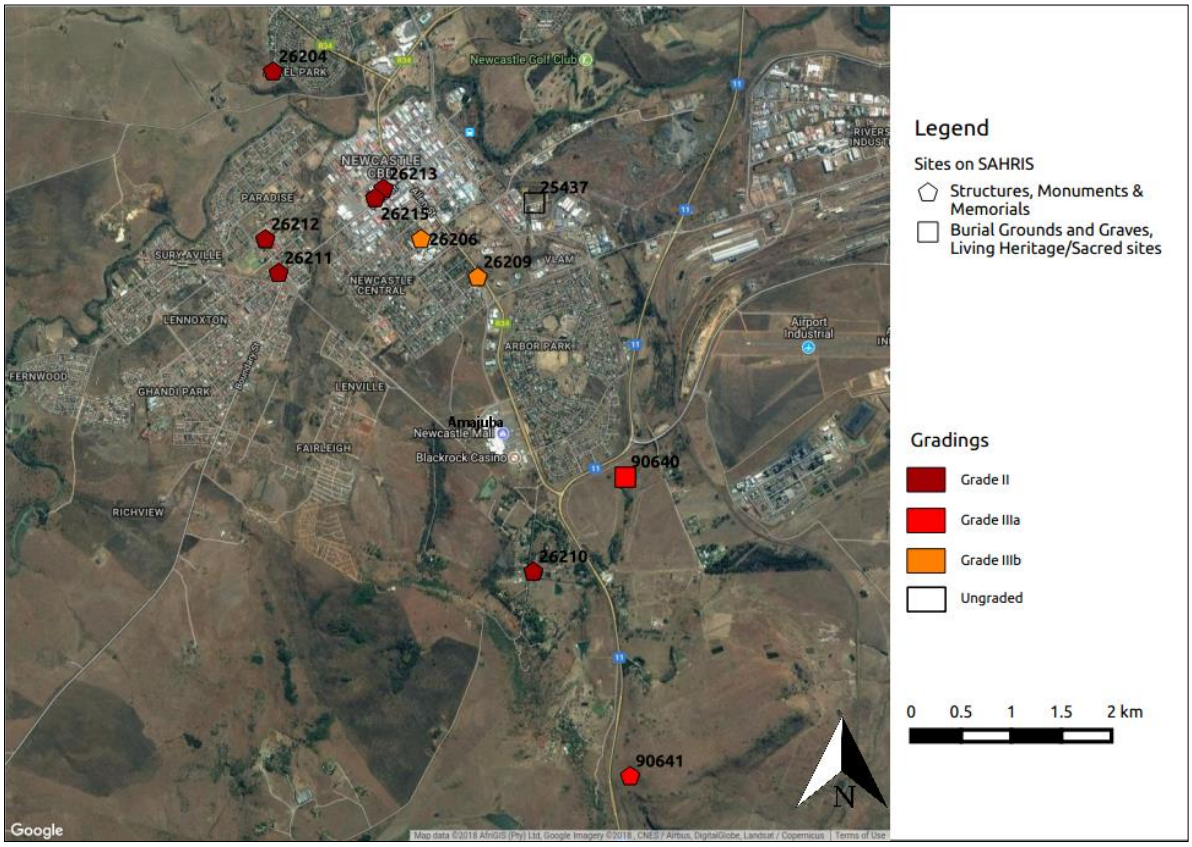


Figure 93: Newcastle inset map

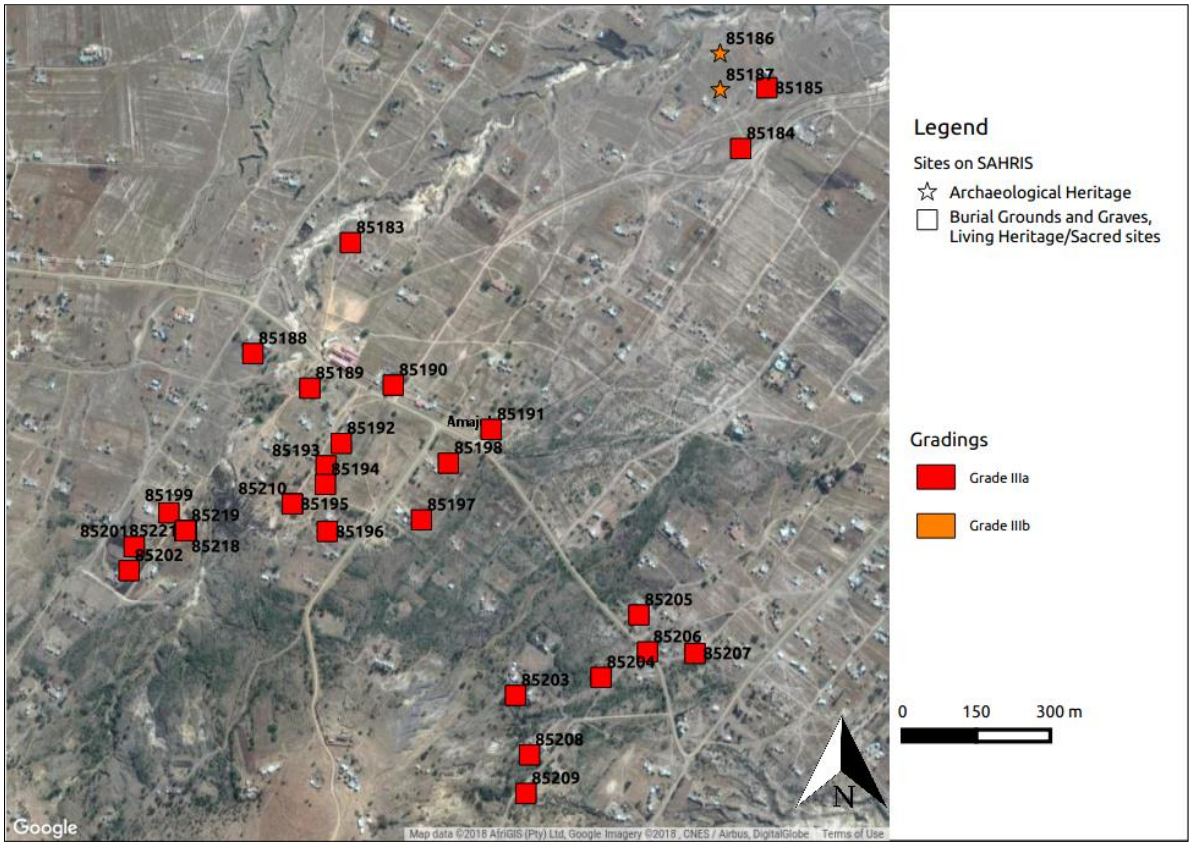


Figure 94: Magdalena Colliery inset map

A further category of sites housed on SAHRIS comprise sites for which coordinate data and other information is not publicly accessible. These protections are put in place by the site recorder who can select which system users are able to view the information. In this way vulnerable and/or valuable sites (economically or for the purposes of research potential) can be protected.

In KZN, many of these sites are held on the KZN Museum database, and information is readily available upon request for appropriate use. The following maps show sites that have resulted from academic research work as well as an HIA compiled for a Wind Energy Facility south east of Utrecht (Figure 95 and Figure 96).

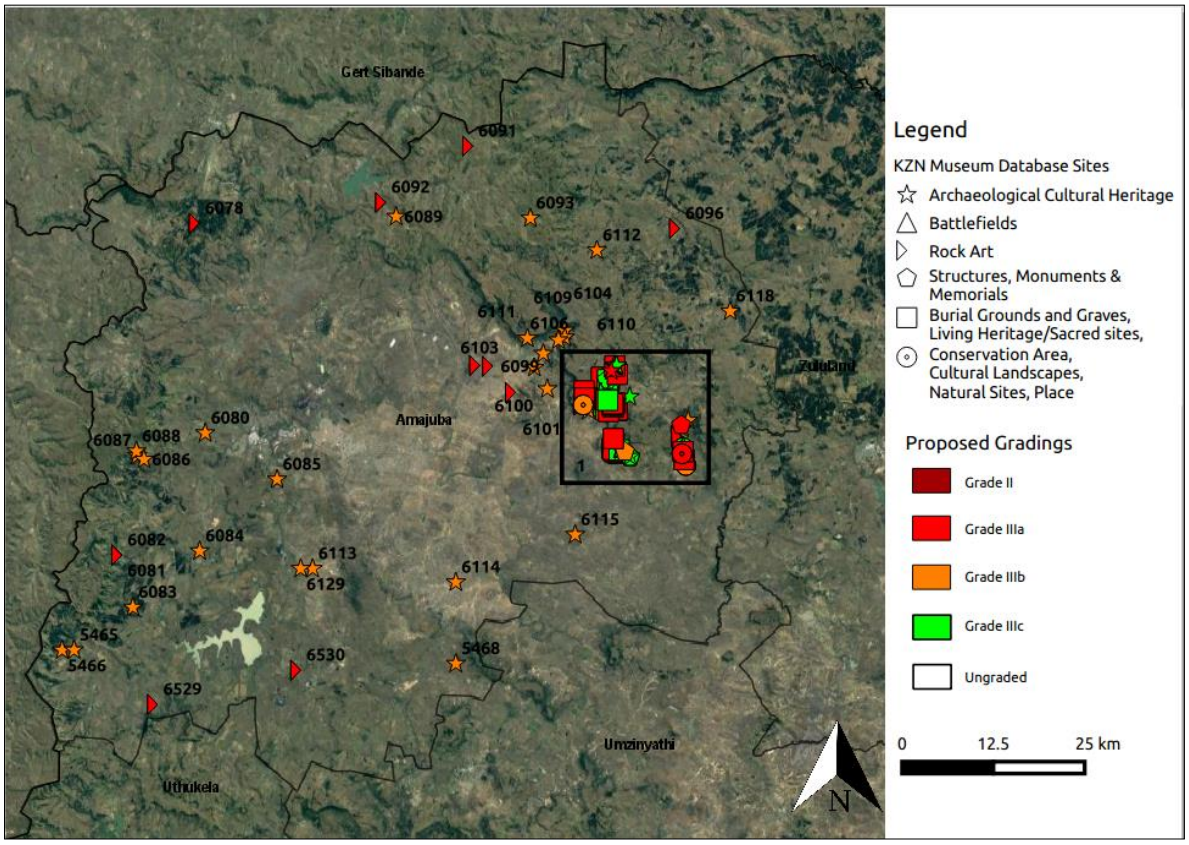


Figure 95: KZN Museum database sites on SAHRIS

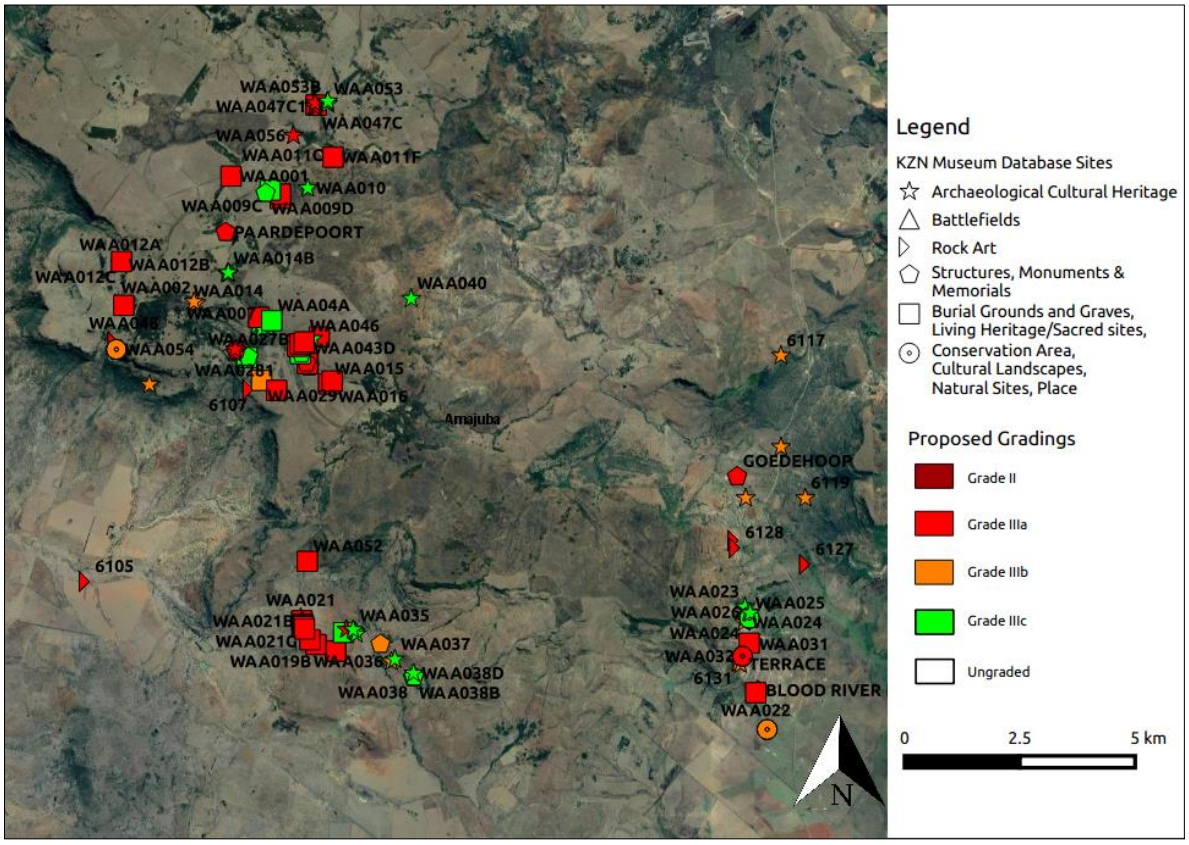


Figure 96: KZN Museum database sites inset map. (SAHRIS site ids/site names provided)

9.2.2 Proposed Sites for Amajuba Freedom Route

An important means of rectifying the omissions and biases in the currently known and recognised heritage sites in this area would be through the identification and proclamation of sites related to the legacy of recent and historic struggle against colonialism and oppression. Possible sites for inclusion on such a Freedom Route are listed and described in Table 37 and Figure 97(Amajuba District Municipality 2018).

Table 37: Sites proposed for inclusion in Amajuba Freedom Route

Site Name	Site Type	Coordinates	Proposed Grading	Description	Category
Old Newcastle Prison	Building	-27.7618; 29.9386	Grade IIIa	Site of imprisonment of King Dinuzulu during the Bambatha Rebellion (1906-1910)	Historic Opposition
				Site of imprisonment of the Presidents of the Natal and Transvaal Indian Congresses (1950s)	Apartheid
Hindu Shiva Temple	Building	-27.7505; 29.9359	Grade IIIa	Miners' Strike led by Gandhi. Location provided of Hindu Shiva Temple in Newcastle where Ghandi stopped to pray	Historic Opposition & Struggle Icons
Blaauwbosch School	Building	-27.7908; 30.0942	Grade IIIa	Methodist Church and school where Albert Luthuli was headmaster	Struggle Icons
Maharaj Residence	Building	-27.7697; 29.9197	Grade IIIa	Birthplace of Mac Maharaj	Struggle Icons

Madadeni	Place	-27.75; 30.062	Grade IIIa	Establishment of Madadeni and Osizweni as part of the Groups Areas	Apartheid
Osizweni	Place	-27.7833; 30.15	Grade IIIa		
Struggle and TRC Sites	Place	Various locations; not mapped	Grade IIIa	Various sites associated with Struggle and TRC Hearings. No specific site identified	Struggle & Liberation History
Post 1994 Monuments	Monuments & Memorials	Various locations; not mapped	Grade IIIa	New monuments in the District post 1994	Democracy

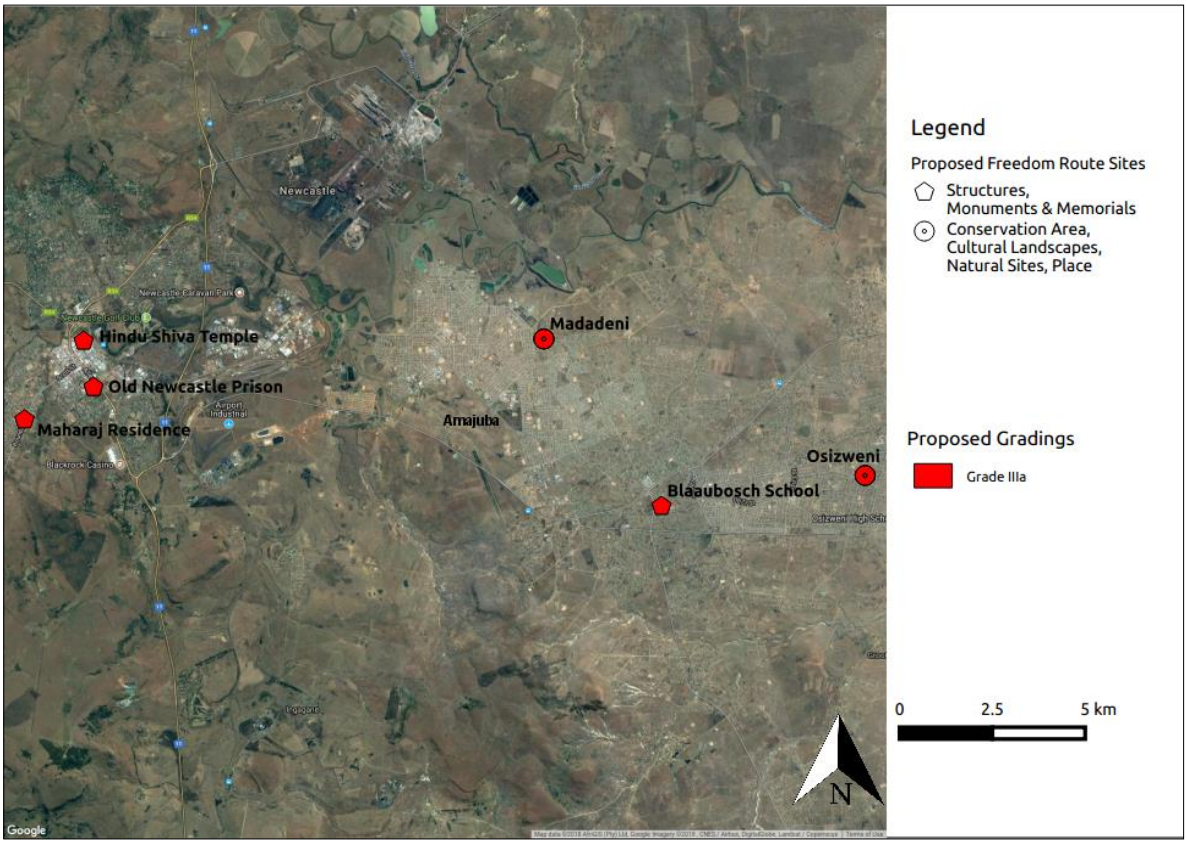


Figure 97: Sites for proposed Amajuba freedom route. Site names indicated.

These sites are currently confined to the Newcastle area, and further research and consultation would be necessary to identify others more widely dispersed around the District. The identification of sites related to the Struggle, identified in the Truth and Reconciliation Commission Hearings, and the sites of monuments erected post 1994 would all provide a fairly simple means of expanding the extent of these Freedom Route sites.

9.2.3 Amajuba District Palaeontological Heritage

In terms of the KZNHA (Act 4 of 2008) and NHRA (Act 25 of 1999) palaeontological heritage comprises any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Palaeontological sensitivity is determined from the underlying geology of an area. The

Amajuba District, by virtue of its varied geological makeup, includes deposits that range from having very low to very high fossil sensitivity (Figure 98).

According to the SAHRIS Palaeosensitivity Map (SAHRIS 2013b), all potentially fossil-bearing deposits in this region are Karoo Supergroup deposits. These include the very highly sensitive Vryheid Formation, the highly sensitive Volksrust Formation and the moderately sensitivity Pietermaritzburg Formation of the Ecca Group, and the very highly sensitive Tarkastad Subgroup of the Beaufort Group. Intruded into these deposits are dolerite sills, sheets and dykes of the Karoo Dolerite Suite, that are unfossiliferous in themselves and can also reduce the fossil sensitivity of surrounding deposits through heat and pressure deformation.

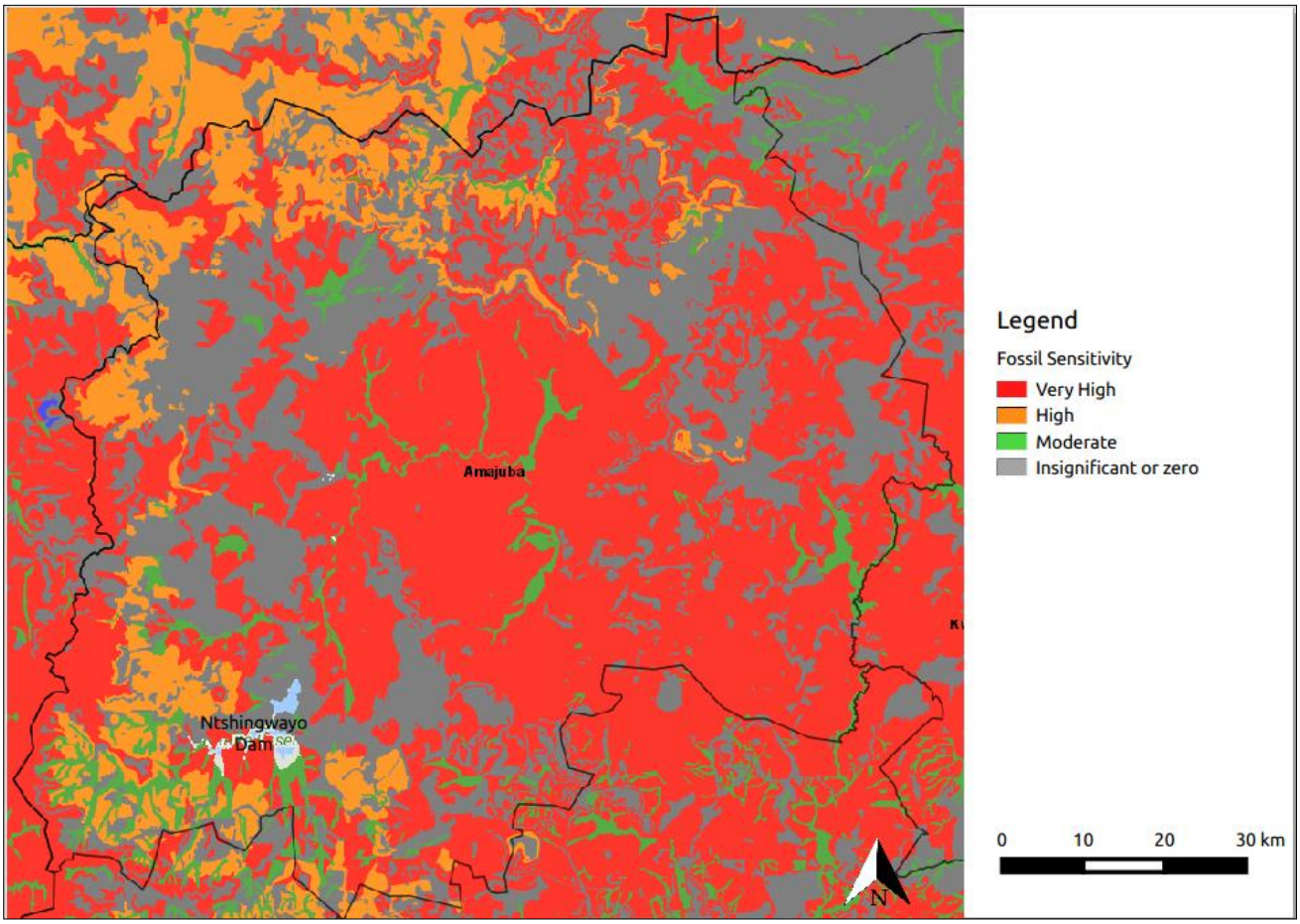


Figure 98: Fossil sensitivity of Amajuba District (SAHRIS 2013b)

The Early Permian Vryheid Formation is known to contain fossils that are of very high scientific significance internationally, particularly the plant macrofossils of the *Glossopteris* flora (SAHRIS 2013b). The Mid Permian – Earliest Triassic Adelaide Formation contains very important fossils of the Dicynodon and Lystrosaurus assemblages that provide key evidence for the evolution of mammalian characteristics, as well as diverse other terrestrial and freshwater fossils (Ibid.). The Early Triassic Tarkastad Formation contains similar fossil assemblages as the Adelaide Formation, and in places, has yielded the richest known Early

Triassic freshwater fauna in the world (Ibid.). The Late Permian Volksrust contains trace fossils and rare amphibian remains as well as insect fossils, according it high palaeontological significance, while the Pietermaritzburg Formation holds moderate significance due to the trace fossils it contains. It can be expected that deposits near to dolerite intrusions are unlikely to retain significant fossil remains.

Any developments that require deep excavation into fresh bedrock, or occur within areas where there are exposures of fossiliferous deposits can, potentially, impact negatively on fossil remains. However, in many instances, it is the development activities themselves that expose buried fossil deposits and enable palaeontological research to proceed. For this reason, in areas of moderate to high fossil sensitivity, a Palaeontological Impact Assessment should always be compiled, even if only at the desktop or scoping level, before development proceeds on site.

9.3 CONSERVATION STATUS

9.3.1 Formally protected heritage resources

Declared PHS's, and sites listed on the KZN Heritage Register, are considered formally declared in terms of Chapter II of the NHRA (Act 25 of 1999). Only one of the area's four battlefields, Majuba, is a declared PHS.

Amajuba District's recognised and proclaimed heritage resources are strongly biased towards settler history, and largely pertain to the settlement of Trekkers in the area, the Anglo Zulu War, and the first Anglo-Boer war otherwise known as the Transvaal War of Independence. There is evidence, however, that a much broader range of heritage sites are located within the region, although knowledge about these sites and their locations is not widely shared.

A further category of sites housed on SAHRIS comprise sites for which coordinate data and other information is not publicly accessible. These protections are put in place by the site recorder who can select which system users are able to view the information. In this way vulnerable and/or valuable sites (economically or for the purposes of research potential) can be protected. In KZN, many of these sites are held on the KZN Museum database, and information is readily available upon request for appropriate use.

9.3.2 Generally Protected Sites

SAHRIS yields further sites known in the district that are not formally protected by declaration or listing. Most of these sites do little to improve the bias of the declared sites, and largely comprise informal community burial grounds identified in the course of a survey for a mine expansion in the south of Amajuba District.

Further sites have been recorded during academic research work in the Amajuba District,

but the details and locations of these sites are protected by SAHRIS' customisable privacy settings designed to protect sensitive site information. While the sites cannot be considered in this report, their existence in the area points to the rich archaeological heritage of this region.

9.3.3 Sites not currently on SAHRIS

Further sites are known in the area that are, as yet, not listed on SAHRIS. These sites should be graded by Amafa and recorded and mapped on the system. Again, most of these sites reflect heritage associated with the wars fought in the area.

9.3.4 Proposed Sites for Amajuba Freedom Route

An important means of rectifying the omissions and biases in the currently known and recognised heritage sites in this area would be through the identification and proclamation of sites related to the legacy of recent and historic struggle against colonialism and oppression.

The sites put forward in this report for such a Freedom Route are currently confined to the Newcastle area, and further research and consultation would be necessary to identify others more widely dispersed around the District. The identification of sites related to the Struggle, identified in the Truth and Reconciliation Commission Hearings, and the sites of monuments erected post 1994 would all provide a fairly simple means of expanding the extent of these Freedom Route sites.

9.3.5 Amajuba District Palaeontological Heritage

In terms of the KZNHA (Act 4 of 2008) and NHRA (Act 25 of 1999), palaeontological heritage comprises any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Palaeontological sensitivity is determined from the underlying geology of an area. The Amajuba District, by virtue of its varied geological makeup, includes deposits that range from having very low to very high fossil sensitivity.

According to the SAHRIS Palaeosensitivity Map (SAHRIS 2013a), all potentially fossil-bearing deposits in this region are Karoo Supergroup deposits. These include the very highly sensitive Vryheid Formation, the highly sensitive Volksrust Formation and the moderately sensitivity Pietermaritzburg Formation of the Ecca Group, and the very highly sensitive Tarkastad Subgroup of the Beaufort Group. Intruded into these deposits are dolerite sills, sheets and dykes of the Karoo Dolerite Suite, that are unfossiliferous in themselves and can also reduce the fossil sensitivity of surrounding deposits through heat and pressure deformation.

Any developments that require deep excavation into fresh bedrock, or occur within areas where there are exposures of fossiliferous deposits can, potentially, impact negatively on fossil remains. However, in many instances, it is the development activities themselves that expose buried fossil deposits and enable palaeontological research to proceed. For this reason, in areas of moderate to high fossil sensitivity, a Palaeontological Impact Assessment should always be compiled, even if only at the desktop or scoping level, before development proceeds on site.

9.4 AMAJUBA HERITAGE RESOURCES SOCIAL VALUE

It must be recognised that the value in heritage resources does not lie in monetary or economic value, and that they are valuable, rather for their intrinsic worth in terms of social, historical and cultural significance, particularly where they can foster social cohesion.

That being said, certain heritage resources can provide economic stimulus through tourism and job creation. The prime example of this exploitation of heritage resources is to be seen in the tourist-driven industry of battlefield routes, and, indeed, the battlefields are Amajuba's biggest tourism attraction (Urban-Econ 2012). Here potential exists not only for trained guides to traverse the routes with tourists, but also for unskilled maintenance and caretaking staff.

To ensure that the sites are maintained in a condition that will attract tourists, and that effective, appropriate signage, information and site access is provided, management agreements should be concluded between relevant landowners, the Battlefields Route and Guides Association and Amajuba District Municipality. This agreement will need support from the Provincial and local government, however, in terms of vigorous marketing to ensure that any jobs created are sustainable through elevated tourist numbers.

Potential further exists to exploit the location of Utrecht within a game park. Where tourists are already visiting the area for the reserve, targeted, informative tourist brochures, guided tours should be made available not only to appraise them of the cultural historic significance of Utrecht itself, but also its wider significance within the rest of the District. Similarly, the links between the wilderness state, as presented in nature reserves, and the prehistoric landscape should be highlighted. People travelling to see nature reserves would conceivably also be interested in archaeological traces in the area, and particularly rock art, for which the wider Drakensberg region is internationally famous.

This integration of single features and clusters of resources into a broader histories of the region can be used to draw tourists, keep them in the area for longer, and ensure that their experience takes in as much of the region as possible.

10. CROSS CUTTING ISSUES

A number of key cross-cutting issues have been identified by this study. These are listed and discussed briefly here, but will be addressed more comprehensively in the Strategic Environmental Assessment report.

10.1 URBAN POPULATION GROWTH

Urban population growth is seen to be a key driver of environmental change across a number of the specialist studies. This phenomenon is not unique to ADM, but is evident across the world. Its resulting impacts are critically important for the District from a planning and service delivery perspective and they form the basis for a number of the key environmental issues identified in this study. These include:

1. The demand for infrastructural development and its associated environmental impacts such as expanded urban and peri-urban footprints which happen at the expense of important biodiversity and agricultural areas.
2. The over-burdening of waste water treatment plants resulting in under performance of these facilities and discharge of sub-standard effluents
3. Increased risk to human well-being through increased exposure to
    a. Contaminated water resulting from lack of improved sanitation infrastructure and contamination of groundwater in particular,
    b. flooding as a result of settlement on floodable areas
4. Lack of investment in rural areas leading to degradation of natural systems, which diminishes their eco-tourism value and ecosystem services values. This is evidenced by the rapid and widespread of invasive alien plants species. Urbanization is another factor (among several others) that is reducing the optimization of agricultural potential.

10.2 WATER

Water is an essential requirement for socio-economic and environmental wellbeing. In almost all of the specialist studies undertaken for this project, water has been identified as a critical component.

1. All water used in the ADM is sourced from within the ADM. Water resource infrastructural development has not kept pace with the growth in demand. Water availability is thus a key limiting factor for economic development.
2. Water is essential for social and economic development and water quality is impacted on by the lack of social development – particularly through inadequate waste water and solid waste management
3. Water is a critical limiting factor in the growth of the agricultural sector which is dependent on the development of new irrigation opportunities. Water quality impacts from urban areas, industry and mining additionally reduce the availability of fit-for-purpose irrigation water.
4. Water is seen as a vital component for facilitating growth in the tourism sector as dams, wetlands and rivers are seen as tourist drawcards for recreational activities. This development opportunity is also impacted by deteriorating water quality.

5. Water is the medium in which all aquatic ecosystems exist and without which associated biodiversity would cease to exist.

10.3 MANAGEMENT OF CATCHMENT AREAS

Closely aligned with the water issue is appropriate management of the ADMs key water producing areas. This is a cross cutting issue because of the importance of these areas for agriculture, biodiversity, tourism and water provision, and because of the pressure on these areas from a variety of factors. Most notable of these are:

1. Mining which results in significant water quality impacts and thus threatens the water production value of these areas.
2. Agriculture is also a key driver of the condition of these catchments and overgrazing, and poor burning practices result in degradation of grasslands, reduction in infiltration capacity and reductions in dry season baseflow.
3. Alien plants have spread dramatically across the higher lying areas of the District in the last two decades. These plants reduce the agricultural potential of the grasslands, eliminate indigenous biodiversity and reduce the volume of water produced by the catchment

These issues are heightened by the impacts of climate change which will see increased variability in already stressed system.

10.4 ECONOMIC GROWTH AND SOCIAL WELLBEING

The Constitution of South Africa provides for a fundamental right for all of an environment that is not harmful to one's health. Two physical elements that are essential for social health and well-being are clean air and clean water. Both of these are presently threatened in the region. Whilst economic activity and growth is important, the impact of various commercial and public service activities on water resources and air quality is clearly evident in the outcomes of this study. Achieving a balance between such activities and a healthy environment requires that infrastructure such as waste water treatment works and the management of such facilities be maintained at a high level of functionality. Without this, sustainable development in the District is threatened.

10.5 MUNICIPAL CAPACITY

Municipal capacity has been identified by a number of the specialist studies as being an important factor in driving deterioration or hindering improvements in the state of the environment in the ADM. This includes both capacity with respect to both financial and human resources. It also includes political will, which sits behind both of these elements and additionally drives the determination to deal with non-compliance with regulatory tools and processes.

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12. APPENDIX 1 – STATUS QUO PUBLIC PARTICIPATION

12.1. AGENDA FOR STATUS QUO PUBLIC PARTICIPATION MEETING

AMAJUBA DISTRICT MUNICIPALITY EMF

STATUS QUO STAKEHOLDER ENGAGEMENT – 28th August 2018

AGENDA

10:00 **Opening, introduction and outline of procedure**

10:10 Background to the EMF process

10:20 Presentation and workshopping of Status Quo

- a. Overarching drivers
  - i. Climate change
  - ii. Land
  - iii. Urbanisation
- b. Socio and economic development context
  - i. Socio economic environment
  - ii. Development planning
  - iii. Infrastructure

11:20 **Tea**

11:30 Presentation and workshopping of Status Quo (continued)

- c. Terrestrial resources
  - i. Agriculture
  - ii. Terrestrial biodiversity
- d. Geotechnical and Groundwater
- e. Air Quality
- f. Cultural heritage resources

13:00 **Lunch**

13:30 Presentation and workshopping of Status Quo (continued)

- g. Water resources
  - i. Water production
  - ii. Water quality
  - iii. Aquatic biodiversity
  - iv. Flood areas

14:45 interacting with wall maps and detailed commenting on SQ topics covered

15:15 Key sustainability issues summary

15:30 **Close**

12.2. ATTENDANCE REGISTER STATUS QUO PUBLIC PARTICIPATION MEETING

Status Quo Stakeholder Engagement
28/08/2018
Abet Room, Department of Public Works, Newcastle

Name	Organisation	Email	Telephone
Josephine Mahoney	Arcelor Mittal	joey.mosh.y@arcelormittal.com	034 318 8077
Sipho Mthembo	ArcelorMittal	Sipho.ndumiso@arcelormittal.com	034 314 8228
Henri Linde	Arcelor Mittal	henri.linde@arcelormittal.com	034 314 8431
Buyi MTSHALI	Amajuba TVET College	Buyizmtshali@gmail.com	082 327 3906
Sim Zuma	Newcastle Municipality	Siya.zuma@newcastle.gov.za	0721093013
Zanele Khumalo	Sport & Recreation	zanele.ndaba@kznsas.gov.za	0724804072
Nothile Mthimkhulu	Amajuba District Municipality	nothilem@amajuba.gov.za	082 908 5764
Ngobile Ndlovu	Newcastle Municipality	ngobile.zulu@newcastle.gov.za	0763348044
Avanti Maharaj	NPC Intercement	AAMaharaj@Intercement.com	0625140058
NTOKOZO NKOSI	EDTEA	ntokozankosi@kznedtea.gov.za	
Bongiwe Msomi	EDTEA	Bongiwe.msomi@kznedtea.gov.za	039 325 0500

Status Quo Stakeholder Engagement
28/08/2018
Abet Room, Department of Public Works, Newcastle

Nonkululeko Mabaso	EDTEA	Nonkululeko.Mabaso@kznedtea.gov.za	034 328 0900
NOMSA KHANYILE	EDTEA-UMZINYATHI	nomsa.khanyile@kznedtea.gov.za	0824618695
Caiphus Gcoph Njilo	EDTEA BKAAMHILL	Caiphus.Njilo@kznedtea.gov.za	033 397 6669 082 728 7732
AYANDA CELE	WWF-SA	acele@wwf.org.za	0748302599
Mathu Mabaso	Emadlangeni municipality	mabasom@emadlangeni.gov.za	034 331 3616
NKANYENG MOTAUNG	DEA	nmotaung@environment.gov.za	083 329 7323
Jonna van Vuuren	AMAFA	jonna@heritagekzn.co.za	082 499 8537
SIBELO NGCOBO	UMKHELA WATER	Sibelo.Ngcobo@Umkhelawater.co.za	
Matthew D'Arcy	IWR		033 346 0796
Leo Quayle	IWR	lquayle@iwr.org.za	0826699298

12.3. STAKEHOLDER DATABASE

See stakeholder consultation report.