10. THE BIOLOGICAL ENVIRONMENT

Groundwater hydrology is a key variable in vegetation structure and composition. The depth to groundwater has a direct interrelationship with vegetation and could be used as an estimate for vulnerability.

10.1 Vegetation

The study area falls within the Maputaland-Pondoland-Albany Biodiversity Hotspot which is recognised as the "second richest floristic region in Africa" containing approximately 80% of South Africa's remaining forests, rich bird life and many other significant flora and fauna species. A large proportion of this hotspot is being transformed and degraded by human activities, resulting in many vegetation types being vulnerable to further disturbances. These disturbances threaten species complexity and lead to imbalances within ecosystems.

The 'Vegetation Types of South Africa, Lesotho and Swaziland' by Mucina and Rutherford[1] is the currently accepted basis for decision making and conservation planning in the country as adopted by SANBI. However, it was prepared for use at a national or provincial scale, with units of less than 10 ha in size not being recorded. The vegetation types of the study area have been described at a finer scale that is appropriate for planning within the Municipality (**Figure 29**)[2], and are therefore adopted in this exercise. The relation between the units used for this study area and the national vegetation description are indicated in **Table 9**.

10.1.1 Vegetation Types

There are eight of Mucina and Rutherford's vegetation types represented within the study area. This is a remarkably large number of national types for so small an area, indicative of the high biodiversity of this region. Each of the vegetation types is briefly described in terms of the fine-scale vegetation types shown in **Figure 21**, as well as conservation status. The main land covers other than natural vegetation are then described in the following section.

Maputaland Coastal Belt

The Maputaland Coastal Belt encompasses areas of recent marine sands and areas on hard geology, which differ to some extent in the nature of supported vegetation. Recent marine sands support a mosaic of dryland and hygrophilous vegetation types. Dryland vegetation types are dominated by grassland or *Syzigium* savanna where fire has been frequent, but tend toward shrubland where fire

[1] Mucina and Rutherford (2006) *The Vegetation Types of South Africa, Lesotho and Swaziland*. Strelitzia Publication, SANBI, Pretoria

[2] uMhlathuze Municipality (2007) *uMhlathuze Environmental Services Management Plan.* Updated report from the original 2005 Plan prepared by FutureWorks and dated December 2007.

regime has been disrupted. Lack of fire and disturbance has promoted the invasion of alien trees and shrubs to the extent that distinct patches of these invaded grasslands can be recognised. In some instances self-sustaining stands of pines, eucalypts or gums have established, with usually an understory of grassland. Areas of hard geology may support grassland but also commonly support *Acacia karroo* savanna or woodland. As with vegetation of marine sands, a decrease in fire frequency or increased disturbance has promoted the establishment of alien shrubs and trees. In addition, preclusion of fire may promote thickening of woody vegetation such that *A. karroo* thickets may develop.

The Maputaland Coastal Belt is classified as **Vulnerable** and correspondingly has a conservation target of 25 %, of which 15 % is contained within the iSimangaliso Wetland Park. This unit is equivalent to the Kwambonambi Grassland that formed a basis of conservation planning in KwaZulu-Natal before the advent of the Mucina and Rutherford national classification. It is under severe pressure from development (also see section 10.2.2).

Northern Coastal Forest

A key distinction made in the fine-scaled mapping of this vegetation type is between forest occurring on the dune cordon and other areas of forest inland of this. A substantial proportion of either has been transformed to secondary forest following disturbance or previous transformation, accompanied by establishment of alien trees and shrubs. *Acacia karroo* Woodland occurs as distinct patches within some parts of the dune system, usually with alien species. Aliens also establish on localised sites of disturbance within otherwise intact forest. Drainage areas within either support a distinct Riverine Forest.

Northern Coastal Forest is classified as **Least Threatened** in general but it is recognised as being under threat on the coastal dunes of KwaZulu-Natal. It has a corresponding conservation target of 43%. It is under threat within the study area to mining and to transformation to sugarcane by small-scale growers (Oellermann). Its conservation value in this region is heightened by the number of coastal forest species at either the southern or northern limit of their distribution.

Swamp Forest

Swamp forest occurs in areas which are near permanently saturated with flowing water but are not permanently saturated. This vegetation type is therefore restricted to relatively level areas through which drainage takes place. Patches could be distinguished in which alien shrubs or alien trees were conspicuous.

Swamp Forest is classified as **Critically Endangered** and accordingly the conservation target is 100 % of what remains. In the study area, swamp forest has and continues to be lost to small-scale cultivation. A further portion was lost to the recent upgrade of the John Ross highway.

Mangrove Forest

The Sanctuary contains the largest mangrove forest in South Africa, with additional patches found within the harbour area. Included for convenience here are the mudflats and salt marshes that are immediately adjacent to the mangrove forest as they function ecologically as an integrated unit.

Mangrove Forest is classified as **Critically Endangered** and has a national conservation target of 100 % of what remains. Subtropical Estuarine Salt Marshes are classified as Least Threatened, for which the conservation target is 24 %, a portion of which is currently met within Richards bay Nature Reserve.

Subtropical Freshwater Wetlands

The composition and structure of wetland vegetation depends on the seasonal pattern of flooding. Consequently, there is a gradient of wetland types from the wet to the drier end of wetlands. They are spatially related to each other and to processes that happen at the landscape scale and can therefore not be considered in isolation of each other. Their position in the landscape are related to the hydrological regime, sediment source and rate of sedimentation as well as to substrate characteristics. The landscape position of these plant communities has been delineated and classified[3]. There are nine wetland types, the most extensive being *Phragmites* Marsh, Hydromorphic Grassland and Papyrus Swamp. Descriptions of the integrity of these wetlands and their functioning are available in specialist work. They are further discussed in terms of significance in Section 10.3 of this report.

Overall, Subtropical Freshwater Wetlands are classified as **Least Threatened** and they have a national conservation target of 24 %. This target refers to wetlands which are still in a relatively unaltered state. However, owing to their contribution to ecosystem services, and to the fact that KwaZulu-Natal has lost more than 50 % of its wetlands already, the provincial target for wetlands is effectively all that remain. In addition, the fine-scale vegetation mapping of the study area reveals wetlands that are of national conservation status due to unique local conditions.

Subtropical Alluvial Vegetation

Dryland alluvial areas adjacent to rivers which are not forested support woodland dominated by *Acacia karroo* or a mix of species. Woody alien species may be conspicuous within either of these.

The majority of this vegetation within the study area has been disturbed, both naturally by strong floods and by human activities, and resembles secondary woodland vegetation. The conservation target is 31%.

[3] Ellery W N, Cyrus D P and Vivier L (2009) *Preliminary Assessment of Impacts of the Planned Expansion of Richards Bay Port on Wetlands*. Report prepared for Transnet National Port Authority, Richards Bay through Ilifa Africa Engineers Pty (Ltd) and dated July 2009. Coastal Research Unit of Zululand, Investigational Report No.129.

Subtropical Seashore Vegetation

The specialised vegetation found on foredunes on which primary succession of dunes is initiated are listed together with the shore area of exposed sand. In addition, areas of *Casuarina equisetifolia* which were planted to stablise moving sand are included here, although they now represent areas transitional to established natural woody vegetation in many cases.

Subtropical Seashore Vegetation is classified as **Least Threatened** with a conservation target of 20 % of what remains, with 30 % already conserved within, *inter alia*, the iSimangaliso Wetland Park.

Subtropical Dune Thicket

This vegetation type of Mucina and Rutherford is mapped within coastal forest along the dune cordon because it is a successional precursor to forest. The only unit listed for this vegetation type are cirques, which are seaward-facing areas of collapsed dune that support distinct vegetation.

Subtropical Thicket is classified as **Least Threatened** and it has a conservation target of 24 %, although 40-50 % has already been conserved including a small portion within the Richards Bay Nature Reserve.

Alien Vegetation

The study area is heavily infested in parts by alien invasive plants. In terms of mapping, only woody plants could be recognised, such that patches of alien trees, alien shrubs or a mixture of the two could be distinguished.

Other Ecosystems

A number of freshwater or marine ecosystems do not map as vegetation types, and are therefore not accommodated by Mucina and Rutherford. Foremost among these are the large freshwater lakes of Msingazi, Cubhu and Nseze with distinct patches of aquatic vegetation within the water body, as well as the estuaries of the Sanctuary (shallow) and harbour (deep).

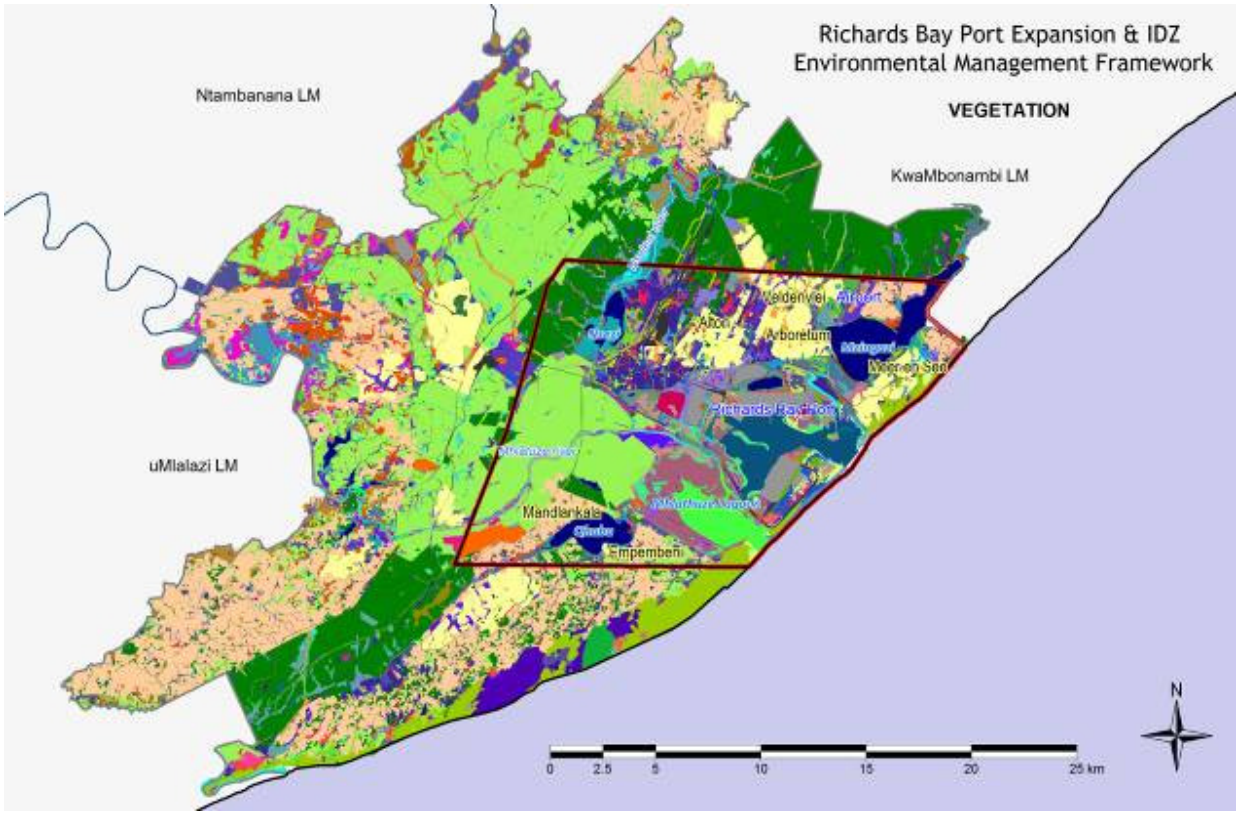

Figure 1: Vegetation in the study area.

VEGETATION

Vegetation Type

- Acacia karroo Riverine
- Acacia karroo Riverine/Aliens
- Acacia karroo Savanna
- Acacia karroo Savanna/Aliens
- Acacia karroo Thicket
- Acacia karroo Thicket/Alien Tr
- Acacia karroo Thicket/Aliens
- Acacia karroo Woodland
- Acacia karroo Woodland/Alien T
- Acacia karroo Woodland/Aliens
- Acacia karroo/Alien Scrub
- Acacia karroo/Alien Trees
- Alien Scrub
- Alien Trees
- Alien Trees/Scrub
- Aquatic Vegetation
- Bananas
- Canal
- Casuarina equisetifolia
- Cirque
- Coastal Forest
- Coastal Forest/Alien Scrub
- Coastal Forest/Alien Trees/Scr
- Cropland
- Cyperus papyrus Marsh
- Dam
- Depot
- Dry Forest
- Dry Forest/Alien Scrub
- Dry Forest/Alien Trees
- Dune Forest
- Earth
- Estuary
- Eucalyptus Self-sown
- Farm Estate
- Foredune
- Golf Course
- Grassland
- Grassland Mown
- Grassland/Alien Scrub
- Harbour
- Hygrophilous Grassland
- Hygrophilous Grassland/Aliens
- Infrastructure
- Lake
- Mangroves
- Marsh
- Marsh/Alien Scrub
- Marsh/Swamp Forest
- Mine
- Mudflats
- Mudflats/Salt Marsh
- Orchard
- Pan
- Pasture
- Phragmites australis Marsh
- Phragmites-Cyperus Marsh
- Phragmites-Sedge Marsh
- Pine Self-sown
- Plantation
- River
- Riverine Bush
- Riverine Bush/Alien Scrub
- Riverine Bush/Marsh
- Riverine Forest
- Riverine Forest/Alien Scrub
- Riverine Forest/Alien Trees
- Riverine Forest/Marsh
- Riverine Vlei
- Riverine Vlei/Alien Scrub
- Road/Rail
- Rural/Peri-urban
- Sand
- Savanna
- Secondary Acacia Savanna
- Secondary Dune Forest
- Secondary Forest/Alien Scrub
- Secondary Forest/Alien Trees
- Secondary Grassland/Aliens
- Secondary Marsh
- Sedge-Grassland
- Shore
- Shrubland
- Shrubland/Alien Scrub
- Shrubland/Alien Trees
- Shrubland/Grassland
- Shrubland/Grassland/Aliens
- Slimes Dam
- Sugarcane
- Swamp
- Swamp Forest
- Swamp Forest/Alien Scrub
- Swamp Forest/Alien Trees
- Swamp Marsh
- Syzigium Savanna
- Syzigium Savanna/Alien Scrub
- Thicket/Alien Scrub
- Transformed
- Urban
- Valley Bushveld
- Verge
- Water
- Wattle Self-sown

Table 1: Vegetation statistics in the study area

Vegetation/ecosystem types & land covers	National unit	Total Area uMhlathuze (Ha)	Total: Study Area (Ha)	Ratio	Condition class
Vegetation Types					
Maputaland Coastal Belt	CB1				
Grassland		1296.8	18.82352818	1.45%	1
Grassland Mown		596.3	298.0495964	49.98%	2
Grassland/Alien Scrub		887.6	17.54592695	1.98%	2
Hygrophilous Grassland		247.7	194.8319441	78.66%	1
Hygrophilous Grassland/Aliens		14.7	12.72067132	86.54%	2
Savanna		510.4	0.308589453	0.06%	1
Acacia karroo Savanna/Aliens		19.5	5.45637334	27.98%	2
Acacia karroo Thicket/Aliens		48.9	0.529454004	1.08%	2
Acacia karroo/Alien Scrub		79.6	23.5891417	29.63%	2
Acacia karroo/Alien Trees		8	5.04805957	63.10%	3
Thicket/Alien Scrub		114.7	12.93582266	11.28%	3
Shrubland		193.4	168.3396024	87.04%	2
Shrubland/Alien Scrub		277.1	179.6645078	64.84%	3
Shrubland/Alien Trees		13.4	13.33799336	99.54%	3
Shrubland/Grassland		1594.5	1187.315189	74.46%	1
Shrubland/Grassland/Aliens		495.8	397.7465073	80.22%	2
Syzigium Savanna		143.2	136.1646324	95.09%	1
Syzigium Savanna/Alien Scrub		22	21.54961701	97.95%	2
Eucalyptus Self-sown		750.7	452.2909142	60.25%	3
Pine Self-sown		165.6	165.29845	99.82%	3
Wattle Self-sown		48	47.94381738	99.88%	3
Secondary Grassland/Aliens		1627.8	215.2996581	13.23%	3
Northern Coastal Forest	FOz7				
Coastal Forest		1079.1	276.9189287	25.66%	1
Coastal Forest/Alien Scrub		248.5	88.23720215	35.51%	2
Coastal Forest/Alien Trees/Scr		211.6	116.9288622	55.26%	3
Dune Forest		2044.5	388.7017255	19.01%	1
Acacia karroo Woodland		171	97.5976169	57.07%	2
Acacia karroo Woodland/Alien T		23.8	17.72372939	74.47%	3
Acacia karroo Woodland/Aliens		156.5	137.7087777	87.99%	2
Riverine Forest		237.5	10.01520947	4.22%	1
Riverine Forest/Alien Trees		7.1	2.150780762	30.29%	2
Secondary Dune Forest		238.8	1.522497656	0.64%	2
Secondary Forest/Alien Scrub		136	114.5655039	84.24%	3
Secondary Forest/Alien Trees		80	69.84301934	87.30%	3
Swamp Forest	FOa2				
Swamp Forest		900.1	576.4291058	64.04%	1

Vegetation/ecosystem types & land covers	National unit	Total Area uMhlathuze (Ha)	Total: Study Area (Ha)	Ratio	Condition class
Swamp Forest/Alien Scrub		105.4	25.805888	24.48%	2
Swamp Forest/Alien Trees		23.3	12.29708248	52.78%	2
Mangrove Forest	FOa3				
Mangroves		1078.9	1067.218848	98.92%	1
Subtropical Estuarine Salt Marshes	AZe3				
Mudflats		334.9	334.5667578	99.90%	1
Mudflats/Salt Marsh		69.2	59.7853415	86.40%	1
Subtropical Freshwater Wetlands	AZf6				
Cyperus papyrus Marsh		674.9	443.0681371	65.65%	1
Marsh		247.7	107.5063757	43.40%	1
Marsh/Alien Scrub		23.7	1.548758984	6.53%	2
Marsh/Swamp Forest		11.5	2.117955078	18.42%	1
Pan		6.9	6.320930762	91.61%	1
Phragmites australis Marsh		991.9	760.76971	76.70%	1
Phragmites-Cyperus Marsh		359	329.2730355	91.72%	1
Phragmites-Sedge Marsh		466.4	174.4960334	37.41%	1
Riverine Vlei		375.4	21.34110573	5.68%	1
Riverine Vlei/Alien Scrub		22.9	2.711258615	11.84%	2
Secondary Marsh		73.4	16.83367842	22.93%	2
Swamp		2.9	2.843881445	98.06%	1
Swamp Marsh		6.7	6.669122559	99.54%	1
Subtropical Alluvial Vegetation	AZa7				
Acacia karroo Riverine		107.8	15.26959961	14.16%	2
Acacia karroo Riverine/Aliens		30.4	9.172490527	30.17%	3
Riverine Bush		337	1.682053809	0.50%	2
Riverine Bush/Alien Scrub		109.6	0.649223145	0.59%	3
Subtropical Seashore Vegetation	AZd4				
Casuarina equisetifolia		215.9	205.5139285	95.19%	4
Foredune		142.8	107.587348	75.34%	1
Shore		8.8	7.211444727	81.95%	1
Subtropical Dune Thicket	AZs3				
Cirque		31.4	9.454571777	30.11%	1
Alien Vegetation					
Alien Scrub		709.9	359.2610808	50.61%	4
Alien Trees		79.1	9.236779069	11.68%	4
Alien Trees/Scrub		877.3	18.23267569	2.08%	4

Vegetation/ecosystem types & land covers	National unit	Total Area uMhlathuze (Ha)	Total: Study Area (Ha)	Ratio	Condition class
Other Ecosystems					
Estuary		782.5	782.4814872	100.00%	2
Harbour		1176.5	1176.490609	100.00%	3
Lake		1905.9	1692.184596	88.79%	2
Aquatic Vegetation		87.4	59.22842617	67.77%	1
River		639.7	200.3796565	31.32%	2
Water		26.8	26.31997178	98.21%	2
Transformed land covers					
Bananas		130.5	62.53715781	47.92%	
Canal		113.8	41.60574661	36.56%	
Cropland		637.6	185.513742	29.10%	
Dam		66.1	4.345715684	6.57%	
Depot		18.8	2.245487793	11.94%	
Earth		141.4	79.3968053	56.15%	
Farm Estate		477.3	31.42859911	6.58%	
Golf Course		97.9	51.66103584	52.77%	
Infrastructure		1099	938.0197935	85.35%	
Mine		347.1	256.410734	73.87%	
Orchard		67.3	27.92534483	41.49%	
Pasture		19	1.917980125	10.09%	
Plantation		11763.3	1517.151239	12.90%	
Road/Rail		827.6	368.3492124	44.51%	
Rural/Peri-urban		12634.3	1391.189892	11.01%	
Sand		40.8	11.73441172	28.76%	
Slimes Dam		118.5	116.7901972	98.56%	
Sugarcane		17569.2	3840.623431	21.86%	
Transformed		204.8	135.3231586	66.08%	
Urban		4589.8	1897.168724	41.33%	
Verge		244.2	47.48185055	19.44%	

10.1.2 Quality of the vegetation (extent of degradation)

Quality of the vegetation is defined for this study as 'biodiversity quality', and is intended to reflect the degree to which potentially supported biodiversity has been compromised as a consequence of direct impacts on the vegetation. Assessment of vegetation quality refers only to remaining natural asset and does not consider transformed areas. In order to assess vegetation quality, a suite of impacting agents was first listed, then each relatively uniform portion of a vegetation type was examined and scored using a four-class scale (1: relatively pristine; 2: some elements impacted; 3: extensive disturbance and some elements missing; 4: degraded with many elements missing). Agents that have impacted quality of the vegetation in the past or at present include: (a) heavy livestock grazing; (b) invasion by alien plants such that abundance of indigenous species has been reduced; (c) harvesting of plants for

a variety of purposes (e.g. medicinal plants, building materials); (d) repeated mowing of grassland, which is known to eliminate many of the non-grass species; (e) burning of fire-intolerant vegetation such as forest; (f) soil disturbance; (g) drainage of wetland or of hygrophilous vegetation; (h) excessive sedimentation of wetland or of estuarine vegetation, and (i) extended preclusion of fire from fire-dependent vegetation types such that they become moribund. The importance of any agent or of their collective effect depends in a large part on the ability of vegetation to respond. For example, mowing has little effect on grass itself but it has a marked negative impact on non-grass species within grasslands. The latter may be resilient to infrequent mowing but many species are eliminated under frequent mowing.

It has not been possible to map all of these impacts owing to nature and scale at which many occur. Vegetation condition of some, however, could be explicitly mapped when mapping vegetation types (**Figure 29**). For example, grassland or forest which had been degraded through invasion by alien plants, repeatedly mown grassland, patches of near total soil disturbance, or where secondary vegetation had developed, were all clearly discernible on aerial photographs. Some of the main vegetation types are briefly described.

***Maputaland Coastal Belt* (CB1).** Table 5 lists 21 mapping units for this vegetation type of Mucina and Rutherford. The units supporting relatively pristine vegetation are grassland, shrubland/grassland, hygrophilous grassland, *Syzigium* savanna, and savanna. The main agent responsible for a decrease in condition of any of these units of this Vulnerable vegetation type has been invasion by alien plants, which has been explicitly mapped (**Table 9; Figure 29**). However, many of the grasslands of the area were degraded by heavy cattle grazing up until the development of the area in the 1970's, resulting in wind erosion of marine-derived sands in particular. Vegetation of such areas has stabilised following the withdrawal of livestock over the past few decades, except within communal settlement areas. This past impact could be revealed by sampling of grassland composition, especially by the abundance of *Aristida junciformis*, but this would require intensive ground sampling. Drainage has resulted in secondary grassland where wetland used to exist, such as within Alton North. Mowing of some of the power line servitudes was observed to have had a negative impact on plant diversity. However, not all servitudes have been mown, and some support excellent grassland beneath them. Some areas of shrubland/grassland are tending toward shrubland or shrubland/aliens as a result of continued preclusion of fire. These areas still maintain high value plant diversity but this would improve if fire was reinstated. Harvesting of plants has become intense in some areas, as was observed for part of the IDZ where large piles of the medicinal (and red data) plant *Hypoxis hemerocallidea* had been assembled (T O'Connor, personal observation). It should be noted that harvesting of medicinal plants is for serving a national commercial industry and not for serving local subsistence needs.

***Northern Coastal Forest* (FOz7).** Coastal Forest, Dune Forest, and Riverine Forest are the three relatively pristine units of this vegetation type which have been mapped (**Figure 29**). As with the

Maputaland Coastal Belt vegetation type, invasion by alien shrubs and trees has been an important cause of vegetation degradation, but the main impact on forest has been previous clearing which has resulted in either secondary forest or *Acacia karroo* woodland, either of which may have high levels of infestation by alien plants. Nine of the twelve units mapped are characterised by aliens or are secondary in nature, indicating the extensive impact forest vegetation has experienced. Much of the current secondary forest results from the withdrawal of plantation forestry, but most of this secondary forest will be impacted shortly by dune mining. Small-scale sugarcane farming has been a cause of ongoing loss of forest in the southern area of dune forest[4], while a few have developed secondary forest vegetation following abandonment. *Acacia karroo* woodland is considered to have developed on abandoned settlement sites or cropping fields, as well as on grassland which used to occur within the dune forest cordon[5]. Some of the patches of coastal forest within the plantation areas have been impacted by fire, and also damaged during logging operations, but not at a scale that can be mapped. Forests are also an important source of medicinal plants and building materials, but the extent of this impact is unknown.

***Swamp Forest* (FOa2)**. The only significant impact on swamp forest, other than transformation by clearing, has been invasion by alien shrubs and trees. Most of this invasion is at the edge of the forest where conditions are slightly drier as there are not many alien plants which are capable of thriving under the saturated conditions of swamp forest.

***Mangrove Forest* (FOa3) *and Subtropical Estuarine Salt Marshes* (AZe3)**. Owing presumably to the saline nature of the substrate on which this vegetation types occur, alien plants are insignificant. Overall they are in good condition. Stems of mangrove trees are a preferred building material owing to their straightness. Anecdotal account suggests that harvesting has intensified. Sustainability of this practice is unknown.

***Subtropical Freshwater Wetlands* (AZf6).** *Phragmites australis* reedbeds are harvested for building materials. This growth form can support sustainable harvesting if properly regulated, such as occurs within iSimangaliso Wetland Park.

***Subtropical Alluvial Vegetation* (AZa7)**. Vegetation on riverine alluvium of larger rivers is accustomed to repeated disturbance from floods, during which standing vegetation (including trees) may be lost and substantial quantities of sediment may be deposited. The last major flood occurred during 1987, although smaller flood events have occurred since. Direct disturbance by humans that has occurred includes the diversion of the Mhlathuze River for port construction, and smaller localised disturbance for construction projects crossing rivers. Disturbance provides an opportunity for alien

[4] Oellermann C G (2001) *Land use analysis using GIS: A Case Study of Richards Bay Minerals' Zulti South Mining Lease Area*. M.SC. thesis. University of Natal, Pietermaritzburg.
[5] Weisser P J (1987) *Dune vegetation between Richards Bay and Mlalazi Lagoon and its Conservation Priorities in relation to Dune Mining.* Natal Town and regional Planning Supplementary Report Volume 19, pp 1-71.

invasive plants to establish. Consequently, this is one of the most heavily infested vegetation types. All mapped units of this vegetation type would support some amount of alien vegetation. The dominance of *Acacia karroo* along many sections of alluvium testifies to the rapid growth of this woody species under such conditions.

Subtropical Seashore Vegetation **(AZd4) and** ***Subtropical Dune Thicket*** **(AZs3)**. Both of these vegetation types can be considered as functional components of dune forest, of which they are precursors. They are dynamic units which change relatively rapidly over time. Both these vegetation types are considered to be in relatively pristine condition owing to the fact that they are usually outside the footprint of development or use.

10.2 Terrestrial Ecosystem Types

An ecosystem is defined as a set of plant and animal communities through which energy and materials flow. Continued delivery of goods and services requires that the pattern of interaction of component vegetation types and other organisms is maintained Vegetation types as discussed above do not adequately represent the nature of functioning of some of the more conspicuous ecosystems of the study area that consist of a set of interacting vegetation types and supported animal biota. The purpose of this section is to complement the description of vegetation types with an account of a selection of the ecosystem types that are significant within the study area.

The Port Due Diligence Investigations have commissioned specialist studies on terrestrial ecosystems. The products of these studies are expected by the end of November 2009 after which they will be considered for integration into the EMF baseline.

10.2.1 Dune cordon

The dune cordon is a conspicuous feature for almost the entire length of the KZN coastline, presenting the highest vegetated dunes in the world at Mapelane. It is a dynamic entity which continues to grow through accretion of sand from the oceans in some places, and erosion and loss of sand to the sea in other places, along this stretch of coastline. The latter mentioned are expected to become increasingly vulnerable to erosion with increasing sea-level rise. A substantial portion of the coastline within the study area is considered to be regressive, and hence this region may be at particular risk. In addition, cirques are formed by sub-surface flow of fresh water resulting in localised collapse of the seaward-facing dune slope to form a vertical wall and near horisontal bed that supports wetland vegetation.

Accreting dunes initiate a primary vegetation succession that is well studied within the study area[6]. Subtropical Seashore Vegetation (**Table 9**) is the precursor of Subtropical Dune Thicket leading eventually to Northern Coastal Forest that is characteristic of the higher dunes. Historical disturbance of iron-age settlement sites and recent disturbances including plantation forestry have resulted in a mosaic of vegetation types along the dune cordon, including some large areas of *Acacia karroo* woodland. Dunes supported grassland twenty or so years ago but these areas have been transformed to woody forms of vegetation as a result of successional vegetation change.

The weakly structured, sandy soils of dunes promote infiltration of incident rainfall that first permeates through the dune to be deflected mainly landward by a relatively impervious layer of hard geology. This water emerges on the landward flank of dunes to form a number of conspicuous drainage systems supporting swamp forest and wetlands, as well as smaller lakes. The functioning of these water-related components cannot be considered independently of the dunes.

10.2.2 Grasslands

Coastal grassland was the most characteristic ecosystem of the Maputaland Coastal plain before extensive transformation to plantation forestry and sugarcane farming took place. Owing to the extent of loss of this vegetation, it is now a **national conservation priority**. This grassland occurs primarily on geologically recent marine sandy deposits, whose topography varies conspicuously across the study area in relation to local landscape agents. In some parts there are mini-dunes and intervening swales; in other places fluvial erosion has created extended slopes. In some places the shallow water table expresses itself as hygrophilous grassland in many places, these units grading into adjacent grassland; while in other places the height of the water table results in permanent pans or wetlands. This scale of topographical variation in relation to water availability also reflects soil texture as fines accumulate in low-lying areas, while wind and water action remove fines from dune crests. Grassland, hygrophilous grassland, small pans and vleis all function as a single system that interacts closely with adjacent wetland and forest systems.

The hallmark of coastal grassland is the phenomenal plant diversity it contains. This system is not only a recognized biodiversity hot spot but also contains 22 of the red data plant species listed for KwaZulu-Natal, of which one is **critically endangered** species, five are **vulnerable species**, ten are **lower risk** species and six are data deficient[7]. This richness is a result of the pronounced environmental gradients which occur. The variation in water table and soil texture described above further reflect variation in soil fertility – the more fines, the more fertile. Many of the species occurring in grassland may be restricted to a limited portion of an environmental gradient. For example, the Critically Endangered *Kniphofia leucocephala* occurs only on the margins of a handful of small vleis. Other

[6] Weisser P J (1987) *Dune vegetation between Richards Bay and Mlalazi Lagoon and its Conservation Priorities in relation to Dune Mining.* Natal Town and regional Planning Supplementary Report Volume 19, pp 1-71.
[7] O'Connor T (2003) *KZN282 identification and Prioritization of Red Data Book Species and Other Conservation Worthy Species*. Report prepared for the uMhlathuze Municipality.

species mirror this pattern of distribution, while yet other species may be restricted to dune crests. In order to maintain the richness of the grassland habitat, it is therefore essential that all such variations in habitat are maintained.

Urban expansion is rapidly destroying grassland ecosystems and is of concern to nature conservationists. Changes in the hydrological regime of the area will also influence the status of these systems. Climate change will further increase the risk of grasslands as increasing carbon dioxide levels encourage the establishment of woody vegetation thereby negatively affecting their structure and functioning. These ecosystems need to be carefully managed.

10.3 Aquatic and Estuarine Ecosystem Types

10.3.1 Wetland Systems

There are nine freshwater wetlands types in the study area. They are spatially related to each other and to processes that happen at the landscape scale and can therefore not be considered in isolation of each other. Their position in the landscape are related to the hydrological regime, sediment source and rate of sedimentation as well as to substrate characteristics. One of these wetland types, **Papyrus Swamp**, have been highlighted as occupying a very unusual and narrow suite of habitat conditions and therefore has a *very high national conservation status*[8]. It has a very limited extent in the area and is under pressure from current use of land (transformation of surrounding land, channeling etc) and the proposed future expansion of the harbour. The health status of the Papyrus Swamp System has been described as largely natural (geomorphology and vegetation) and moderately modified (hydrology). The functioning of these swamps is described in detail in the specialist work. The significance of the system lies in ecosystem services such as flood attenuation, streamflow regulation, water quality enhancement benefits, and carbon storage and biodiversity maintenance. The critical role of this system in supporting the ecological functioning of the Estuary must be noted. The likely trajectory of change for the remaining swamps under conditions of no development is as follows:

Significance of Papyrus Swamp

The Richards Bay Papyrus Swamp is the most significant population in southern Africa.

It fulfils a significant role in pollution reduction into the port.

An endemic fish species whose distribution is restricted to parts of coastal KwaZulu-Natal is present in the swamps.

- Gypsum Dam Swamp: appropriate management measures will support maintenance and system health.

[8] Ellery W N, Cyrus D P and Vivier L (2009) *Preliminary Assessment of Impacts of the Planned Expansion of Richards Bay Port on Wetlands*. Report prepared for Transnet National Port Authority, Richards Bay through Ilifa Africa Engineers Pty (Ltd) and dated July 2009. Coastal Research Unit of Zululand, Investigational Report No.129.

- Lake Nsezi Swamp: the system's health is threatened by the poor link of the Mhlathuze Floodplain with the swamp.

10.3.2 River Systems

While the Mhlathuze and Nseleni Rivers comprises the primary drainage system of the study area, they are linked to the main water bodies in the area, Lake Mzingazi, the Harbour Estuary and the Mhlathuze Estuary (Sanctuary), as well as . These water bodies are also linked to another via channels so that Lake Mzingazi flows into the Harbour and the Sanctuary and the Harbour transfer water to and fro, depending on the tide and the runoff. Lake Nsezi and Cubhu also drains to the Sanctuary. These water bodies and their associated drainage systems are spatially related to each other and to processes that happen at the landscape scale and can therefore not be considered in isolation of each other. Together they constitute an ecosystem that plays a significant role in the maintenance of ecosystem goods and services and should therefore be considered in the management of the area, particularly the open spaces that encompass the drainage system and the development areas that impact on the natural system and its ability to sustain itself[9].

Specialist's investigations on the Lake Nsezi-Estuary Link are being concluded as part of the Port Due Diligence Investigations. The products of these studies are expected by the end of November 2009 after which they will be considered for integration into the EMF baseline.

10.3.3 Richards Bay Port Estuary

The natural functioning of the original estuary may have been impaired but there are features and characteristics in the Richards Bay Port estuary that emphasize the ecological significance of this area as an ecosystem type. The port estuary has an important role in providing refuges, nursery grounds and feeding areas for marine and estuarine dependent organisms and parts of the port are rated as nationally important aquatic ecosystems. Up to 40% of the Tugela Bank prawn stock spends their juvenile stage in the Port of Richards Bay.

Old established ***mangrove stands*** (remnants of the original estuary) are of species significance and are nationally recognised. They provide breeding grounds for fish and other marine life; trap silt, and protect the bay's shoreline from erosion. The wake from passing ships impacts on these mangroves through erosion of the shoreline. Mangrove stands within the Richards Bay Coal Terminal area are vulnerable to expansion of infrastructure. Warmer climates and sea level rise may further threaten the mangrove system[10].

[9] uMhlathuze Municipality (2002) *Integrated Development Plan – Situation Analysis*. Report prepared by Vuka Town and Regional Planners Inc. report: TRP_449_N_Rp169 and dated April, 2002.
[10] uMhlathuze Local Municipality (2009) City of uMhlathuze Climate Change Vulnerability Assessment. Prepared by Zitholele Consulting for the City of uMhlathuze and dated May 2009. Report Nr 11970.

Intertidal mudflats have a high habitat value from the point of view of marine species such as prawns and fish that are dependant, or partially dependant, on estuaries for part of their life cycle. Four fish species listed on the International Union for the Conservation of Nature and Natural Resources (IUCN) 2003 Red Lists of Threatened Species have a strong preference for mudflats over other harbour habitats. An area of approximately 125ha of this habitat occurs along the south-western edge of the harbour, with the major area located at the outlet of the Bhizolo Canal. The intertidal mudflats are under threat by port expansion.

Intertidal sandflats have a high conservation value as feeding grounds for fish and are particularly valuable from the point of view of birdlife that utilise the flats for feeding and roosting purposes. Sandflats function as nutrient processing areas by supporting a high diversity of microbial, meiofaunal and macrofaunal communities. This habitat has high conservation significance.

The ***Bhizolo/Manzamnyama Canal Complex*** has a high species diversity and density of fish. It is also the nursery ground for juvenile stocks of the breeding population of marine prawns (*Peneaeus* spp.).[11] Losses of this habitat type could have a significant impact on the prawn trawling industry. The complex has been identified as a potential ecological corridor between the Municipality area and the Sanctuary.

The National Ports Authority has recognised the ecological significance of the Richards Bay Port Estuary. They have undertaken habitat assessments and assigned values to those habitats that have been identified as significant. Of the 22 habitats identified and rated, 12 had a high conservation significance score, 8 had a moderate score and only 2 had a low conservation significance score[12].

10.3.4 The Mhlathuze Estuary (Sanctuary)

The Sanctuary estuary comprises mangrove forest, *Phragmites australis* reed beds, an open water area containing *Zostera* stands, mudflats and salt marshes. An estuary is the downstream product of its catchment and its connection with all freshwater sources, specifically the Nseleni River, Mhlathuze River, and Lake Cubhu, is an integral part of its continued functioning. The amount of freshwater entering the estuary is a critical factor for maintaining the salt balance in the system.
The Sanctuary contains the largest mangrove forest in South Africa, which has developed during the past 30 years as a consequence of sedimentation processes due to large-scale land transformation. Mangrove progression has reportedly ceased, indicating that the system is stabilizing[13].

[11] CSIR (2002) *Strategic Environmental Assessment for the Port of Richards Bay: Scoping Report*. Report produced by Heather-Clark S and Govender K from the CSIR for the National Ports Authority, June 2002. CSIR Project No: JX287, Congella, Durban.
[12] CSIR (2005) *Strategic Environmental Assessment for the Port of Richards Bay: State of the Environment Summary Report*.
[13] Bedin T (2001) The progression of a mangrove forest over a newly formed delta in the Umhlathuze estuary, South Africa. Candidata Agriculturae Theses Agricultural University of Norway.

The Mhlatuze Estuary is rated as a nationally important aquatic ecosystem particularly for fish and birds. The system is ranked 10th overall out of some 250 South African estuaries in terms of estuarine function; it is also nationally important for fish (ranked 4th) and birds (ranked 5)[14]. Water quality problems the Sanctuary have been identified although very little information is available.

10.4 Terrestrial Fauna

10.4.1 Birds

Richards Bay has been ranked the second most important habitat for birds along the entire KwaZulu-Natal coastline, while Thulazihleka Pan is ranked third[15]. This is to be expected considering the abundance of aquatic habitats in the study area. There are 350 known species of birds in the area, and 66 internationally significant waterbird species. The latter has been identified as significant species under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) in terms of the Bonn Convention[16]. These species utilises the wetlands, tidal flats and sand spits in the Port Estuary and the Mhlatuze Sanctuary Estuary. The abundance of particular species is dependent on the water levels in these habitats.

A total of 44 Red Data bird species have been listed for the broader municipality area (**Table 10**). Grassland or Grassland/Savanna supports the highest proportion (30 %), followed by various wetland types (25 %), various forest types (25 %), with estuaries, mangroves and rivers supporting the remainder.

Table 2: Red Listed Bird Species

RED LISTED BIRD SPECIES	
RED LISTED CATEGORIES	**NUMBER LISTED**
CRITICALLY ENDANGERED	1
ENDANGERED	3
VULNERABLE,	15
NEAR THREATENED.	25
TOTAL	**44**

[14] Du Toit F (2009) *Due Diligence Investigation for Acquisition of Land for Future Port Development: Gap Analysis.* Report produced by Ilifa Africa Engineers (Pty) Ltd for Transnet National Ports Authority, March 2009. Ilifa document no 28007/Transet Richards Bay, Meerensee. Page 22

[15] BirdLife International (2009) *Important Bird Area factsheet: Richards Bay Game Reserve*, South Africa. Downloaded from the Data Zone at http://www.birdlife.org on 7/9/2009

[16] CIC International (2009) *Richards Bay Environmental Resource Economics Evaluation*. Version 4. Prepared for Transnet Limited and dated February 2009.

10.4.2 Amphibians, Reptiles and Mammals

The study area is considered to be of significance as a biogeographical corridor for many species. Extensive loss and fragmentation of wetlands and other habitat types in the study area has restricted populations of species. Nineteen species of mammal occur in the municipal area in special habitats, ranging in size from a shrew to hippopotamus. Sixteen species of mammal are red listed species.

A new frog species has recently been discovered north of the study area in forest habitats[17]. *Hyperolius pickersgilli* is a high priority frog species (ENDANGERED) because of its narrow distribution. It occurs in wetlands. Amphibians are good indicators for assessing ecosystem health as they are generally sensitive to environmental change. The Port Due Diligence Investigations have commissioned specialist studies that include the taxonomic order of Anurans as indicator. The products of these studies are expected by the end of November 2009 after which they will be considered for integration into the EMF baseline.

Eleven species of reptile is of significance in the study area, occurring in wetlands, forests and grasslands. Two of these species are classified as VULNERABLE, one as RARE, while three are KwaZulu-Natal endemics and six are peripheral in South Africa, but rare. There are also five species of turtle, all listed internationally as ENDANGERED and as VULNERABLE in South Africa, that occur along the coastline. These species are the Loggerhead Sea Turtle (*Caretta caretta*), Green Sea Turtle (*Chelonia mydas*), Hawksbill Sea Turtle (*Eretmochelys imbricata*), Olive Ridley Sea Turtle (*Lepidochelys olivacea*), and Leatherback Sea Turtle (*Dermochelys coriacea*). The occurrence of these species along the coastline serves to highlight the importance of the marine environment[18].

10.5 Visual Quality and Sensitivity

Specific qualities of a landscape infuse a site with a sense of place for people. Natural vegetation, water bodies, landscaped parks, and the sea in particular, provide aesthetically pleasing environments for the inhabitants of an area. This is important to note in any discussion of land conservation and growth management, because development activities tend to eliminate unique features of the landscape. The cumulative impact of sprawl development is often not recognised and in a growing city the effect is only realised once the development has actually taken place. By that time it is often too late to mitigate the loss of visual quality and sense of place. Therefore it is imperative that the EMF, as a planning tool, will also address this issue.

[17] Minter, L.R. (2003) Two new cryptic species of Breviceps (Anura:Mycrohylidae) from southern Africa. African Journal of Herpetology, 52, 9-21.
[18] O'Connor T (2003) *KZN282 identification and Prioritization of Red Data Book Species and Other Conservation Worthy Species*. Report prepared for the uMhlathuze Municipality.

Being a coastal town in a sub-tropical climate, surrounded by a variety of water features, Richards Bay has the potential of being an attractive city. This character has to a certain extent been preserved by careful town planning and layouts incorporating vast open space, as illustrated in the photographs in **Figure 30.** At first site, this leaves one with a pleasant feeling of the environment. However, this is spoilt not only by sight of towering industrial buildings, but offensive odours emanating from these. Together with health related connotations, industrial development is a serious threat to the sense of place and the visual character of the study area (**Figure 31**).

Figure 2: Open space in Meerensee

The quantification of visual quality is somehow difficult, since aesthetic judgement may be considered a matter of personal taste, which is often influenced by emotions and feelings. On the other hand, the aforementioned features certainly have a positive effect on a person's sense of place, as it is formed in respect of the study area. Hence, by assigning values to land use and vegetation classes, the visual character of the study area can be visualised on a map (**Figure 32**).

Figure 3: View of Foskor (left) and Tata Steel (far right) with a foreground of degraded vegetation.

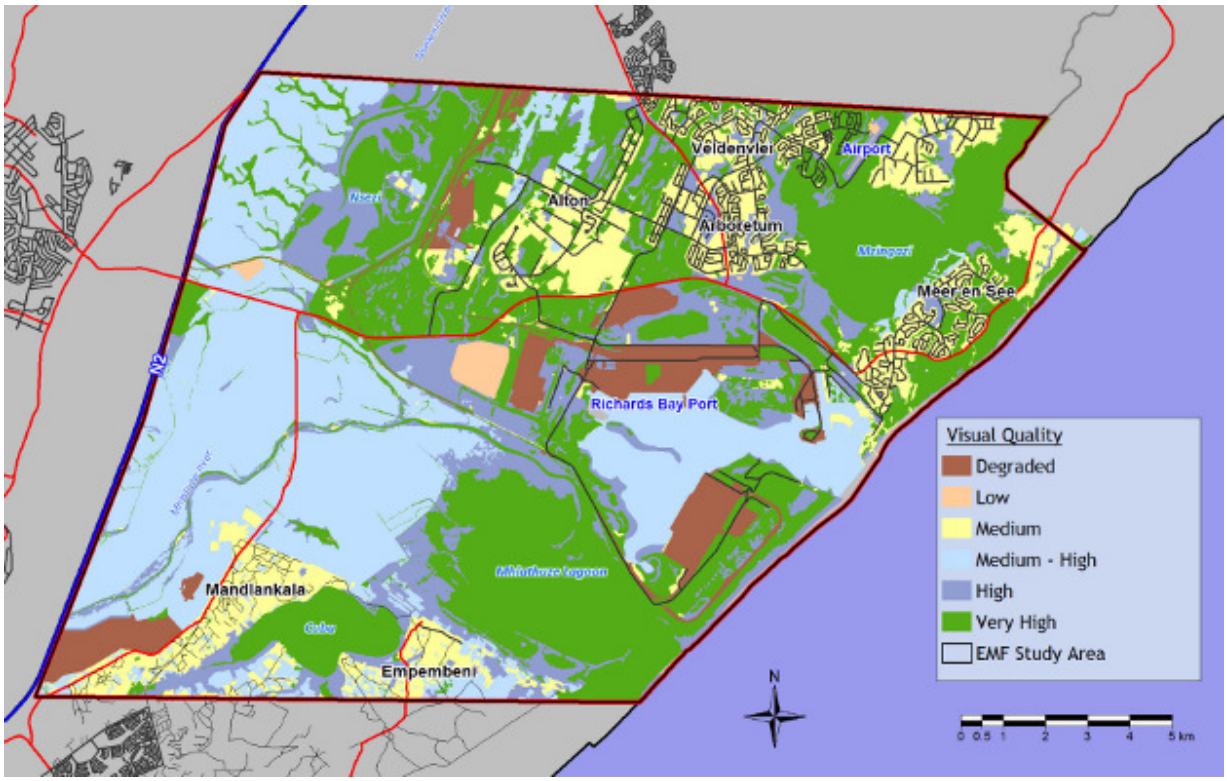

Figure 4: Visual quality

The classification of visual qualities has been done as follows:

Degraded:	Industrial activities, including the port;
Low:	Disturbed areas;
Medium:	Built-up areas associated with open space and landscaping;
Medium to high:	Agriculture, Forestry and the harbour;
High:	Grassland, mangroves, swamps, etc;
Very high:	Open water, natural forest, dunes.

The attraction of areas with high visual qualities lies in its ability to be utilised and exploited. In the study area opportunities for recreation exist in the form of the following:

- Swimming: Alkantstrand Beach;
- Fishing: Various locations along the beach and around the port area;
- Whale watching: Alkantstrand Beach;
- Yachting: Harbour;
- Golf: Meerensee;
- Birding: Various spots associated with natural forests and open water;

A general concern is limited accessibility to the beach, and limited public amenities around the lakes and rivers. Enclosed by the port, cane farming and the villages of Mandlankala and Empembeni, the Mhlathuze River and the estuary with its unique mangroves, are virtually inaccessible by the general public.

11. CULTURAL AND HISTORICAL FEATURES

Several archaeological and paleontological sites have been recorded in the broader municipal area. For example over 350 sites of archaeological significance have been recorded in the coastal dune system of Richards Bay Minerals.

A heritage survey was recently completed[19] as a component of the Transnet National Ports Authority Due Diligence Study. The results of the study and the significance thereof for this EMF are briefly described as follows:

- Several archaeological and palaeontological sites have been recorded within a radius of 10 km around the port development area.
- A large number of sensitive archaeological sites exist in the coastal dune areas (coinciding with mining lease areas) and are of high significance.
- Palaeontological remains occur in the Cretaceous layer underlying the study area. These are of high significance.
- The existence of historical buildings has been recorded around the historical Mhlathuze lagoon, but most of them have been destroyed during construction of the port. Any existing buildings older than 60 years should be identified and protected.

Areas of significance that would require monitoring during future developments, and which should be addressed in the EMF, are the following:

- Any area below the surface that has paleontological remains;
- Undeveloped land north of the John Ross Parkway;
- Coastal dune areas.

[19] Anderson G and Anderson L (2009) *Heritage Survey of the Proposed Expansion to the Transnet National Ports Authority, Richards Bay.* Report prepared by Umlando Archaeological Tourism and Resource Management for MSA Environmental, Legal and Mining Services and dates June 2009.