STRATEGIC ENVIRONMENTAL ASSESSMENT FOR GAS PIPELINE DEVELOPMENT IN SOUTH AFRICA

Biodiversity and Ecological Impacts

(Terrestrial Ecosystems and Species) - Indian Ocean Coastal Belt Biome

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR GAS PIPELINE DEVELOPMENT

Draft v3 Specialist Assessment Report for Stakeholder Review

INDIAN OCEAN COASTAL BELT BIOME

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ABBREVIATIONS AND ACRONYMS

AIP	Alien Invasive Plant
ASL	above sea level
CB 1	Maputaland Coastal Belt
CB 2	Maputaland Wooded Grassland
CB 3	Kwazulu-Natal Coastal Belt
CB 4	Pondoland-Ugu Sandstone Coastal Sourveld
CB 5	Transkei Coastal Belt
CBA	Critical Biodiversity Area
CR PE	Critically Endangered Possibly Extinct
CR	Critically Endangered
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
ECBCP	Eastern Cape Biodiversity Conservation Plan
EKZNW	Ezemvelo KZN Wildlife
EN	Endangered
ESA	Ecological Support Area
GIS	Geographic Information System
IOCB	Indian Ocean Coastal Belt Biome
KZN	KwaZulu-Natal
NLC	National Land Cover
NPAES	National Protected Area Expansion Strategy
PCE	Pondoland Centre of Endemism
SANBI	South African National Biodiversity Institute
SAPAD	South African Protected Areas Database
SEA	Strategic Environmental Assessment
VU	Vulnerable

1 SUMMARY

This assessment aims to identify the potential impacts of constructing and maintaining gas transmission pipeline infrastructure (i.e. the gas transmission pipeline and associated infrastructure, such as, but not limited to, block valves, pigging stations and access roads as described in the Project Description Chapter of this SEA Report) in the Indian Ocean Coastal Belt Biome (IOCB) of South Africa.

This Biome comprises five dominant and six associated azonal and intrazonal vegetation units, some of which are important from ecological and conservation perspectives. Clusters and potential hotspots of threatened plant species appear to be concentrated in or around formally protected areas. The IOCB is characterised by diverse ranges of habitat and a concomitantly diverse faunal assemblage due to the Biome's location in a climatic niche in a topographically diverse environment with a relatively recent history of human settlement.

The purpose of this assessment was to review available GIS data relevant to the IOCB and terrestrial ecology and assign a sensitivity rating to the feature layers, which could then be used to inform a more detailed gas pipeline servitude. The IOCB covers only a small portion of the eastern corridors (Phases 4 and 7), but is diverse in terms of habitat and land use. The study area stretched between the Mozambique border to the Kei River Mouth in the Eastern Cape.

The activities associated with gas pipeline construction and maintenance may pose a risk of disturbance and transformation of natural vegetation; disturbance of fauna; and constraining existing and earmarked conservation initiatives and connection of protected areas. With regards to the latter impact, for example, the Opathe – Imfolozi corridor is a long term initiative to link these two reserves for the benefit of land conservation and migration of larger fauna. If a pipeline route is to be located within or close to the Opathe – Imfolozi corridor, the requirement to maintain the pipeline servitude will create additional disturbances and constraints that may hinder the management of the protected area. A further example specific to the IOCB is the potential for a linkage between the Nseleni Nature Reserve and the New Mouth area near Richards Bay.

The IOCB has extensively been transformed by agriculture, forestry plantations and urban development. Any proposed gas pipeline routes should be planned and placed to align with existing transformed areas as close as possible.

2 INTRODUCTION

The proposed establishment of a gas transmission pipeline corridor that will, in part, traverse portions of the eastern extent of South Africa holds the potential to affect a number of habitats that lie within this region. More specifically the Indian Ocean Coastal Belt (IOCB) is the dominant biome on the east coast of KwaZulu-Natal (KZN) and comprises of a number of vegetation units or veld types, some of which are important from ecological and conservation perspectives. The establishment of a sub-surface structure such as a gas pipeline will potentially, by its very nature, irreversibly affect some of the vegetation units within the IOCB. As such, consideration should be given to the alignment and routing of such pipelines to avoid the most important habitats within the IOCB.

This report forms one of a number of environmental investigations that have been undertaken to evaluate and provide recommendations on the alignment of the proposed Phased Gas Pipeline corridors, and focusses specifically on the IOCB, with some consideration being given to azonal- and intrazonal habitats that may be located within or adjacent to the IOCB.

3 SCOPE OF THIS STRATEGIC ISSUE

The IOCB is a biome driven primarily by its proximity to the shoreline, the ameliorating effects of the coastal climate, and prevailing geophysics of the south eastern coastline of South Africa (Figure 1). The IOCB is one of approximately 9 recognized biomes that have been categorised for the country, based on plant associations and affiliations with climatic and other variables (Box, 1981; Mucina & Rutherford, 2006). The IOCB comprises only 1.1% of the land area of South Africa, extending between Mozambique to a point just north of East London (Eastern Cape), with a maximum inland extent approximating 50 kilometres in the north of KwaZulu-Natal. The scope of this assessment includes the extent of the IOCB as described in the two relevant proposed Phased Gas Pipeline corridors: Phase 4 and Phase 7 (Figure 1).

This strategic environmental assessment of the proposed Phased Gas Pipeline corridors through the IOCB has been compiled to provide a high level approach to the evaluation of the proposed gas pipeline corridors and the potential influence and effect that the construction and maintenance of the gas transmission pipeline and associated infrastructure will have on the various IOCB vegetation units and associated fauna. This study includes an assessment of gas transmission pipelines, servitudes, block valves, pigging stations and access roads as described in the Project Description Chapter of this SEA Report.

This assessment provides guidance from a broad, eco-morphological perspective that can support decision making on and planning for the establishment of the proposed Phased Gas pipeline corridors and associated infrastructure within the extent of the IOCB. Furthermore, an overview of opportunities to avoid impacts or apply alternative mitigation measures is provided, while also offering opportunities to ameliorate technical issues that may arise in the establishment of such infrastructure.

The assessment therefore evaluates a number of available spatial data sets relevant to the IOCB and assigns specific sensitivity ratings to relevant layers and features. Through this analysis, recommendations can be made regarding the potential routing of the proposed gas pipeline within the identified corridors. Relevant data includes readily available Geographic Information System (GIS) data sets provided by the South African National Biodiversity Institute (SANBI), the Council for Scientific and Industrial Research (CSIR), as well as relevant Provincial Nature Conservation Authorities and National Departments. Since this particular study is a broad scale ecological study, datasets highlighting areas of ecological importance and relevant land uses were prioritised. The key focus was the terrestrial environment within the IOCB. Wetlands, watercourses, estuaries, bats and avifauna have been separately assessed in detail by relevant specialists, although this study does touch on some of these aspects where pertinent to the IOCB.

The core area of this study is the eastern extent of two of the proposed Phased Gas pipeline corridors: Phases 4 and 7 between the Mozambique border and Kei River Mouth (Eastern Cape), extending from the coastline to approximately 30 - 50 km inland. As illustrated in Figure 1, the IOCB only comprises a narrow portion of each corridor, in the eastern extent. Although defined as a clear finite area for the purposes of this study, on the ground and in practical terms, the IOCB can be variable and merge with neighbouring biomes and vegetation types, sharing common characteristics, climatic features and biota.

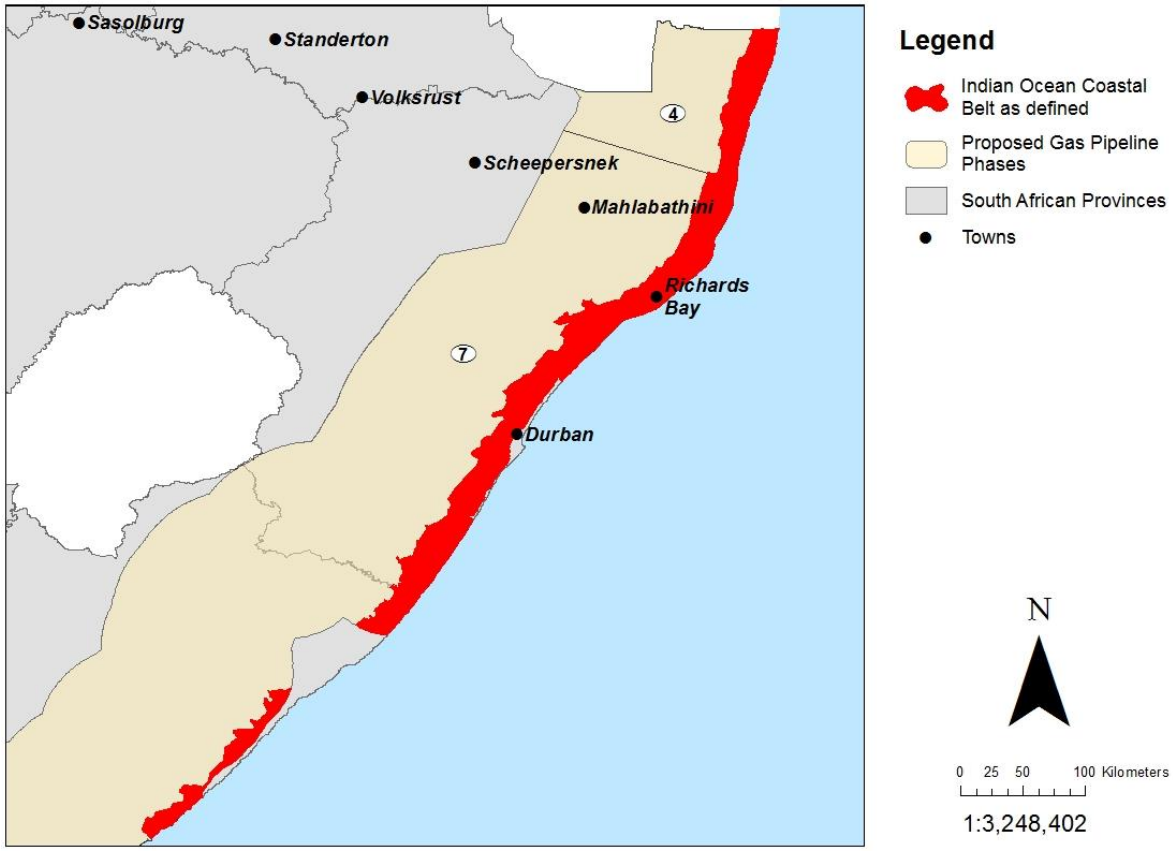

Figure 1: The extent of the IOCB Biome as defined, within the relevant proposed Phased Gas Pipeline Corridors.

3.1 Study Methodology

The assessment of the proposed Phased Gas Pipeline corridors and their relationship to the IOCB was undertaken using the following:

- GIS mapping tools, information and data;
- The review of current and available data and databases (Section 3.1.1. below);
- The analysis and handling of data to align with the IOCB region including the extraction of relevant layers,
- The review of draft environmental sensitivity ratings (provided by SANBI) in relation to the proposed gas pipeline corridors and amendment thereof.
- Designation of sensitivity ratings of new feature layers.

Using the above information specific consideration was given to the alignment of the Phased Gas Pipeline corridors and its intersections with the IOCB. The relevance and refinement of data was undertaken, based on recent aerial imagery (Arc GIS online, Google Earth circa 2015 to 2018) and specific historical imagery (based on 1937 historical imagery for specific areas including the greater Durban area and Isimangaliso Wetland Park). Specialist knowledge of the subject area and high level verification of areas was undertaken where data was deficient or required updating.

The information was then further interrogated against an understanding of the required activities associated with the establishment and maintenance of a gas transmission pipeline and the forecasting and projection of expected changes in the habitat or its drivers.

3.1.1 Data Sources

The data and literature sources presented in Table 1 were considered and assessed in this report.

Table 1: A summary of datasets reviewed and applicable to the IOCB

Data title	Source and date of publication	Data Description
Protected Areas	• National Department of Environmental Affairs (DEA) South African Protected Areas Database (SAPAD), 2017. • SANBI Protected Areas Database, 2011. • Ezemvelo KZN Wildlife Protected Areas, updated 2017 • Critical Biodiversity Areas (CBAs) and Statutory Reserves for the Eastern Cape, 2017	The DEA SAPAD was compared against the SANBI Protected Areas database, and discrepancies were resolved. This data was provided by the CSIR. Provincial data was added for KwaZulu-Natal and the Eastern Cape.
National Protected Area Expansion Strategy focus areas	• DEA Priority areas for protected area expansion, 2017	This data was provided by the CSIR and used without modification.
CBAs	• Ezemvelo KZN Wildlife CBA, 2016 • Eastern Cape Biodiversity Conservation Plan (ECBCP), 2017	A CBA layer was provided by the CSIR, which included national CBA data. This layer was given a default sensitivity rating of "Very High." The updated KZN CBA data was added separately and specific sensitivity ratings assigned to each CBA category within KZN. The draft ECBCP CBA data was assessed in a similar manner. The data was sorted according to CBA category and assigned a sensitivity according to the CBA category.
Private Nature Reserves, game farms and "stewardship areas"	• Ezemvelo KZN Wildlife Private Nature Reserves 2016 • Provincial Game Farm Data	The game reserve data was provided by the CSIR. Additional private nature reserves were added to include any areas not considered to be game farms.
Forest Nature Reserve	• National DEA SAPAD, 2017.	Provided by SANBI/DEA
Ramsar Sites	• National DEA SAPAD, 2017.	Provided by SANBI / DEA.
World Heritage Sites	• National DEA SAPAD, 2017.	Provided by SANBI / DEA.
Vegetation	• SANBI Vegetation Map, 2012. • Ezemvelo KZN Wildlife Vegetation Conservation Status, 2011	The thicket layer was obtained from the SANBI Vegetation Map while the vegetation type conservation status data was included. This data set provides the conservation status of the specific vegetation types within KZN based on various attributes, such as percentage statutorily conserved. This layer was used to derive the vegetation sensitivity ratings.
Landcover	• National Land Cover (NLC) 2013/2014 DEA, 2014 and Habitat Modification Layer SANBI, 2017 • Field Crop Boundaries, Department of Agriculture, Forestry and Fisheries, 2017	The modified and agricultural layers were retained and applied. These indicate the transformed areas that characterise much of the KZN coastal hinterland – sugar cane farms and plantations.
Ecoregion	• SANBI undated (based on Burgess 2004)	Basic ecoregion layer, applied unmodified.
National Forests	• National Forest Inventory, Department of Agriculture, Forestry and Fisheries, 2016.	The extent of the National Forests. This layer complements the vegetation layers above and due to their protected status allow for a higher sensitivity to be applied to relevant areas.

3.2 Assumptions and Limitations

3.2.1 Spatial data

Much of the spatial information utilised in this investigation was sourced from Provincial and National institutions. While the comments below may have to be verified by the institutions concerned, the following factors must be considered:

- As use has been made of primarily secondary data, the verification of accuracy cannot be provided by either the primary source nor the authors, although knowledge of the region has assisted in identifying anomalies;
  The data presented has been collected over an extended time period and has been subject to differing forms of manipulation and evaluation by the various compilers; and
- KZN's coastal environment, and therefore IOCB, is a rapidly growing economic region. The information presented may be subject to change over the short term.
- The IOCB can be considered to be a variable habitat complex and is often found to merge and overlap with neighbouring biomes and vegetation types, sharing common characteristics. On the ground, IOCB aligned habitat may at points be found to lie beyond the western extent indicated in the spatial mapping provided.
- A difference between the available data for KwaZulu-Natal and the Eastern Cape is evident. The inclusion of the Draft ECBCP (2017) provided additional data, comparable to the EKZN Wildlife CBA and improved the available data for interpretation for the Eastern Cape. These two data sets where however not directly comparable due to slight differences in assigned categories.
- Faunal records are limited to primarily, conservation areas and areas where monitoring is safe to undertake e.g. gated residential estates, protected areas.

3.2.2 Intrazonal vegetation

In addition to the above, "intrazonal" forest forms may be evident at points within the IOCB, more specifically Sand Forest (FOz8) and Northern Coastal Forest (FOz7). These forest types are not classified as being part of the IOCB but may be evident at points within the proposed Phased Gas pipeline corridors, particularly in the Maputaland region. The understanding is that the Forest Biomes will largely not be considered for the development of gas pipeline infrastructure and will, in general, be avoided. Consideration is given to them in the context of the IOCB, as discussed below.

3.2.3 Fauna data

Comment and integration with existing faunal population data has been presented in this report, however the integration of such data may be of limited value as such data is based on observation records, which may be over-represented at particular points, in particular protected areas. It is recommended that matters relating to fauna should be considered as an independent and site-specific aspect of the management of the construction and operations of the gas transmission pipeline (i.e. detailed faunal assessments should be conducted on a project specific basis, once a route has been determined). Fauna-related data, presented as point data at the spatial level of evaluation, may be over-represented in protected areas. Due to protected areas being mostly the focus of research and sampling efforts and are thus better represented in data, as such, data representing faunal populations outside of these areas can be expected to be less complete. Therefore, faunal data was not included in the sensitivity mapping, but as supplementary data for descriptive and illustrative purposes. Areas of importance mentioned above have been included / covered or considered by other data sets – Protected areas and KZN CBAs.

3.2.4 The IOCB and neighbouring Biomes

The IOCB makes up only a small portion of the corridors and its review and deduced conclusions must therefore be seen in context. Inconsistencies in interpretations and alignment with neighbouring biomes, vegetation and habitat specialists may arise.

3.2.5 Information deficiencies and spatial contradictions

Available data for the study area is well established and of reasonable accuracy (Jewitt et.al. 2015). The area is however, currently subject to relatively rapid land use changes associated primarily with continuous peri-urban expansion, outside of formal agricultural areas and urban centres. Anthropogenic influences and

land use change in the region therefore renders older data a less reliable indicator of the present state. An attempt has thus been made to rationalise this transformation and limit contradiction through the incorporation of land use data and specialist knowledge to provide recommendations that may be more applicable to conditions on the ground.

3.3 Relevant Regulatory Instruments

Various legal instruments that serve to regulate activities within portions of the IOCB and include international, national and provincial, as well as municipal laws and regulations are presented in Table 2.

Table 2: Relevant legislation and regulatory instruments applicable to the IOCB

Instrument	Key objective
International Instrument	
Ramsar Convention (The Convention of Wetlands of International Importance (1971 and amendments)	Protection and conservation of wetlands, particularly those of importance to waterfowl and waterfowl habitat.
Convention concerning the Protection of the World Cultural and Natural Heritage, adopted by UNESCO in 1972 (World Heritage Convention)	Preservation and protection of cultural and natural heritage throughout the world.
National Instrument	
National Environmental Management: Protected Areas Act, (Act Number 57 of 2003)	No development, construction or farming may be permitted in a nature reserve without the prior written approval of the management authority (Section 50 (5)). Also in a 'protected environment' the Minister or MEC may restrict or regulate development that may be inappropriate for the area given the purpose for which the area was declared (Section 5).
National Environmental Management Act (Act Number 107 of 1998), as amended	Restrict and control development and potential harmful activities through the Environmental Impact Assessment (EIA) regulations and the undertaking of relevant assessments prior to commencement of listed activities (Section 24 (5) and 44). Imposes "duty of care" (Section 28) which means that all persons undertaking any activity that may potentially harm the environment must undertake measures to prevent pollution and environmental degradation.
National Water Act (Act Number 36 of 1998)	Restriction of water use activities (Section 21) and disturbance of water resources (wetlands, rivers and ground water).
National Environmental Management: Integrated Coastal Management Act (Act Number 24 of 2008)	To determine the coastal zone of South Africa and to preserve and protect coastal public property. To control use of coastal property (Section 62, 63 and 65) and limitation of marine pollution (Chapter 8).
National Forest Act (Act Number 84 of 1998)	Protection of natural forests and indigenous trees species through gazetted lists of Natural Forests and Protected Trees (Sections 7 (2) and 15 (3) respectively). Disturbance of areas constituting natural forest or the disturbance of a protected tree species requires authorisation from the relevant authority.
National Environmental Management: Biodiversity Act (Act Number 10 of 2004)	Protection of national biodiversity through the regulation of activities that may affect biodiversity including habitat disturbance, culture of and trade in organisms, both exotic and indigenous. Lists of alien invasive organisms, threatened and protected species and threatened ecosystems published and maintained (Sections 97 (1), 56 (1) and 52 (1)(a) respectively).
Provincial Instrument	
Natal Nature Conservation Ordinance No. 15 of 1974 and KwaZulu-Natal Nature Conservation Management Act, (Act 9 of 1997)	According to the Natal Nature Conservation Ordinance No. 15 of 1974 and the KwaZulu-Natal Nature Conservation Management Act, 1992 (Act 9 of 1997), no person shall, among others: damage, destroy, or relocate any specially protected indigenous plant, except under the authority and in accordance with a permit from Ezemvelo KZN Wildlife (EKZNW). A list of protected species has been published in terms of both acts.
Transkei Environmental Conservation Decree (9 of 1992), Ciskei Nature Conservation Act 1987 and Cape Nature and Environmental Conservation Ordinance (19 of 1974)	Three similar items of legislation promulgated for the former Transkei, Ciskei and the Cape Province. All three remain active in the Eastern Cape, within their relevant geographic area. All provide lists of indigenous fauna and flora and outline various management measures such as hunting seasons, bag limits and other recreational activities. Allowances are made for the

Instrument	Key objective
	proclamation of nature reserves and the general protection of the environment.
Municipal Bylaws	Numerous municipalities have promulgated bylaws that relate to conservation of the environment and these may include the application of land uses through the town planning scheme. e.g. eThekwini Municipality's Open Space System as well as the iLembe and uMhlathuze Municipal bylaws. These will need to be considered in more detail during the detailed planning and EIA phases.

4 IMPACT CHARACTERISATION

In order to understand the potential impacts and identify sensitive features that may be affected by the construction and maintenance of the proposed gas pipeline, it is important to consider and characterise the nature and extent of impacts associated with gas pipeline development on relevant features. The following impacts have been identified and are discussed:

4.1 Disturbance and transformation of natural vegetation

A sub-surface pipeline may traverse an extended linear extent of hundreds of kilometres, however, its width is generally constrained to a few metres. In addition, once established, with the exception of some occasional aboveground infrastructure, pipelines are generally hidden from view. Figure 2 below, indicates an image of a gas pipeline that lies proximal to the Hluhluwe-Umfolozi Game Reserve (outside of the IOCB, but relevant for illustration purposes). In this particular portion of pipeline, the route is managed in a manner that seeks to maintain the area in an early seral state (e.g. grass or small shrubs are tolerated but larger trees are removed).

It follows that the impact of the gas pipeline can thus be an enduring feature although the structure itself may be hidden from view.

As a consequence of the excavation for the pipeline, deep excavations below the upper soil horizons are disturbed. Such disturbance may be of little influence on the prevailing habitat where soil horizons and edaphic factors are not a significant driver of habitat form. However in other habitats where edaphic drivers are primary drivers within the ecosystem, such disturbance serves to alter both habitat form and structure. For example, grassland habitats are particularly vulnerable, where soil structure (in addition to factors such as fire and grazing) determines the nature of these graminoid dominated habitats. A change in any one of these factors serves to change the nature of these areas, with evident changes in species diversity or association and often invasion by woody species, such as *Acacia nilotica* and *A. natalitia*, as indicated in Figure 2.

Figure 2: Image showing an area where a gas pipeline has been constructed at Hluhluwe-Umfolozi, KZN. Grasses and shrubs are tolerated, but larger trees are prevented from re-establishment (Photo: SDP)

Under some situations, such change in vegetation form may serve to bisect habitats resulting in altered habitat structure and function.

4.2 Alien invasive plants

As indicated above, the construction of the pipeline will result in extensive changes to soil profiles. Such disturbance is a key driver of exotic and invasive vegetation establishment, where species compete with early seral species that may be naturally associated with the seral processes within the affected habitat. Following construction, and during the operations stage where maintenance or regular inspections of the pipeline may ensue, further disturbance of the area can be expected through the passage of vehicles and other maintenance activities. It follows that low and sustained levels of disturbance along the pipeline servitude presents suitable conditions for the establishment and spread of alien invasive plants (AIPs). As such, servitudes often act as repositories and vector corridors of exotic plant propagules, thereby promoting and facilitating the spread of AIPs.

4.3 Faunal disturbance

Habitat loss and transformation both within the maintained servitude and immediately adjacent areas are likely to affect faunal populations within particular areas, or alternatively give rise to change in species' behaviour. The clearance of large swathes of land, for the gas pipeline infrastructure (including temporary clearance for installation of the pipeline as well as more permanent clearance for ancillary infrastructure and maintenance) is likely to affect faunal populations directly and indirectly and in the medium to long term, and lead to the ousting of specific faunal populations and/or promote the establishment of others. For example, the clearance of treed areas and establishment of scrub or graminoid veld forms within a

servitude will favour grazers and may lead to the ousting of frugivorous species that were reliant upon fruiting tree species. In addition, such transformation may also alter transitory niche and migratory routes of certain species or act as physical barriers to others.

4.4 Constraining of conservation initiatives

Within both the IOCB of KZN and the Eastern Cape, initiatives to expand and connect protected areas have been undertaken in the past, with new opportunities likely in the future. An example of a past initiative was the proposed linking of the Nseleni Nature Reserve and the New Mouth area near Richards Bay. This initiative was championed by the uMhlatuze Municipality with the intention of protection marginal habitats such as the "Kwambonambi Grasslands". The placement of pipeline servitudes outside of protected areas, while well intentioned, may however nullify and disrupt initiatives that are presently underway, effectively constraining long term conservation efforts.

5 KEY ATTRIBUTES AND SENSITIVITIES OF THE INDIAN OCEAN COASTAL BELT BIOME

5.1 Vegetation and spatial definition

The IOCB is defined by five dominant vegetation types (Mucina & Rutherford, 2006). These are generally termed:

- CB 1 – Maputaland Coastal Belt;
- CB 2 – Maputaland Wooded Grassland;
- CB 3 – Kwazulu-Natal Coastal Belt;
- CB 4 – Pondoland-Ugu Sandstone Coastal Sourveld; and
- CB 5 – Transkei Coastal Belt.

The drivers, characteristics and conservation significance of the abovementioned five dominant vegetation types are summarised in Table 4 below (adapted from Mucina & Rutherford, 2006). The climate of the east coast of southern Africa is controlled by the presence of a high pressure system lying to the east of the sub-continent and intermittently, the area is influenced by low pressure systems arising from the Southern Ocean, particularly during winter. In the late summer, cyclonic systems moving across the Indian Ocean often lead to catastrophic storm events along the coastline (Tinley, 1985). This meteorological regime plays a significant role in determining the form of habitats that are found within the IOCB (Mucina and Rutherford 2006). As can be seen from Table 3 below, it is clear that there is significant variation and differentiation in the climate regime from the south of the IOCB to the north. This variance gives rise in part, to fundamentally differing habitat types within the biome. For example, within the northern areas, grasslands and forest habitats that are proximal to the coastline, are subject to intensive storm activity associated with cyclonic activities, which play a key role in forest gap dynamics (Yamamoto, 1996) while the high level precipitation associated with these events is an important driver in grassland and woodland communities in the north of KZN. Rainfall in the southern extent of the IOCB is comparatively less than that encountered in the north, although less seasonal with a more bimodal rainfall regime. It is perhaps due to these drivers that these vegetation types are primarily grassland and open woodland-mosaic environments which form an association of habitats within any given range.

Additionally, edaphic form and function within the IOCB can also be considered a primary driver of many of these habitats, tempering growth in woody species through the availability of freshwater and nutrients. The influence of anthropogenic factors, mainly fire but often the grazing of livestock, must also be considered one of the major drivers of the habitat forms within the IOCB, particularly over the last 500 years (McCracken, 2008).

Table 3: Comparative meteorological data from urban centres located in the south, centrally and north of the IOCB.

		St Lucia	Durban	East London
Temperature (˚C)	Maximum.	29.3	28.1	24.5
	Minimum.	17.5	11.3	9.8
	Annual average	21.7	20.9	18.2
	Variance	11.8	7.7	14.7
Rainfall (mm)	Annual average	1129	975	822
	Average maximum	139	125	97
	Average minimum	58	30	36
Wind velocity (km/h)	1954-1963 (15h00)	20	20	17

(Data source: Climate-Data.org, 2018)

Associated with these vegetation types are a number of additional zonal, azonal and intrazonal vegetation units such as “sand forest” and “lowveld riverine forest”. These vegetation units are, from a holistic, ecological perspective, interwoven into the broader eco-type that defines the “KZN and Eastern Cape coastal belt” and, bearing in mind that the definition of “vegetation unit” and “Biome” are fundamentally scientific constructs, these units should also be given recognition and considered holistically in any review of coastal habitat in KZN and the IOCB.

Table 4 indicates the 11 vegetation units that are considered to be primarily “terrestrial” in nature and lie within or adjacent to the definitive IOCB vegetation types, as defined. The 11 vegetation types consist of the five defining vegetation types and six azonal and intrazonal vegetation types that are prominent within the IOCB. Table 5 provides more definitive consideration of the vegetation units that fall within the IOCB Biome. Notably, of the 11 vegetation units under consideration in the south eastern coastal extent, two of the five units within the IOCB are considered to be “endangered”, while three are considered to be “vulnerable”. Comparatively, two of the four forest types are considered “critically endangered”, while the rest are considered to be “least threatened”. These ecological aspects are afforded some further consideration below (Table 4).

The extent and distribution of the IOCB vegetation units and relevant azonal and intrazonal vegetation are mapped in Figure 3 and Figure 4.

Table 4: Summary of the veld types encountered within or proximal to the defining IOCB vegetation types, including azonal and intrazonal vegetation units, and key zonal units (Mucina and Rutherford 2006) that may be encountered within the proposed gas pipeline corridors.

Vegetation Type	Code	Biome/Veg. Unit	Distribution	No. of endemic taxa	Conservation status (NEMBA 2011)	Comment
Sub-tropical dune thicket	AZs3	Eastern strandveld	Azonal, associated with stable secondary dunes and beyond.	2	Least threatened/Not listed	Threatened by heavy metal dune mining - prospecting and extraction. Alien plant invasion is common. Low likelihood of interface with gas pipeline development except where corridor arises close to coastline (Northern KZN)
Sub-tropical seashore vegetation	AZd4	Seashore vegetation	Azonal, associated with frontal coastal dunes.	5	Least threatened/Not listed	Transformed by tourism development. Low likelihood of interface with gas pipeline development.
Maputaland Coastal Belt	CB1	IOCB	Mtunzini in KZN northwards to Southern Mozambique - landward up to 35 km.	6	Least threatened/Not listed	Transformed by plantations. High levels of plant diversity in northern areas around Mozambique border. Highly transformed in RSA, some well-preserved areas iSimangaliso Wetland Park and Mozambique. Probable likelihood of interface with gas pipeline development
Maputaland Wooded Grassland	CB2	IOCB	Southern Mozambique to south of St Lucia. Primarily on coastal plain surrounding inter dune depressions / wetlands.	4	Vulnerable	Exploited primarily for commercial and small scale woodlot plantation. Probable to high likelihood of interface with gas pipeline development
Kwazulu-Natal Coastal Belt	CB3	IOCB	South of the uMlalazi River, near Richards Bay to Port Edward.	1	Vulnerable	Subject to variable impacts including mining, urban settlement and agriculture. Low likelihood of interface with gas pipeline development
Pondoland-Ugu Sandstone Coastal Sourveld	CB4	IOCB	Port Shepstone to Port St Johns. Primarily coastal areas but up to 20 km inland at points.	33	Endangered	Associated with rocky cliff-type environments. May be associated with gas pipeline development inland of Port Shepstone. Possible likelihood of interface with gas pipeline development corridor inland / south coast of KZN

Vegetation Type	Code	Biome/Veg. Unit	Distribution	No. of endemic taxa	Conservation status (NEMBA 2011)	Comment
Transkei Coastal Belt	CB5	IOCB	Coastal areas south of Port St Johns to Kei River. Undulating topography with grassland and valley forests.	0	Least threatened/Not listed	Little likelihood of interface with proposed gas pipeline routings within the corridor
Lowveld Riverine Forest	FOa1	Azonal forest	Azonal forest associated with river systems. Primarily Phongolo, Mkhuze and uSutu Rivers.	0	Vulnerable	Under threat from subsistence agriculture and alien invasion as well as changes to river systems
Scarp Forest	FOz5	Zonal and Intrazonal forest	Forest associated with rocky areas, distributed from Northern KZN to Eastern Cape.	49	Vulnerable	Intermittent across KZN escarpment and coastal environment. Although “niche” type environment, the gas pipeline development poses some, primarily indirect threat to this vegetation unit, where the corridor spans escarpments. Possible points of interface in Northern and Central KZN
Northern Coastal Forest	FOz7	Zonal forest	Extends from Eastern Cape north to Mozambique/Tanzania. Found at 10 -150m.a.s.l.	1	Endangered	Under threat on coastal dunes. Includes "dune forest" (Acocks, 1988) which is under threat from mineral exploitation and settlement. Limited probability of interface with gas pipeline development corridor
Sand Forest	FOz8	Intrazonal forest	Fragmented patches - Mozambique (Tembe region) at between 20 - 160m.a.s.l.	14	Least threatened/Not listed	Associated with paleo dunes in Northern KZN. Interface with proposed gas pipeline corridor likely in northern region of KZN

1 Table 5: The five defining vegetation groups of the IOCB (Mucina & Rutherford, 2006)

Vegetation Type	Distribution	Vegetation and Landscape Features	Geology and Soils	Climate	Endemic Taxa
CB 1	KZN Province and Southern Mozambique. Mozambique border to Mtunzini	Flat coastal plain. Densely forested in places. Range of non-forest vegetation communities – dry grasslands/palmveld, hygrophilous grasslands and thicket.	18 000 year old Quaternary sediments of marine origin. Berea and Muzi Formations of the Maputaland Group.	Weak rainfall seasonality at the coast. Summer rainfall inland. Up to 1200 mm rain per annum. High humidity. Mean maximum temperature – 35.3°C and Mean minimum temperature 5.5°C.	Herbs: *Helichrysum adenocarpum* subsp. *Ammophilum. Vahlia capensis* subsp. *Vulgaris* var. *longifolia.* Geophytic herbs: *Asclepias gordon-grayae, Kniphofia leucocephala, Raphionacme lucens*. Graminoid: *Restio zuluensis*.
CB 2	KZN Province and Southern Mozambique. Mozambique border to Sileza, Sibaya, Mseleni, Mbazwana, Sodwana Bay, Ozabeni, Eastern and Western Shores of Lake St Lucia, Kwambonambi and Richards Bay.	Flat coastal plain. Sandy grasslands rich in geophytic suffrutices, dwarf shrubs, small trees and rich herbaceous flora.	Quaternary redistributed sands of the Berea formation (Maputaland Group). Shallow water table.	Weak rainfall seasonality at the coast. Summer rainfall inland. Up to 1200 mm rain per annum. High humidity. Mean maximum temperature – 35.3°C and Mean minimum temperature 5.5°C	Geoxylic suffrutices: *Ochna* sp. nov., *Syzigium cordatum*. Succulent herb: *Aloe* sp. nov. Geophytic herb: *Brachystelma vahrmeijeri*.
CB 3	KZN Province. Mtunzini to Margate and Port Edward	Highly dissected undulating coastal plains. Subtropical coastal forest presumed to have been dominant. *Themeda triandra* dominated primary grassland.	Varying Natal Group Sandstone, Dwyka Tillite, Ecca shale and Mapumulo gneiss. Berea Red Sand in places.	Summer rainfall. High humidity. No frost. Mean maximum temperature – 32.6°C and mean minimum temperature – 5.8°C (Durban).	Herb: *Vernonia africana* (extinct). Geophytic herb: *Kniphofia pauciflora.* Low shrub: *Barleria natalensis* (extinct).
CB 4	Eastern Cape and KZN Province. Port St. Johns to Port Shepstone.	Coastal peneplains and undulating hills with flat table lands and very steep slopes of river gorges. Species rich grassland punctuated with scattered low shrubs or small trees.	Restricted to sandstones of the Msikaba Formation	Summer rainfall. No to infrequent frost. Mean maximum temperature – 32.2°C and mean minimum temperature – 5.8°C (Paddock).	Graminoid: *Fimbristylis vareigata*. Herbs: *Eriosema umtamvunense, Geranium sparsiflorum, Lotononis bachmanniana, Selago peduncularis, Senecio erubuscens* var. *incisus.* Geophytic herbs: *Brachystelma austral, B. kerzneri, Watsonia inclinata, W. mtamvunae. Geoxylic suffrutex: Rhus acocksii*. Low shrubs: *Leucadendron spissifolium* subsp. *natalense, L. spissifolium* subsp. *oribinum, Acalypha* sp. nov., *Anthospermum steryi, Erica abbottii, E. cubica var natalensis, Eriosema dregei, E. latifolium, E. luteopetalum, Euryops leiocarpus, Gnidia triplinervis, Leucadendron pondoense,*

Vegetation Type	Distribution	Vegetation and Landscape Features	Geology and Soils	Climate	Endemic Taxa
					Leucospermum innovans, Raspalia trigyna, Struthiola pondoensis, Syncolostemon ramulosus, Tephrosia bachmannii. Tall shrub: *Tephrosia pondoensis.*
CB 5	Eastern Cape Province. Port St. Johns to Great Kei River.	Highly dissected, hilly coastal country. Alternating steep slopes of low reach river valleys and coastal ridges. Grasslands on higher elevations alternative with bush clumps and small forests.	Karoo Supergroup Sediments – sandstone and mudstone of the Adelaide Subgroup. Shale, mudstone and sandstone of the Ecca Group and Dwyka tillite.	Summer rainfall with some winter rain. No frost. Mean minimum temperature of 7.7°C (Bashee Lighthouse).	None listed.

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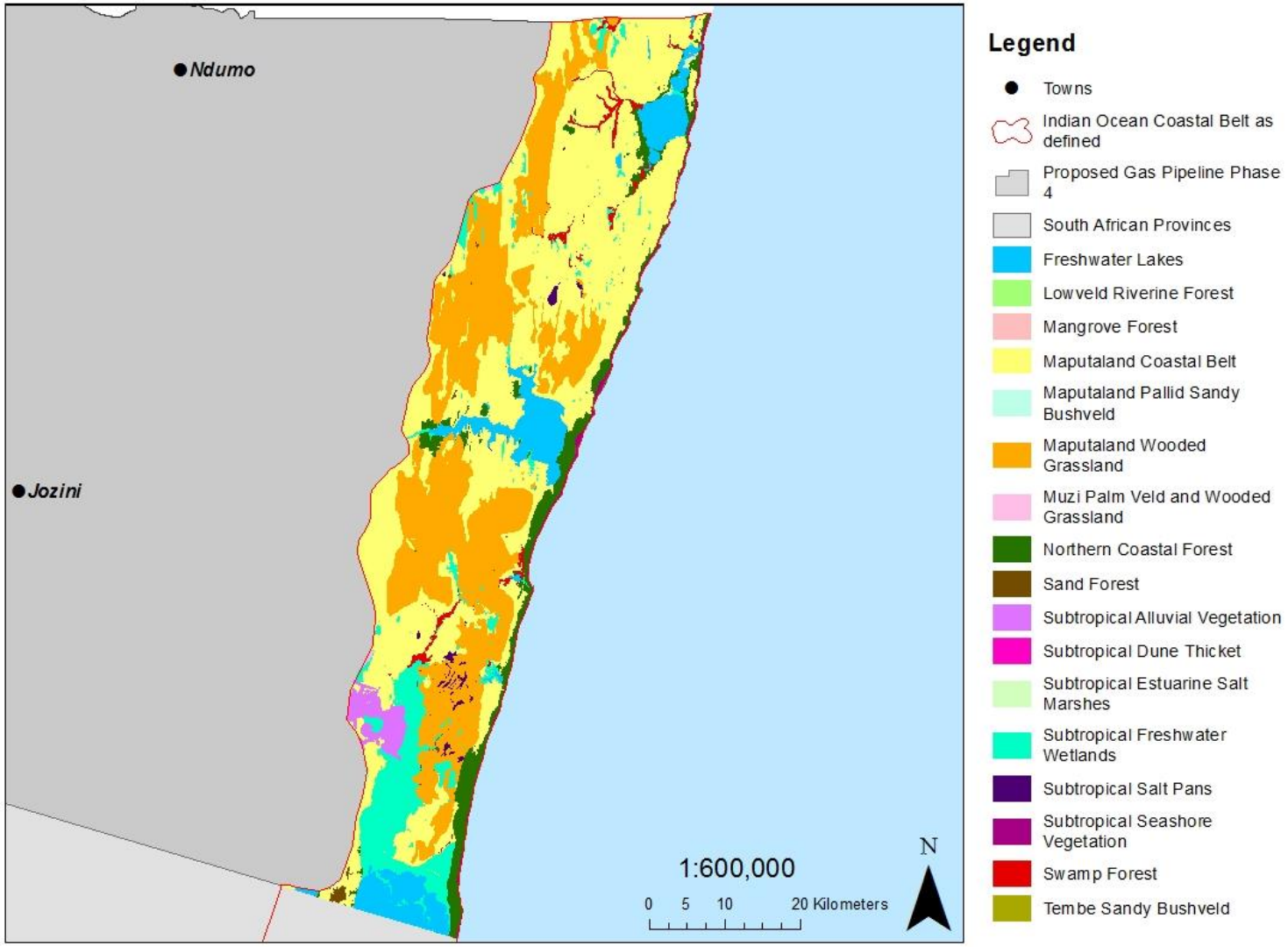


Figure 3: An overview of the vegetation types, including azonal vegetation with the portion of the IOCB affected by the northern portion of the Phase 4 corridor (SANBI 2012).

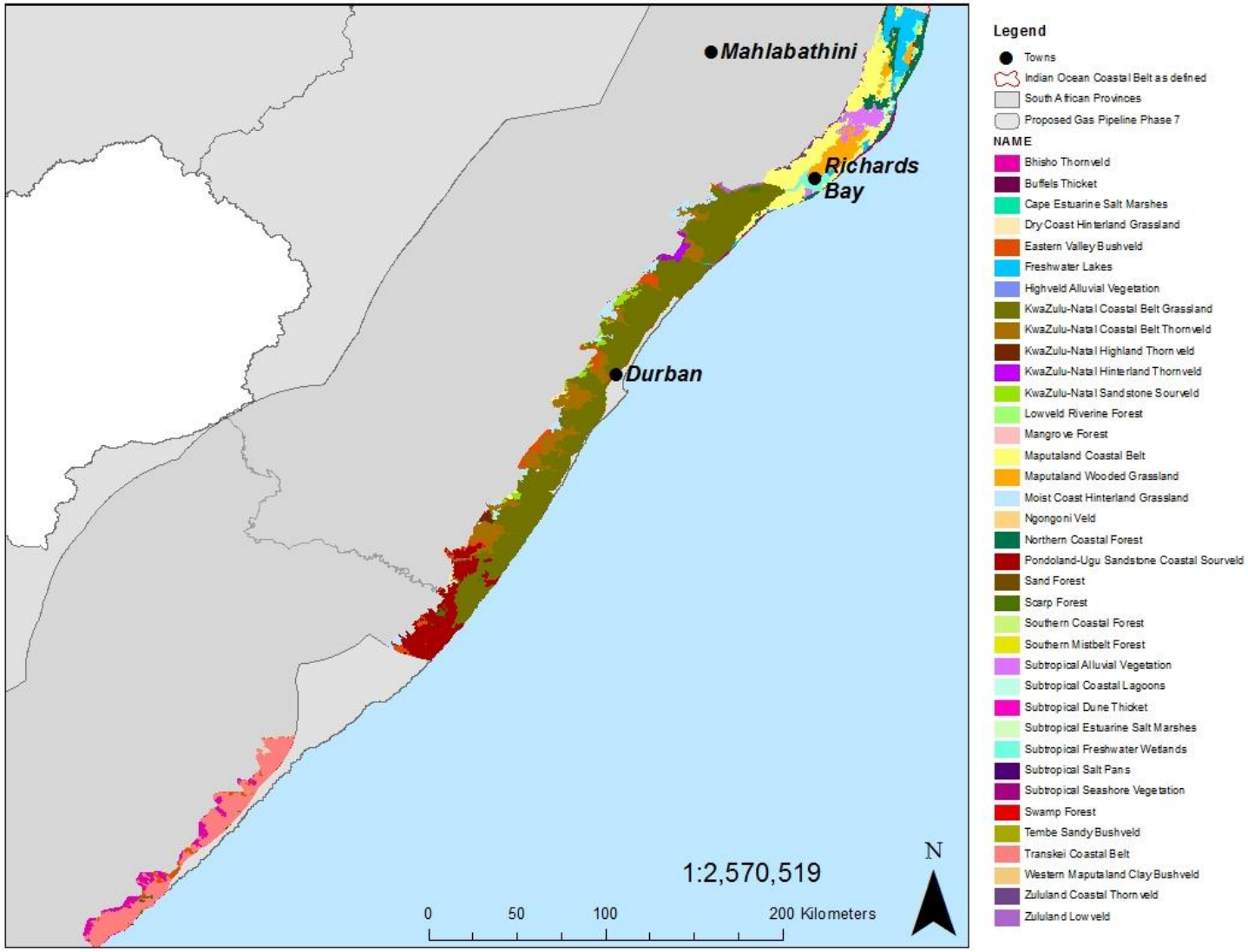


Figure 4: An overview of the vegetation types, including azonal vegetation with the portion of the IOCB affected by the upper section of the Phase 7 corridor (SANBI 2012).

5.1.1 Vegetation types of the IOCB

5.1.1.1 CB 1 – Maputaland Coastal Belt

The Maputaland Coastal Belt vegetation type is restricted to the north of the KZN within Phase 4 of the proposed project areas and is primarily located to areas north of Richards Bay (Figure 3). The habitat comprises of a grassland mosaic and often secondary forest dominated by species such as *Syzigium cordatum, Acacia natalitia* and *Phoenix reclinata* (Figure 5). In northern KZN the habitat type is found primarily within an undulating terrain of sands to clayey sands, often interspersed with shallow depression wetlands which are paleo dune slacks. The veld type is considered to be "vulnerable" from an ecological conservation perspective, although recent review of habitat destruction around the iSimangaliso Wetland Park suggests that settlement in the region has seen a rate of loss of this veld type of up to 105 ha per year (SDP- Isimangaliso WP, 2015), which would suggest that the vegetation unit is under increasing anthropogenic pressures.

Figure 5: Example of Maputaland Coastal Belt vegetation near Mbazwana. (Photo: SDP)

5.1.1.2 CB 2 – Maputaland Wooded Grassland

Maputaland Wooded Grassland has been defined as a "sub-class" of CB1 on account of the absence of wetland environments and variation in species composition (Figure 6). The major threat to this habitat form has been the expansion of the silviculture industry in the north of KZN (primarily *Eucalyptus* spp and in some areas *Pinus* spp) which is the most appropriate economic land use in the nutrient poor sands that dominate this area.

Figure 6: Example of Maputaland Wooded Grassland near Kwandalane. (Photo: SDP)

5.1.1.3 CB 3 – KwaZulu-Natal Coastal Belt

CB3 stretches from south of the uMlalazi River to Port Edward (Transkei) in a broad band that runs parallel to the coastline (Figure 3 and Figure 4). The landscape comprises of a mosaic of grassland and forested habitat, the latter normally associated with lower elevations (Figure 7). Notably, fire and grazing has played a significant role in the establishment of this veld type. Phase 7 of the gas pipeline may interface with this habitat as far north as Richards Bay but is superseded by thornveld, inland of this region.

Significant transformation has taken place within this vegetation unit, attributed primarily to agriculture and urban expansion. Within abandoned agricultural fields, a secondary habitat may arise of similar form but devoid of a number of key graminoid, herbaceous and woody species.

Figure 7: Typical KwaZulu-Natal Coastal Belt located near Mtunzini. (Photo: SDP)

5.1.1.4 CB 4 – Pondoland-Ugu Sandstone Coastal Sourveld

Pondoland-Ugu Sandstone Coastal Sourveld is a highly diverse habitat form found primarily to the south of KZN and associated with sandstone geologies (Figure 8). The azonal Scarp Forest may be encountered in association with this veld type, particularly in the southern extent of the IOCB. CB4 may also be encountered some distance from the coast, although it is primarily associated with the lower to mid elevations, below the KZN escarpment and may interface with the gas pipeline in southern KZN.

5.1.1.5 CB 5 – Transkei Coastal Belt

The Transkei Coastal Belt (Figure 9) is located along the coastline of the northern Eastern Cape southwards to beyond East London. This vegetation unit is unlikely to be affected by the establishment of the gas pipeline, which is likely to be established some distance inland of the coast.

Figure 8: Pondoland-Ugu Sandstone Coastal Sourveld near Margate. (Photo: SDP)

Figure 9: Transkei Coastal Belt located near Gwe Gwe. (Photo: SDP)

5.1.1.6 Azonal, zonal and intra zonal vegetation types

Within the IOCB are embedded a number of zone specific and azonal vegetation types (Table 6). Some are unique to the IOCB, and others have a wider distribution. Azonal vegetation types are thus included in the definition of the IOCB and are themselves often considered to be "sensitive" habitats, worthy of conservation. Table 6 below presents the most predominant and significant azonal, terrestrial vegetation types within the IOCB, however most of these vegetation forms are aligned with riverine, wetland or estuarine habitats which are subject to separate review by specific authors covering those habitats. In addition, some consideration and expansion on those vegetation types that are most likely to be encountered in the IOCB is presented below (based on descriptions provided by Mucina and Rutherford 2006), these vegetation forms being:

- FOa 1 Lowveld Riverine Forest;
- FOz 5 Scarp forest;
- FOz 8 Sand Forest;
- FOa 2 Swamp Forest;
- FOz 7 Northern Coastal Forest;
- AZd 4 Subtropical Seashore Vegetation; and
- AZs 3 Subtropical Dune Thicket.

Table 6: Azonal and intrazonal vegetation found within the IOCB (Mucina and Rutherford 2006).

Vegetation type	Description	Conservation status (NEMBA 2011)
FOa 1 Lowveld Riverine Forest	Tall forests fringing larger rivers (gallery forest) and pans. Dominated by *Ficus sycamorus* or *Diospyros mepiliformis*. Forests are dense, tall, structured and with a well-developed shrub layer.	Vulnerable
FOz5 Scarp Forest	Stratified forest with high canopy and shrub strata, with a number of epiphytic species associated with sub canopy.	Vulnerable
FOz7 Northern Coastal Forest	Species rich, tall or medium height subtropical coastal forests that occur on coastal plains and stabilized coastal dunes.	Endangered
FOz8 Sand Forest	Stratified forest in patches associated with paleo dunes – well developed shrub strata and poor herb layer.	Least threatened/Not listed
FOa 2 Swamp Forest	12 – 15 m forests with two main strata (canopy and shrub layer). Dominant trees include: *Ficus trichopoda, Barringtonia racemosa, Casearia gladiiformis, Cassipourea gummiflua, Syzigium cordatum, Phoenix reclinata, Raphia australis*. Understorey poorly developed.	Vulnerable
FOa 3 Mangrove Forest	Species poor and often monospecific, low and dense forests in tidal zones of coastal lagoons.	Endangered
AZe 3 Subtropical Estuarine Salt Marshes	Estuaries and coastal salt-marsh plains supporting complexes of low herbs dominated by succulent chenopods and other flood tolerant halophytes. Salt marsh meadows dominated by Spartina flooded swards and submerged Zostera sea meadows are often present.	Least threatened/Not listed
AZd 4 Subtropical Seashore Vegetation	Open, grassy, herbaceous, dwarf shrubby and often dominated by a single species of pioneer character. Plant communities are representative of the age of the substrate.	Least threatened/Not listed
AZs 3 Subtropical Dune Thicket	Very dense shrubby thickets of spiny shrubs, large leaved mega herbs, dwarfed tree species, abundant vines and with poorly developed undergrowth due to shading by the closed canopy.	Least threatened/Not listed
AZf 6 Subtropical Freshwater Wetlands	Flat topography supporting low beds dominated by reeds, sedges and rushes, water logged meadows dominated by grasses. Typically associated with depressions, alluvial backwater pans and artificial dams.	Least threatened/Not listed
Aza 7 Subtropical Alluvial Vegetation	Flat alluvial riverine terraces supporting an intricate complex or macrophytic vegetation, marginal reed belts as well as extensive flooded grasslands, ephemeral herblands and riverine thickets.	Least threatened/Not listed

5.1.1.7 FOa 1 Lowveld Riverine Forest

Lowveld Riverine Forest is confined primarily to riverine environments in and around the northern regions of KZN, extending into the Mpumalanga Province. The forest type is generally associated with alluvial soils and may be subject to some level of inundation under flood events. The vegetation form comprises of a stratified forest canopy with a number of tall dominant species - in KZN this species being *Ficus sycamorus*. Lowveld Riverine Forest is particularly abundant on the Phongolo River system (Figure 10), but may be encountered further to the south.

This vegetation type has succumbed to significant levels of clearance to make way for agricultural activities in and around floodplains. The clearance of sub canopy layers within forest systems has also led to invasion by exotic plant species. This forest type is considered to be Vulnerable.

Figure 10: Image of Lowveld Riverine Forest on Phongolo River. (Photo: SDP)

5.1.1.8 FOz 5 Scarp forest

Scarp forest is a stratified forest form that is primarily associated with cliffs and rocky krantzes (Figure 11). This forest type extends from the Lebombo Mountain range in Northern KZN through to the southern extent of the IOCB in the Eastern Cape. The vegetation type is considered to be vulnerable from a conservation perspective on account of the fact that it is associated with steep and rocky areas not generally sought after for settlement and other human land use requirements. Notably, Mucina and Rutherford (2006) recognise this as “the most valuable forest form in South Africa”, counting important taxa such as *Streptocarpus spp* and *Encephalartos spp* as being endemic to this habitat form.

Due to the association of this habitat form with steep and rocky environments, it is unlikely that Scarp Forest will be affected by the gas pipeline.

Figure 11: Image showing Scarp Forest on uMzimvubu River near Port St Johns. (Photo: SDP)

5.1.1.9 FOz 8 Sand forest

Sand forest does not ostensibly lie within the IOCB as defined in this investigation, however as a highly fragmented and edaphic-driven forest form, Sand Forest is likely to be encountered in small to moderate sized pockets within the IOCB (Figure 12). It is considered to be least threatened from a conservation perspective on account of indiscriminate settlement in northern KZN and its affiliation to ancient aeolian soils. Sand forest is noted as being the "core" of the Maputaland Centre of Endemism (Van Wyk & Smith, 2001). This forest type has a high number of endemic plant species and is also noted to be associated with key faunal species such as the Tonga red squirrel (*Paraxerus palliatus tongensis).* There is a high likelihood that the gas pipeline may intersect with at a minimum, relic pockets of sand forest.

Figure 12: Image of Sand Forest, located near Ndumo (Photo: SDP)

5.1.1.10 FOz 7 Northern Coastal Forest

This forest veld type is particularly well developed in the region between Richards Bay and Kosi Bay, primarily along the upper and landward portions of the high secondary dunes (Figure 13) at the coast (Acocks, 1988). This forest form is common to those areas that have been identified as being subject to the mining of heavy minerals and therefore is presently subject to this and other anthropogenic pressures. As a result of the ongoing clearance and loss of this forest form, Northern Coastal Forest is considered to be "endangered" from a conservation perspective.

The gas pipeline is likely to interface with communities of Northern Coastal Forest in the north of KZN, where the corridor is situated proximal to the coastline, particularly in Phases 4 and 7 of the project.

Figure 13: Northern Coastal Forest within the iSimangaliso Wetland Park (Photo: SDP).

5.1.1.11 AZd 4 Subtropical Seashore Vegetation

This azonal vegetation type is located within the Eastern Cape and KwaZulu-Natal provinces, extending from Kei Mouth in the south to the Mozambique border and is associated with coastal dune features, near the shoreline. Vegetation consists of open, grassy, herbaceous, dwarf shrub vegetation. This vegetation type is considered to be "least threatened"/not listed with sufficient coverage in statutorily protected areas to meet conservation targets (Mucina & Rutherford, 2006; Tinley 1985). Due to the confinement of AZd4 to the near shore environment, this vegetation type may be affected where such pipeline intersects with the shoreline and coastal environment.

5.1.1.12 AZs 3 Subtropical Dune Thicket

The distribution of Subtropical Dune Thicket is similar to AZd 4; however this habitat does differ in species composition and structure. Vegetation within Subtropical Dune Thicket comprises of very dense, shrubby thickets often with dwarf tree species, abundant vines and a poorly developed undergrowth due primarily to shading by the closed canopy. This vegetation type is associated with recent dunes overlying calcretes (Figure 14). Where the pipeline lies proximal to the shoreline, particularly in Northern KZN, this habitat form may be affected by pipeline establishment.

Figure 14: Image of Subtropical Dune Thicket located near Sodwana Bay. (Photo: SDP)

5.1.2 Threatened Plant Species

SANBI point data for threatened plant species was provided by the CSIR, cropped to the IOCB extent and reviewed. Figure 15 provides an overview of the distribution of threatened plant species within the affected portions of the IOCB. Although the data is not exhaustive, it provides an indication of the areas where threatened plant species may be encountered. Clusters and potential hotspots appear to be concentrated in or around formally protected areas – Umlalazi Nature Reserve, Ongoye Forest, Umtamvuna Nature Reserve and Isimangaliso Wetland Park – with isolated occurrences outside of these areas, such in the Durban Metro.

With specific reference to Umtamvuna Nature Reserve (Figure 16) the area supports a number of threatened plant species, many associated with the preserved scarp and grassland habitat. The Umtamvuna Nature Reserve supports 94 threatened plant species from the categories: Declining, Rare, Near Threatened, Vulnerable, Endangered and Critically Endangered (Pondoland CREW, 2016). The Umtamvuna Nature Reserve is the northern extent of the Pondoland Centre of Endemism (PCE), which extends as far south as the Kei River. Phase 7 excludes a significant section of the upper PCE in the Mkambathi and Port St Johns areas.

With the level of transformation that is present within the IOCB, KwaZulu-Natal in particular, the importance of similar isolated pockets of natural vegetation within the IOCB cannot be overstated.

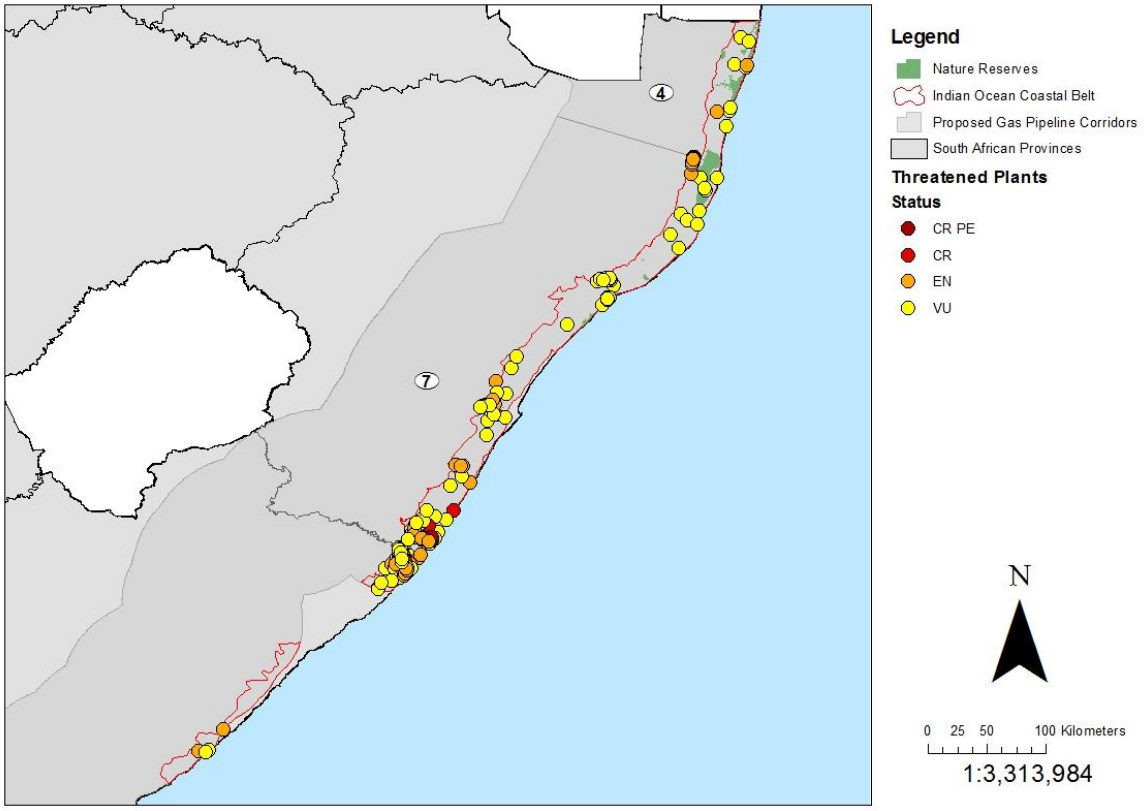


Figure 15: The distribution of recorded threatened plant species within the IOCB portion of the Gas Pipeline Corridors (Phases 4 and 7). Note the dense cluster corresponding with the KZN and Eastern Cape Border. CR PE represents Critically Endangered Possibly Extinct.

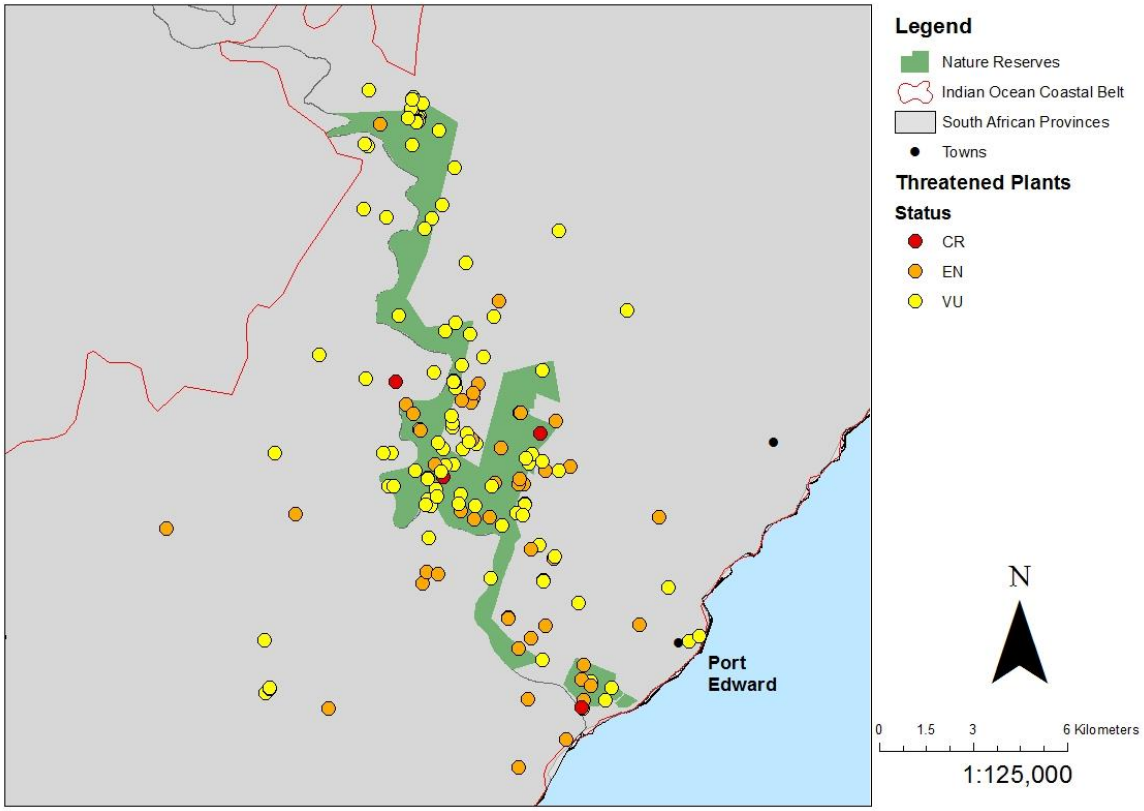


Figure 16: Concentrated distribution of recorded threatened plant species within the Umtamvuna Nature Reserve and immediate surrounds.

5.1.3 Fauna

The IOCB occupies a climatic niche identified using the Koppen – Geiger classification system as Cfa (*warm temperate; fully humid; hot summer*) (Kottek et al., 2006). This climatic regime, as explained above, as well as a topographically diverse environment and a relatively recent history of human settlement has given rise to some diverse ranges of habitat and a concomitantly diverse faunal assemblage. It follows that both **habitat form and structure** and **faunal presence** as well as the interface between these two elements forms the guiding pre-requisites for evaluation of suitable routes for the gas pipeline within the IOCB.

However, the rapid expansion of human settlement in the region, particularly following the nagana of the 1860s has seen the confinement of much of the larger fauna to protected areas and private game farms, while smaller species, including invertebrates are confined to niche environments, such as scarp forest, that are not affected by human activities. Notably, some species have benefitted from human settlement and agricultural activities, at the expense of others.

The subtropical climate experienced by the IOCB, as well as the availability of water, offer suitable habitat for a wide range of fauna. The network of protected areas, particularly in the northern portion of the IOCB are critical for the maintenance of faunal biodiversity, in the wake of the extensive disturbance which has been associated with urbanisation, peri-urban settlement and agriculture in surrounding area with the IOCB.

More specific to the Margate region and the sandstone grasslands of the lower KwaZulu-Natal South Coast in particular, is the presence of two butterfly species, *Lepidochrysops ketsi leucomacula* (white blotched ketsi blue) and *Durbania amakosa albescens* (whitish amakhoza rocksitter). The presence of these two species has been verified by EKZN Wildlife during field reconnaissance undertaken as recently as March 2017 (Armstrong pers comm, 2017). *L. ketsi leucomacula*, according to Armstrong, is endemic to the coastal stretch between Margate and Port Edward and is probably only associated in the Margate region. Due to a complex lifecycle including an association with the presence of formicids (ants) (Woodhall, 2005), the species may be considered to be susceptible to impacts of both a direct and indirect nature. *D. amakosa albescens* is considered to be "vulnerable" from a conservation perspective, primarily on account of a decline in suitable habitat. Habitat includes "rocky ledges" and open lichen-encrusted terrain. Open areas of rugged terrain, unaffected by development, are considered to be important for the continued preservation of the species. This is an example of a faunal species that may be significantly impacted by the disturbance caused by the construction of a pipeline, due to its dependence on specific habitat, interactions and associations. Many larger, more mobile and adaptable fauna species may simply relocate temporarily and remain largely unaffected.

In addition to the above, consideration of the South African Bird Atlas Project 2 (SABAP2, 2018) (Pentad 3050_3020 / QDGC: 3030CD) indicates that a total of 201 bird species have been logged for the lower KZN South Coast including a number of distinctly uncommon species, as well as species associated with grassland environments. Birds and their habitat has also been considered in detail as part of the Avifauna strategic issue of the overarching Strategic Environmental Assessment of the proposed gas pipeline corridors

Analysis of available species data for amphibians, reptiles and butterflies (SANBI, 2018) indicated clusters of occurrence correlating with protected areas/more intact habitat areas within the IOCB (Figure 17 - Figure 19). Of the 53 amphibian species present, only two were threatened (near threatened and endangered). The reptile species present (21 in total) were all threatened with only one species being data deficient and the other two not having a listing category. The butterfly data lacked a clear species reference and any indication of the conservation status.

With reference to Figure 17 - Figure 19 below, The Futululu and Dukuduku Forest areas as well as the Umfolozi floodplain between St Lucia and Mtubatuba indicates a concentration of reptile records, indicating a potential “hot spot” that should be avoided. In this instance the majority of records were *Bitis gabonica* (Gaboon adder). This species is common within the intact moist grasslands and forest margins that are present in this area. Another potential “hot spot” is Ongoye Forest inland of Mtunzini. This scarp forest and reserve is shown to support butterfly, amphibian and reptile species as per the SANBI Data. Other areas of importance include Umlalazi Nature Reserve, Vernon Crookes, Oribi Gorge, Margate and Umtamvuna Nature Reserves.

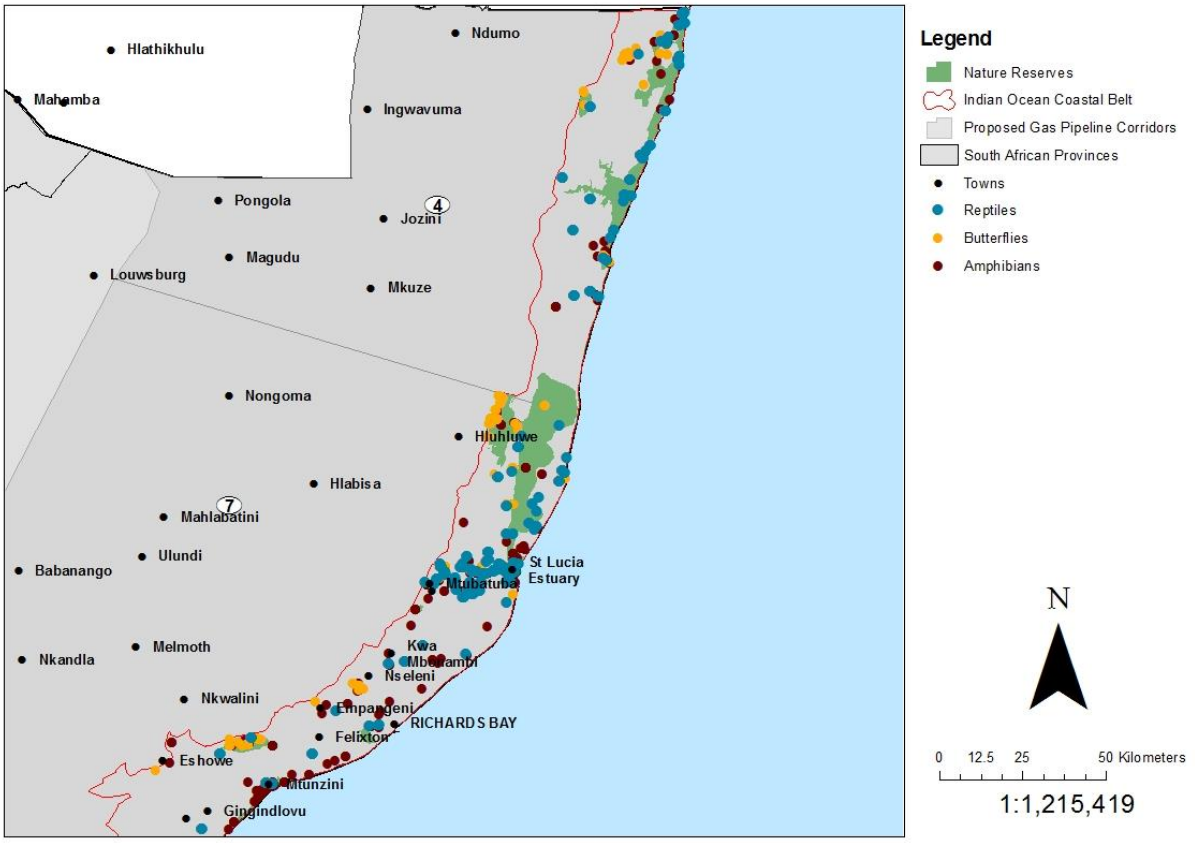


Figure 17: The distribution of recorded threatened reptiles, amphibians and butterflies within the IOCB in the Phases 4 and 7 corridors.

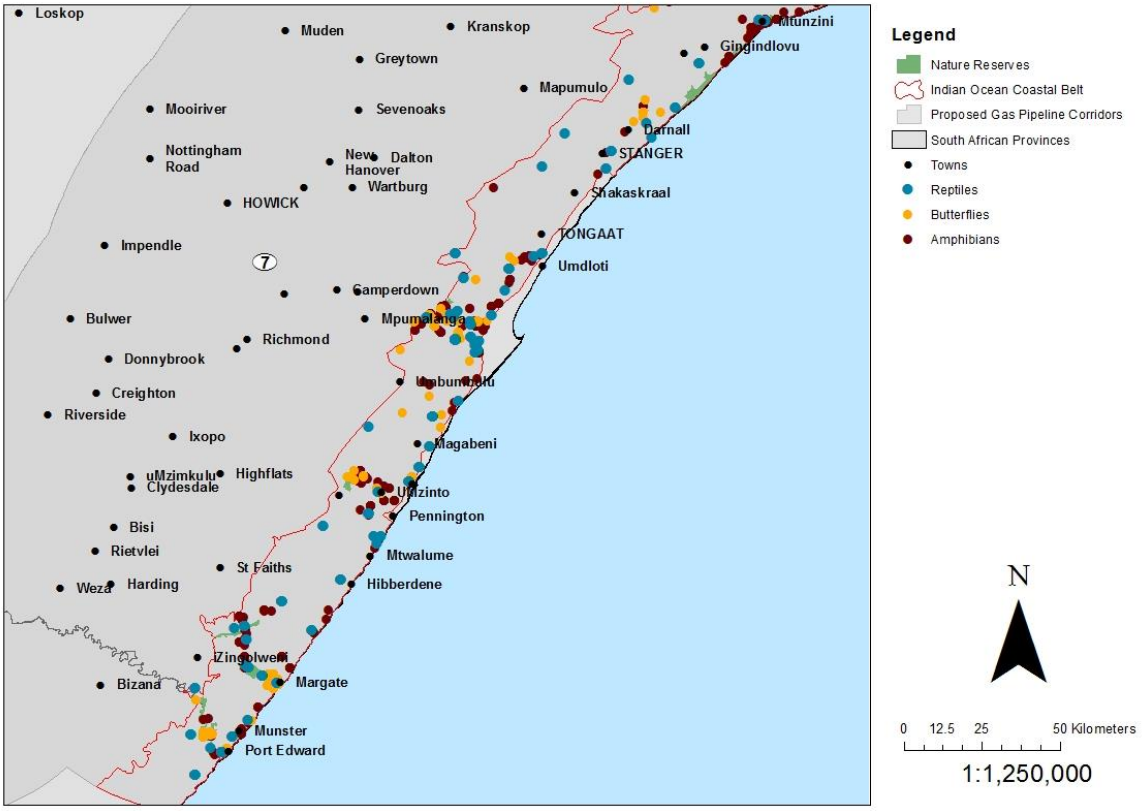


Figure 18: The distribution of recorded threatened reptiles, amphibians and butterflies within the IOCB in the upper portion of the Phase 7 corridor.

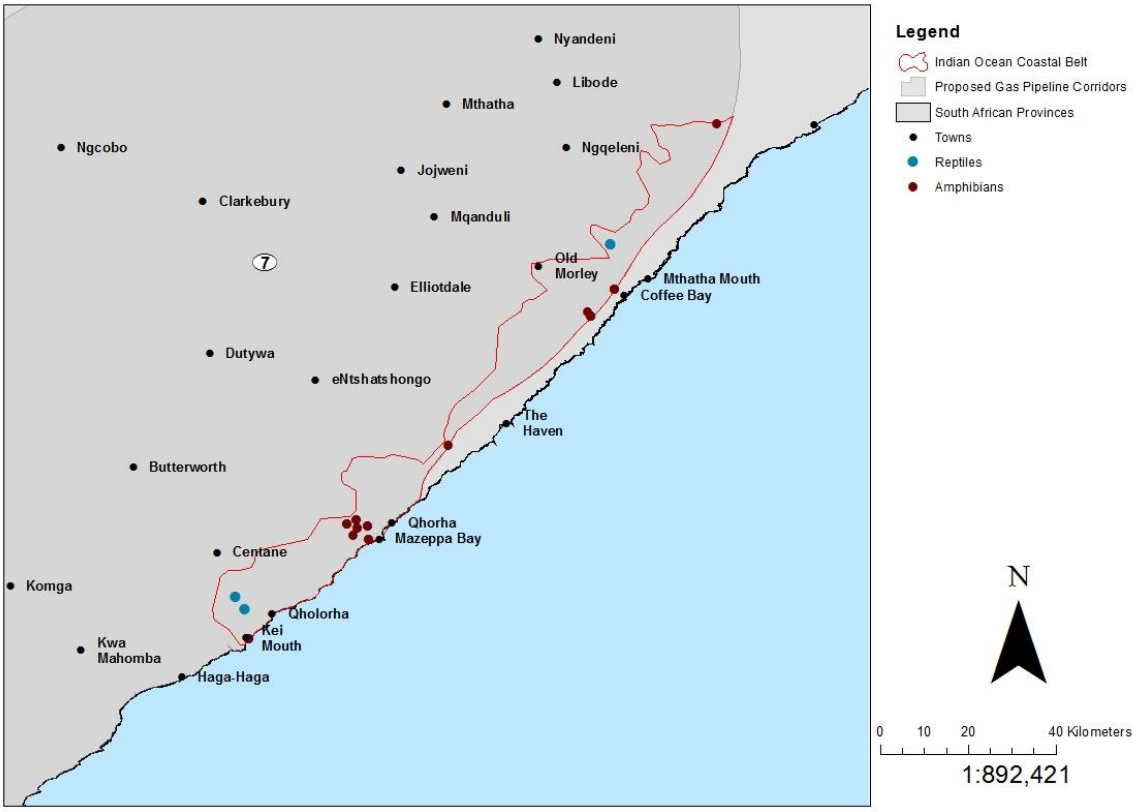


Figure 19: The distribution of recorded threatened reptiles and amphibians within the IOCB in the Eastern Cape section of the Phase 7 corridor. No butterfly data for the IOCB portion of the Eastern Cape was available.

5.2 Corridors Description

Two proposed corridors, namely Phases 4 and 7 fall within the IOCB (refer to Figure 1). These corridors and the nature of the receiving environments within and associated with the IOCB are described below. The corridors are however, very expansive (100 km wide) and the IOCB only constitutes a very narrow band along the eastern seaboard. A description of the features of the IOCB within the three corridors is provided below in Table 7.

Table 7: Summary of the nature of the IOCB in the three proposed gas pipeline corridors, within which the IOCB falls.

Site	Brief description
Phase 4	The Phase 4 corridor is a short linkage which overlaps the eastern most portion of Phase 4 and links with Phase 7. It extends from Richards Bay in the South to the Mozambique border. The IOCB within this corridor is made up of the Maputaland Coastal Belt (CB 1) and Maputaland Wooded Grassland (CB 2). Subtropical Freshwater Wetlands and Lowveld Riverine Forest are two significant azonal vegetation types found within this section of the IOCB. A prominent feature is the Isimangaliso Wetland Park, a significant protected area, Ramsar Site and World Heritage Site. This extends from Maphelane, north of Richards Bay to Kosi Bay and extends inland to the Mkuze Nature Reserve. The bulk of the Isimangaliso Wetland Park, from Lake St. Lucia to Kosi Bay falls within this corridor phase.
Phase 7	The Phase 7 corridor extends along the east coast of the Eastern Cape and KwaZulu-Natal from Coega in the south to Hluhluwe in the north. This corridor affects the largest section of the IOCB, which includes a combination of very sensitive unique habitats associated with the Pondoland area and severely degraded and highly urbanised areas such as the greater Durban area. Between Richards Bay and Hluhluwe, a significant portion of the Isimangaliso Wetland Park associated with Lake St Lucia is located. Outside of this protected area, the landscape is dominated by peri-urban settlement, extensive timber plantations and sugar cane cultivation. Prominent azonal vegetation includes Swamp Forest (FOa 2) which is largely limited to isolated undisturbed areas in the Richards Bay and St Lucia areas. Extensive Northern Coastal Forests (FOz 7) occur, such as Futululu near Monzi. Furthermore, The section of the IOCB affected by this corridor includes the lower extent of the Maputaland Coastal Belt (CB 1), the KwaZulu-Natal Coastal Belt (CB 3), Pondoland-Ugu Sandstone Coastal Sourveld (CB 4) and Transkei Coastal Belt (CB 5) major vegetation types. The Kwazulu-Natal south coast and Pondoland area are traversed by a large number of incised coastal and major river systems and undulating valleys. Where not transformed for agricultural purposes, these support Northern Coastal Forest and scarp forest. A prime example is the Umtamvuna River Valley (Umtamvuna Nature Reserve) on the KZN/EC border. The northern section between Durban and Richards Bay is largely degraded, with the exception of a few pockets of undisturbed and protected habitat, such as the Amatikulu Nature Reserve (Dokodweni/Nyoni area) and The Ongoye Forest, near Mtunzini. The N2 corridor, extensive sugar cane farming and dune mining near Mtunzini are major disturbances within this section of the IOCB.

5.3 Feature Sensitivity Mapping

5.3.1 Identification of feature sensitivity criteria

The following features of the IOCB were selected for further consideration. The rationale behind each feature and the details thereof are discussed below. A summary is available in Table 8.

5.3.1.1 Protected areas

Protected areas are primarily public and in some cases private areas of land that have been set aside for the achievement of conservation objectives. Most of these areas have been statutorily proclaimed under the National Environmental Management: Protected Areas Act or similar legislation. A number of protected areas are private lands that enjoy recognition by the conservation authorities.

A number of statutory protected areas occur within the IOCB. These include the following:

- Isimangaliso Wetland Park (Including Mapelane)
- Nseleni Nature Reserve
- Richards Bay Game Reserve
- Umlalazi Nature Reserve and Siyaya Coastal Park
- Ongoye Nature Reserve
- Amatikulu Nature Reserve
- Harold Johnson Nature Reserve
- Umhlanga Nature Reserve
- Beachwood Nature Reserve
- North Park Nature Reserve
- Kenneth Stainbank Nature Reserve
- Bluff Nature Reserve
- Vernon Crookes Nature Reserve
- Mehlomnyama Nature Reserve
- Oribi Gorge Nature Reserve
- Mbumbazi Nature Reserve
- Trafalgar Nature Reserve
- Umtamvuna Nature Reserve
- Mkambathi Nature Reserve
- Silaka Wildlife Reserve
- Hluleka Nature Reserve
- Dwesa-Cwebe Wildlife Reserve
- Kei Mouth State Reserve

These protected areas are of very high conservation importance, many of them protecting the last remaining primary habitat within the IOCB. The inclusion of these features in the assessment was deemed essential, and recommended for exclusion from pipeline establishment.

In addition to and in recognition of the ecological value of the conservation authorities, municipalities and other statutory organs of state have sought to further enhance and improve the management of the above protected areas through the establishment of a network of important habitats and environments. These areas are discussed below, but can be considered to generally lie outside of the formally established protected areas, but are to be seen as providing specific and important benefits, both from an ecological perspective and a management perspective to protected areas. These areas are considered to have a high level of conservation value.

5.3.1.2 National Protected Area Expansion areas

The National Protected Area Expansion Strategy (NPAES) details the need to consider the expansion of existing protected areas in order to improve ecological sustainability and increase resilience to climate change (Holness et al., 2016). The aim of the strategy is to identify priority areas for expansion and put in place mechanisms for such expansions to happen (facilitation). The most recent version of the spatial data (2016) was utilised and treated as a high level feature.

5.3.1.3 Critical Biodiversity Areas

Critical Biodiversity Area (CBA) data uses the occurrence of numerous "features" (faunal or floral species or vegetation types and habitats) to determine the biodiversity importance or irreplaceability of an area (Escott, 2012). The higher the biodiversity value, the higher the irreplaceability. The updated 2016 version of the KZN CBA (EKZN Wildlife, 2010) uses three categories:

- Irreplaceable — designated in this assessment as high level features
- Optimal — designated in this assessment as medium level features
- Ecological Support Area — designated in this area as low level features

The Eastern Cape CBA data was sourced from the 2017 Draft Eastern Cape Biodiversity Conservation Plan (ECBCP, 2017). The categories utilised in the ECBCP include the following:

- PA - Protected Areas
- CA – Conservation Areas
- CBA 1 – Critical Biodiversity Area 1 (High biodiversity value)
- CBA 2 – Critical Biodiversity Area 2
- ESA 1 – Ecological Support Area 1 (Essential for connectivity within the terrestrial environment)
- ESA 2 - Ecological Support Area 2
- Other Natural Areas - Natural areas not identified as priority areas

5.3.1.4 Private Nature Reserves and game farms

Private Nature Reserves and game farms include formally protected areas that are not managed by a conservation or government authority, but private landowners and companies. Only one occurs in the IOCB, according to the data, this being the Palmiet Nature Reserve near Westville/Pinetown, within the eThekwini Municipal region, which was proclaimed in 2006.

5.3.1.5 Stewardship areas

In addition to managing numerous protected areas, Ezemvelo KZN Wildlife are engaged in a number of stewardship agreements aimed at improving the integrity and conservation status of private land, through the co-operation of private landowners. Examples include the Red Desert Nature Reserve (Port Edward) and the Roosfontein Nature Reserve (Westville).

5.3.1.6 Forest Reserve

A forest reserve layer was provided by the CSIR/SANBI which contained data on forest reserve in the IOCB. Only Mapelane, within the iSimangaliso World Heritage Site can be considered to be a forest reserve.

5.3.1.7 Ramsar Sites

A layer identifying Ramsar Sites within South Africa was provided by the CSIR. Four Ramsar sites occur within the IOCB, these being the following:

- Turtle Beaches/Coral Reefs of Tongaland
- St Lucia System
- Kosi Bay
- Lake Sibaya

All of the above sites fall within the Isimangaliso Wetland Park, a World Heritage Site.

5.3.1.8 World Heritage Sites

One World Heritage site falls within the IOCB, specifically the Isimangaliso Wetland Park which lies between the town of St Lucia in the north coast of KZN and the Mozambique border. The World Heritage Site extends along the coastline between these two areas and some distance inland to include areas such as Mkuze and Makakatana.

5.3.1.9 Vegetation

The updated SANBI Vegetation Map (2012) was utilised as the primary mapping data for the IOCB, including azonal and intra zonal vegetation. Ezemvelo KZN Wildlife (Scott-Shaw and Escott, 2011) compiled an updated vegetation conservation status map for KwaZulu-Natal. This layer classifies the conservation status of the various vegetation types within KwaZulu-Natal in terms of:

- Least Threatened;
- Vulnerable;
- Endangered; and
- Critically Endangered.

The update process was detailed and a full description is provided within the metadata. Essentially the conservation status in this data set has been assigned based on the conservation targets for vegetation types in the Province (Jewitt, 2016).

5.3.1.10 Landcover

The National Land Cover, modified layer, was utilised to determine change across veld types within the IOCB (SANBI, 2017). As well as field crop boundary data (DAFF 2017) which identified current and old agricultural fields and land uses. This information is deemed essential in identifying disturbance and habitat modification the IOCB. The other broad layers for KwaZulu-Natal, with the possible exception of the updated CBA data do not take into consideration the status quo and are often based on theoretical boundaries. Sugar cane cultivation has been a dominant land use for over 100 years and has been a significant factor in influencing the nature of the IOCB in its current form and the changes brought about as a result needs to be considered.

5.3.1.11 Ecoregion

The ecoregion layer forms a base layer that is superseded by other data but captures any areas not included in other feature/sensitivity layers. The ecoregion layer is the least deterministic of the habitat information.

5.3.1.12 National Forests

The National Forest Inventory data (2016) indicates natural forest types and declared natural forests. The following forest types are found within the IOCB:

- Northern Coastal Forest
- Sand Forest
- Scarp Forest
- Swamp Forest
- Mangrove Forest
- Lowveld Riverine Forest

Forest ecosystems are generally highly threatened in the IOCB with large areas having been lost to agriculture and development. Examples of significant natural forests within the IOCB include Ongoye, Futulu and Dukuduku (large area recently lost to peri-urban settlement and subsistence agriculture). This information was refined as some areas (although occurring as outliers) adjacent to or within the IOCB (i.e.

not classified as part of the IOCB), were subject to specific evaluations under different specialist investigations (e.g. swamp forest and mangrove forest).

5.3.1.13 Buffer Zones

Default buffer zones were provided with the SANBI/CSIR data pack. The following were provided:

- A 5 km buffer layer from all Nature Reserves/Protected Areas;
- A 1 km coastal setback;
- A 2500 m buffer around Game Farms;
- A 5000 m buffer around Game Farms; and
- A 10 000 m buffer around Game Farms.

Table 8: A summary of the sensitive features of the IOCB in the proposed Phases 4 and 7 gas pipeline corridors.

Sensitivity Feature Class	Data Source + Date of Publications	Data Description, Preparation and Processing
Protected Areas	• National Department of Environmental Affairs SAPAD, 2017. • SANBI Protected Areas Database, 2011. • Ezemvelo KZN Wildlife Protected Areas updated 2015 • Critical Biodiversity Areas and Statutory Reserves for the Eastern Cape 2007	DEA protected areas database was compared against the SANBI protected areas database discrepancies were resolved. This data was provided by the CSIR. Provincial data was added for Kwazulu-Natal and the Eastern Cape.
Protected Area Expansion Areas	• Department of Environmental Affairs Priority areas for protected area expansion 2017	This data was provided by the CSIR and used without modification.
Critical Biodiversity Areas	• Ezemvelo KZN Wildlife CBA 2016 • Eastern Cape Biodiversity Conservation Plan 2007	A CBA layer was provided by the CSIR, which included national CBA data. This layer was given a default sensitivity rating of "Very High." This was retained however the KZN CBA data was added separately and specific sensitivity ratings assigned to each CBA category within KZN and using the draft ECBCP CBA data. The National data aligned with the "irreplaceable" layer of the KZN CBA. The "Optimal" and "Ecological Support Area" layers provided additional sensitivity contrast.
Private NR and game farms	• Ezemvelo KZN Wildlife Private Nature Reserves 2016 • Provincial Game Farm Data	The game reserve data was provided by the CSIR. Additional private nature reserves were added to include any areas not considered to be game farms.
Stewardship sites	• Ezemvelo KZN Wildlife Stewardship areas (draft) 2016	This layer was added un-modified and reflects the areas actively being pursued by the Ezemvelo KZN Wildlife Stewardship Programme. Although not protected areas, these areas are of conservation importance and are being actively managed as such.
Forest Nature Reserve	• National Department of Environmental Affairs SAPAD, 2017	Provided by SANBI/DEA
Ramsar Sites	• National Department of Environmental Affairs SAPAD, 2017.	Provided by SANBI/DEA
World Heritage sites	• National Department of Environmental Affairs SAPAD, 2017	Provided by SANBI/DEA
Vegetation	• SANBI Vegetation Map 2012. • Ezemvelo KZN Wildlife Vegetation conservation Status 2011	The thicket layer was obtained from the SANBI Vegetation Map while the vegetation type conservation status data was included. This data set provides the conservation status of the specific vegetation types within KZN based on various attributes, such as percentage statutorily conserved. This layer

Sensitivity Feature Class	Data Source + Date of Publications	Data Description, Preparation and Processing
		was used to derive the vegetation sensitivity ratings.
Landcover	• National Land Cover 2013/2014/DEA and Habitat Modification Layer SANBI 2017 • Field Crop Boundaries, Department of Agriculture, Forestry and Fisheries 2017	The modified and agricultural layers were retained and applied. These indicate the transformed areas that characterise much of the KZN coastal hinterland – sugar cane farms and plantations.
Ecoregion	• SANBI (Burgess 2004)	Basic ecoregion layer, applied un modified.
National Forests	• National Forest Inventory, Department of Agriculture, forestry and Fisheries, 2016.	The extent of the National Forests. This layer complements the vegetation layers above and due to their protected status allow for a higher sensitivity to be applied to relevant areas.
Buffer Zones	• Assigned by SANBI/CSIR. Date unknown.	Simple buffer extents for Nature Reserves/Protected Areas, Game Farms and a coastal setback.

All the above features were cropped to the IOCB area. Sourced data sets that did not illustrate any presence with the IOCB were discarded as was data that was not considered to be of ecological importance. Assigning sensitivity ratings to the layers was undertaken based on the 4 tier rating system as specified. Assigning sensitivities to the layers discussed above varied from layer to layer. Complex layers, such as the KZN Vegetation conservation status layer was broken down according to the conservation status ratings of the vegetation types. The data for each of the 4 conservation status layers was extracted and exported to a separate layer and assigned a corresponding sensitivity as "conservation status" was deemed to be a proxy for "sensitivity". Other simpler layers were assigned sensitivity ratings based on expert knowledge and the nature of the feature. The various ratings have been provided in Table 11 below.

As indicated above all features are displayed with the highest sensitivity category shown in the upper most layer. This shows the most sensitive layers but is not necessarily a reflection of the status quo. The inclusion of the NLC modified areas layer is however considered to be an acceptable representation of the status quo in respect of land use and transformation in the IOCB. Being representative of habitats disturbed by anthropogenic activities, the NLC layer is rated as having a low sensitivity and indicates transformed areas. This layer should be viewed as the upper most layer as many of the other layers do not consider the status quo but are applied based on probabilities, assumptions and theoretical knowledge. Site specific knowledge and observations support the extent of transformation that is illustrated by the modified habitat layer. An example can be seen in the KwaZulu-Natal Coastal Belt, which is highlighted as being "critically endangered" equating to a "very high" sensitivity rating. The majority of the KwaZulu-Natal Coastal Belt has however been converted to sugar cane or urban settlement with a distinct North – South corridor of disturbance associated with the N2 motorway evident up to and beyond Hluhluwe. Very little primary habitat remains in this region and therefore it is not accurate to consider such disturbed areas as "highly sensitive".

1
2 Table 9: Sensitivity ratings of the relevant environmental features of the IOCB.

Corridor	Feature Class	Feature Class Sensitivity	Buffer Distance Sensitivity
Phase 4	Coastline Buffer	Very High	Not applicable
	Protected Areas	Very High	May vary from 0 to 5 km (To be determined based on site specific evaluation). See generic 5 km Nature Reserve Buffer in "Buffer zones" Feature Class.
	World Heritage Site	Very High	None (The identified World Heritage Site falls within a protected area)
	Ramsar Sites	High	None. (as per World Heritage Site above)
	Protected Area Expansion Areas	Medium	None
	National Forests	Very High	Up to 100m (To be determined based on site specific evaluation)
	KZN CBA	CBA Irreplaceable - High	None
		CBA Optimal - Medium	
		ESA - Low	
	Landcover	Modified: Low	Not applicable
		FCB: Low	
		FCB other: Low	
	Vegetation	KZN Veg. Cons. Status "Least Threatened" – Low	None
		KZN Veg. Cons. Status "Vulnerable" - Medium	
		KZN Veg. Cons. Status "Endangered" - High	
		KZN Veg. Cons. Status "Critical" – Very High	
		Thicket Vegetation: High	
	Ecoregion	Medium	None
	Private Nature Reserves and Game farms	Game Farms Title Deeds – Medium	None
	Buffer zones	5 km buffer layer from all Nature Reserves/Protected Areas – Medium	Not applicable
		2500 m buffer around Game Farms - Medium	
		5000 m buffer around Game Farms - Medium	
		10 000 m buffer around Game Farms - Low	

Corridor	Feature Class	Feature Class Sensitivity	Buffer Distance Sensitivity
Phase 7	Coastline Buffer	Very High	Not applicable
	Protected Areas	Very High	May vary from 0 to 5 km (To be determined based on site specific evaluation)
	World Heritage Site	Very High	None (The identified World Heritage Site falls within a protected area)
	Ramsar Sites	High	None. (as per World Heritage Site above)
	Forest Nature Reserve	Very High	None (The only Forest Nature Reserve falls within a protected Area)
	Protected Area Expansion Areas	Medium	None
	National Forests	Very High	Up to 100m (To be determined based on site specific evaluation)
	KZN CBA	CBA Irreplaceable - High	None
		CBA Optimal - Medium	
		ESA – Low	
	ECBCP CBA	PA – Very High	As per Protected Areas above
		CA – High	None
		CBA 1 - High	None
		CBA 2 - Medium	None
		ESA 1 - Low	None
		ESA 2 - Low	None
		Other Natural Areas - Low	None
	Landcover	Modified: Low	Not Applicable
		FCB: Low	
		FCB other: Low	
	Vegetation	KZN Veg. Cons. Status “Least Threatened” – Low	None
		KZN Veg. Cons. Status “Vulnerable” - Medium	
		KZN Veg. Cons. Status “Endangered” - High	
		KZN Veg. Cons. Status “Critical” – Very High	
	Private Nature Reserves and Game farms	Private Nature Reserves – Very High	None
		Game Farms Title Deeds - Medium	
	EKZN Wildlife Stewardship areas	Very High	None
	Ecoregion	Medium	None
	Buffer Zones	5 km buffer layer from all Nature Reserves/Protected Areas – Medium	Not applicable

Corridor	Feature Class	Feature Class Sensitivity	Buffer Distance Sensitivity
		2500 m buffer around Game Farms - Medium	
		5000 m buffer around Game Farms - Medium	
		10 000 m buffer around Game Farms - Low	

5.3.2 Feature maps

Feature maps illustrating the relevant characteristics discussed above are provided below for the three corridors. Due to the high number of features and the concentration of these features within the IOCB, some may not be clearly visible on the map. The order of the features displayed in the image is arbitrary with the exception of the National Forest Inventory and Protected Area data which has been prioritised and the more expansive vegetation and biome layers displayed lower so that as many features as possible are visible.

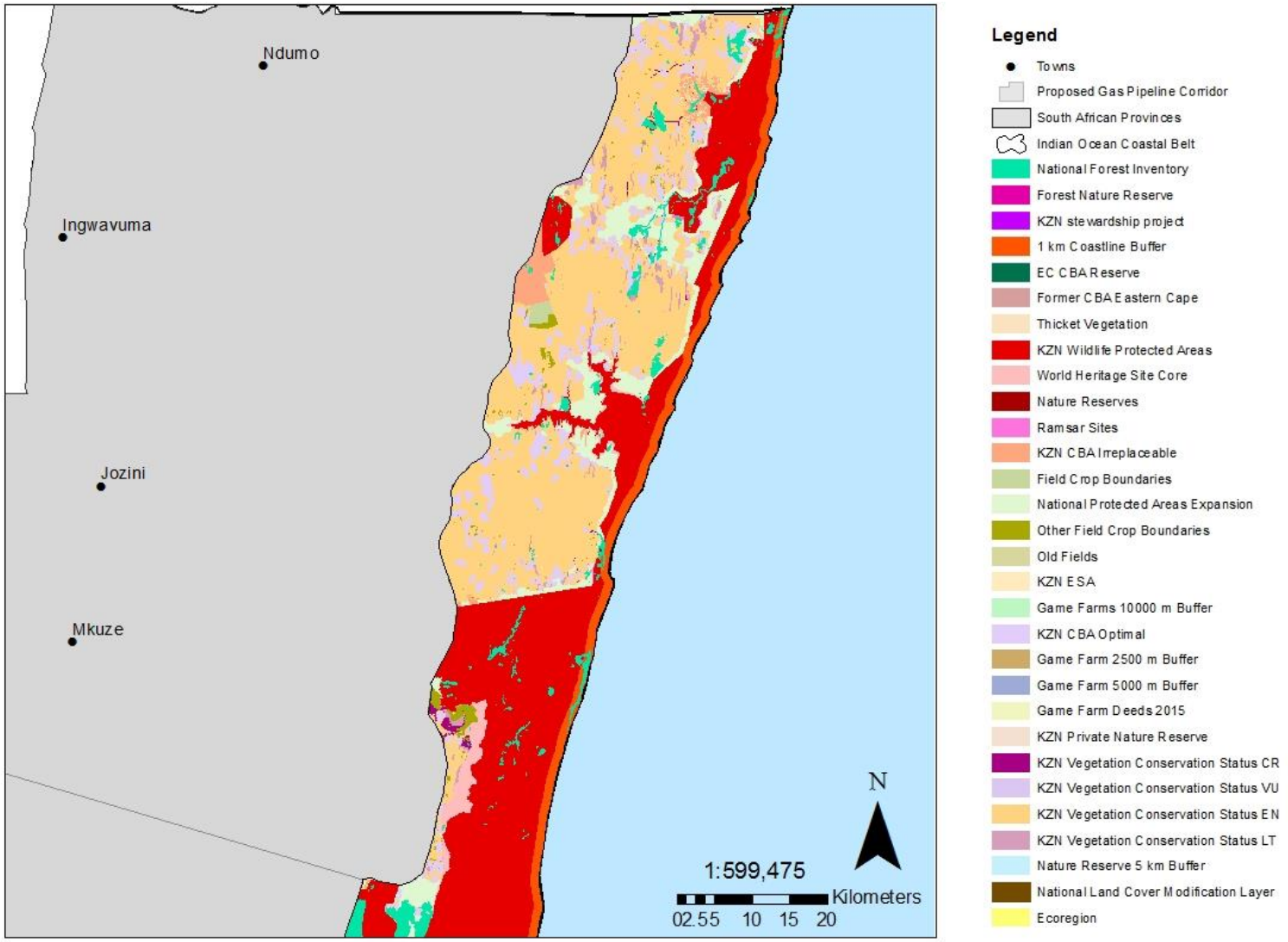
5.3.2.1 Phase 4

With reference to Figure 20, the most prominent feature within Phase 4 is the Isimangaliso Wetland Park, which extends from immediately North of St Lucia, to the Mozambique border (the portion within Phase 4). The width varies, but in places it incorporates the entire width of the IOCB, linking with other Protected areas, such as Mkhuze Nature Reserve. A number of forest outliers or "patches", game farms and threatened vegetation types occur within this section of the IOCB. Although not clearly visible in Figure 20, modified land use and transformed areas are present outside of the Isimangaliso Wetland Park and consideration of this particular layer has been taken in the interpretation of the sensitivity analysis.

5.3.2.2 Phase 7

Phase 7 extends through three sections of the IOCB – the central area north (up to Lake St Lucia) and immediately south of Durban, the KZN South Coast and the Eastern Cape, north of the Kei River Mouth (Figure 21). Prominent features within the KwaZulu-Natal portion include the Ongoye Forest, numerous smaller nature reserves, threatened vegetation types (KwaZulu-Natal Coastal Belt in particular), the 1 km coastal setback and CBA zones. The modified land use layer is another important layer, as with Phase 4. Prominent features within the Eastern Cape include forest patches, CBA zones, the coastal setback (along the lower extent) and the modified land use layer.

1



2
3 Figure 20: Features within the section of the IOCB affected by the Phase 4 corridor. The Isimangaliso Wetland Park North of St Lucia is a significant feature.

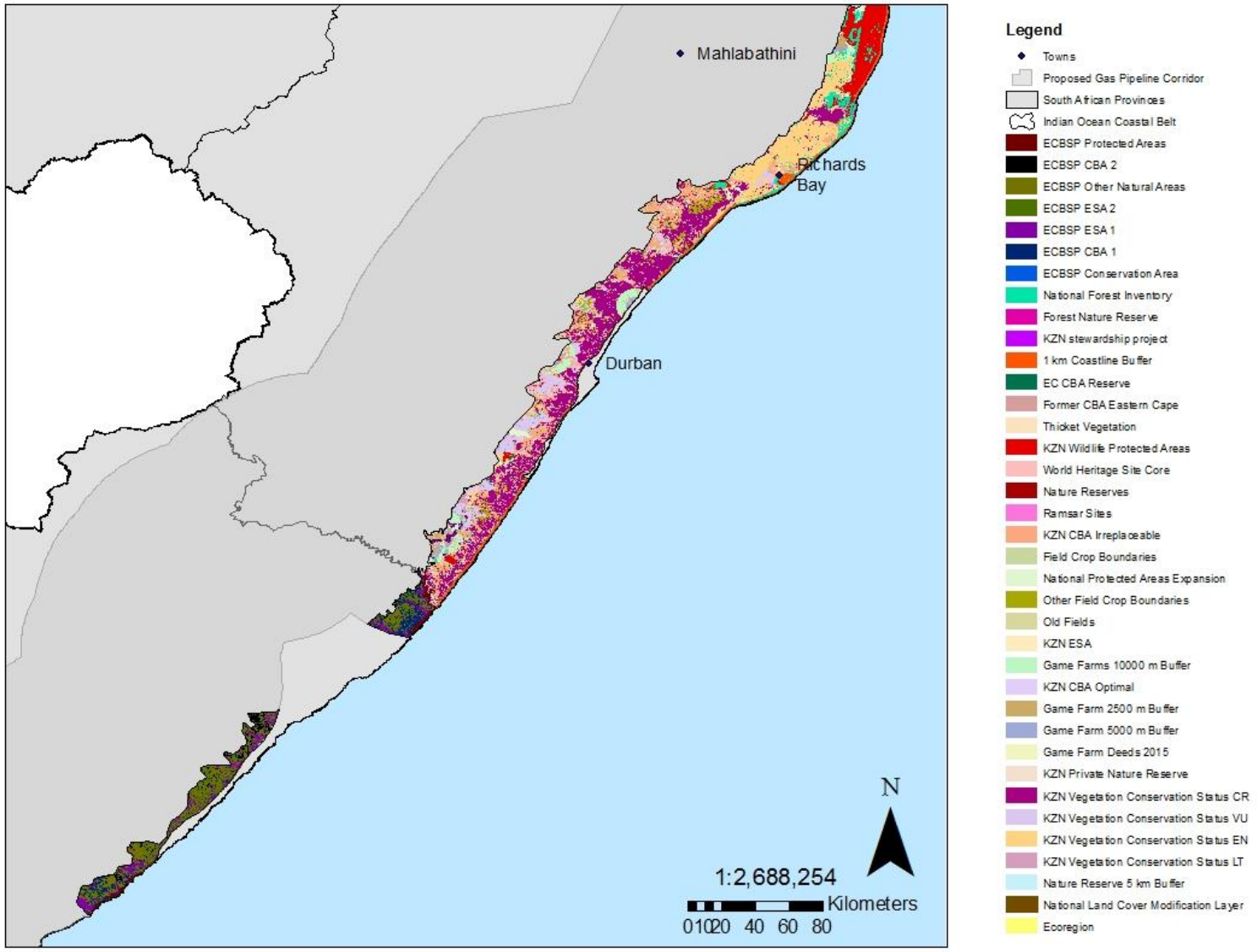


Figure 21: Features within the section of the IOCB affected by the upper portion of the Phase 7 corridor.

5.4 Four- Tier Sensitivity Mapping

5.4.1 Default Sensitivity Map

The default sensitivity maps represent the layers of highest sensitivity, with no prioritisation. This shows the most sensitive layers but is not necessarily a reflection of the status quo. This theoretical importance may become evident when defining triggers during the Environmental Impact Assessment (EIA) process and determining the extent to which site specific assessment may be required.

The inclusion of the NLC modified areas layer provides a fair representation of the status quo. Being an area subject to disturbance, this layer is rated as having a low sensitivity and indicates transformed areas. This layer should be viewed as the upper most layer as many of the other layers do not consider the *status quo* but are applied based on probabilities, assumptions and theoretical knowledge. Site specific knowledge and observations support the extent of transformation that is illustrated by the modified habitat layer.

An example is the KwaZulu-Natal Coastal Belt, which is highlighted as being "critical" and equates to a "very high" sensitivity rating. This and other extensive vegetation types of "very high" and "high" sensitivity result in the blanket of maroon and red that covers most of the IOCB. The majority of the KwaZulu-Natal Coastal Belt has however been transformed to sugar cane or urban settlement with a distinct north – south corridor of disturbance associated with the N2 up to Hluhluwe. Very little true habitat remains and thus it is not accurate to consider such transformed areas as being of "very high" sensitivity, as the drivers and primary attributes of this habitat have been removed.

Phase 4

Figure 22 illustrates the sensitivity of the section of the IOCB within the Phase 4 Corridor. The majority of the area is rated as having a "high" or "very high" sensitivity. This is due to the prevalence of extensive protected areas, primarily the Isimangaliso Wetland Park, a World Heritage Site, and the inherent sensitivity and conservation threat posed to the prevailing vegetation types due to past and ongoing transformation and loss.

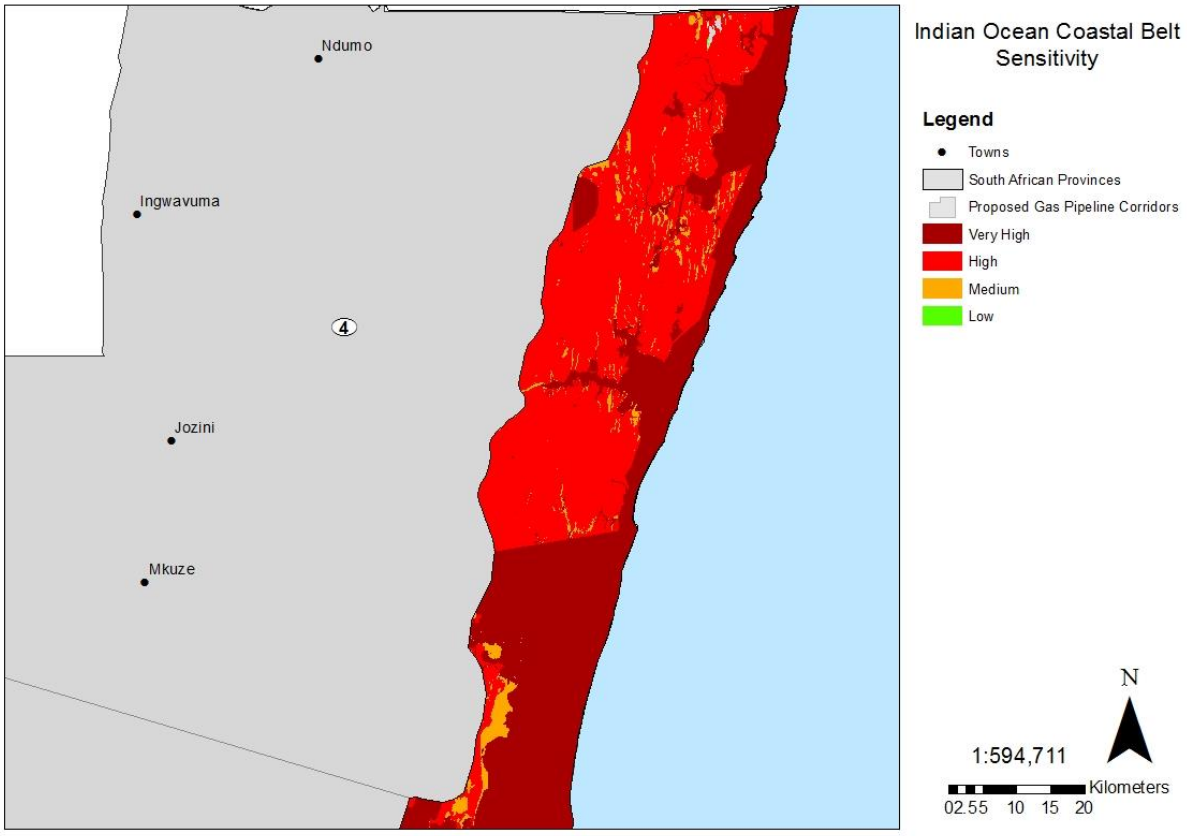


Figure 22: Sensitivity mapping for the portion of the IOCB in the proposed Gas Pipeline Phase 4 corridor.

Phase 7

The Phase 7 corridor covers an extensive area and has been shown as three maps to assist with clarity (Figure 23). The section of the IOCB that falls within KwaZulu-Natal is dominated by the very high sensitivity of the CB 3 vegetation type which is considered to have a conservation status of "critical". The sensitivity rating does not illustrate the extent of habitat transformation that occurs within this section of the IOCB. Marked differences are visible between the Eastern Cape Portion and the KwaZulu-Natal portion due to a discontinuation of data.

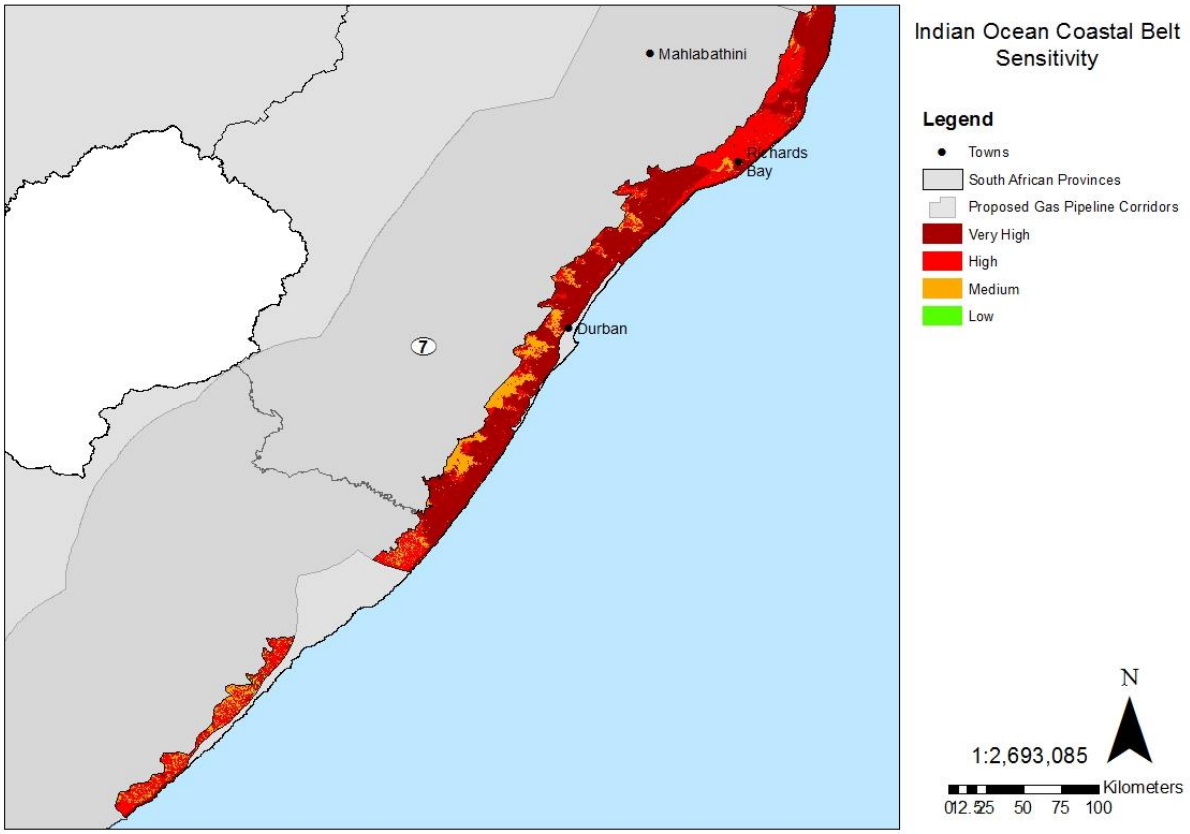


Figure 23: Sensitivity mapping for the portion of the IOCB in the upper portion of the proposed Gas Pipeline Phase 7 corridor.

5.4.2 Land Use (Priority) Map

Figure 24 and Figure 25 below provides a contrast to Section 5.4.1 above as a result of the prioritisation of the National Land Cover (modified and agricultural areas) layer. As noted above, this layer, because it consists of areas that are transformed, is rated "low sensitivity". This layer provides a more realistic representation of the transformation that has taken place within the IOCB, particularly between Richards Bay and Durban and Durban and Port Edward, which has been extensively transformed for the cultivation of sugar cane. The extent of transformed land decreases slightly north of Richards Bay, primarily due to the existence of the Isimangaliso Wetland Park. Areas that have not been transformed within the portion of the IOCB relevant to the Gas Pipeline Corridors, are either protected, inaccessible or cannot be cultivated.

Phase 4

With reference to Figure 24 below, the modified and transformed areas are apparent outside of the Isimangaliso Wetland Park. The extent of large scale timber plantations can be made out between Lake Sibaya and Kosi Bay as well as smaller irregular subsistence agriculture plots associated with rural and peri-urban settlement.

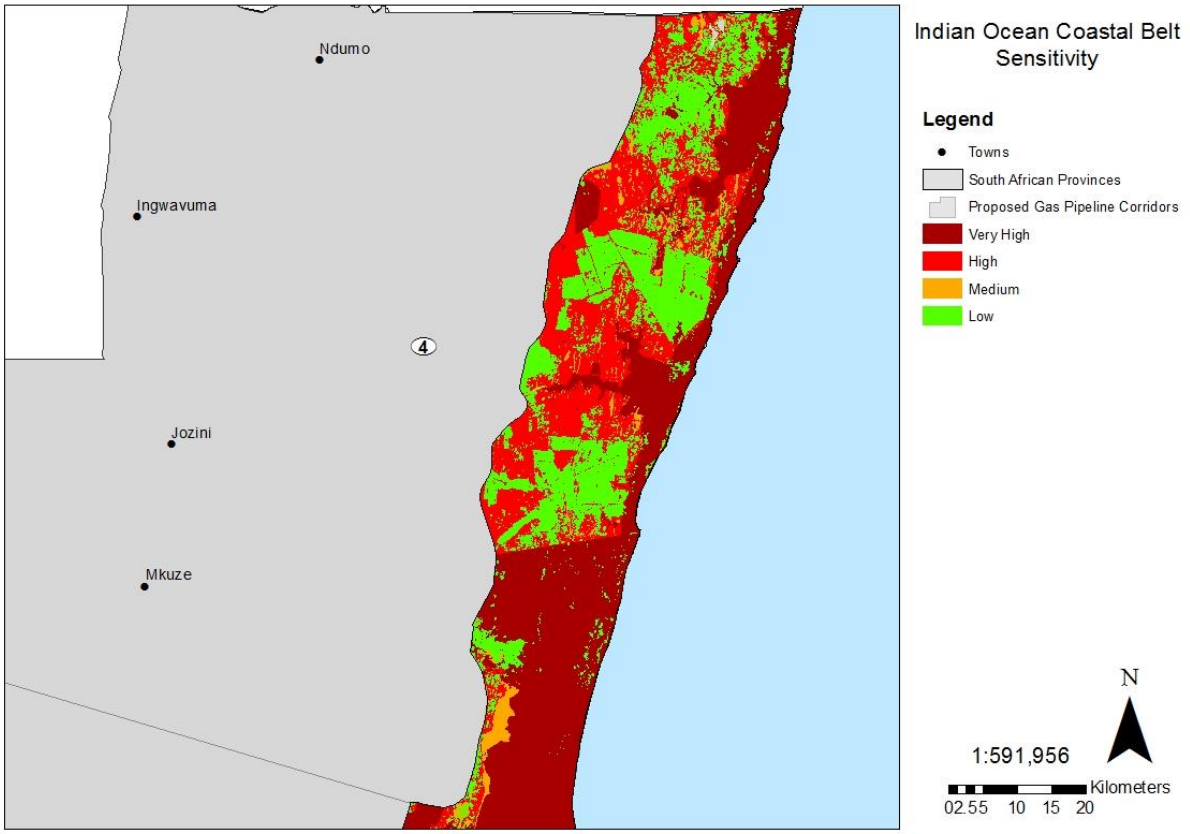


Figure 24: The extent of transformed and modified land within the IOCB (proposed Gas Pipeline Phase 4).

Phase 7

One of the features of the stretch between Durban and Richards Bay, particularly along the R102 and N2 roads, is the extent of sugar cane and timber plantations, both formal and informal. These areas of transformation are densest around Amatikulu, Tongaat and Stanger (Figure 25). These areas have been under cultivation for more than 100 years with only very minor pockets of relict vegetation remaining – usually associated with the coastline, steep areas (cliffs and scarps) and watercourses. The eThekwini Municipal area, which encompasses the city of Durban and extends between Tongaat and Scottburgh is urbanised and consists of an intricate mosaic of formal and informal townships, industrial development, commercial nodes and agricultural land.

South of Scottburgh, extensive agriculture again becomes a feature forming a wide band along the N2 until Margate, where the terrain and topography become a constraint. Urban nodes are concentrated along the coastline with the inland settlement being peri-urban and rural in nature. Within the upper Eastern Cape between Bizana, Port Edward and Mkambathi, transformation is associated with the R61. Major urban nodes are limited and much of the settlement is rural in nature segmented by natural features such as river valleys. The IOCB within the Eastern Cape, based on the National Land Cover Data appears less transformed, with more natural habitat remaining. Although primarily driven by past laws and socio-economic factors, the topography is harsh and a contributing factor to the lack of development within this portion of the IOCB.

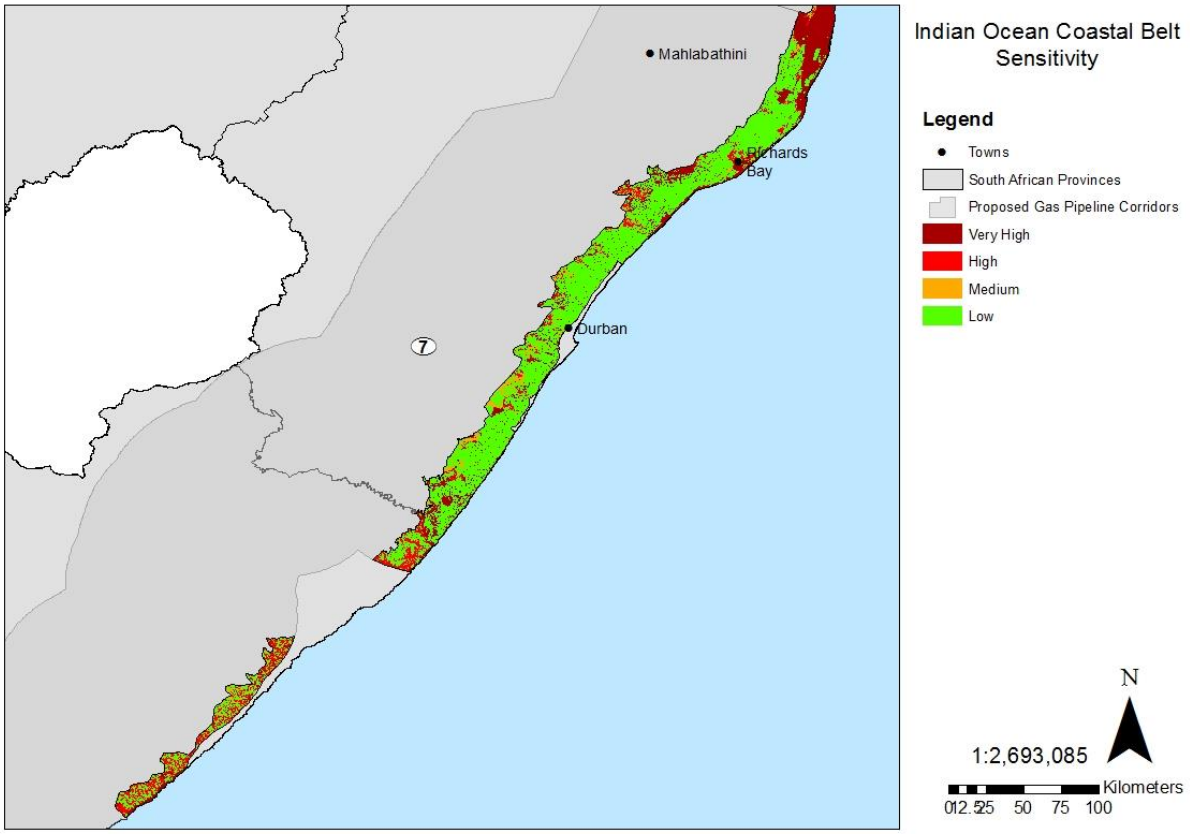


Figure 25: The extent of transformed and modified land within the IOCB (proposed Gas Pipeline Phase 7 between Durban and Richards Bay).

6 KEY POTENTIAL IMPACTS AND THEIR MITIGATION

Establishment of the gas pipeline will entail the following steps and processes (Ephraim, 2017):

- Survey and staking;
- Front-end clearing;
- Right-of-way grading;
- Stringing pipe;
- Bending pipe;
- Line-up, initial weld;
- Trenching;
- Final coating and inspection;
- Lowering pipe into trench;
- Pad, backfill, rough grade;
- Testing and final tie in; and
- Final clean up, full restoration.

During construction, a working servitude of 30 to 50 m will be established which will include space for the stockpiling of excavated soils, piping and equipment as well as the established trench. Trenches will be established using mechanical trench diggers or excavators where terrain is challenging. A site camp area will be established and the pipeline will be constructed in sections, following the steps and work flow listed above.

The following potential broad scale impacts have been identified (Section 6.1- 6.4).

6.1 Disturbance and transformation of natural vegetation

6.1.1 Impact description

Construction of the pipeline will result in the clearance of a "working servitude". Based on the nature of the pipeline, this could be as much as 50 m wide. All vegetation within this working servitude will be removed and as such, "habitat" will be "lost" or transformed. As mentioned, within the IOCB, much of the proposed pipeline route will comprise of cultivated lands or secondary vegetation, although the pipeline will likely pass through pockets of undisturbed and perhaps primary or climax vegetation (Northern Coastal Forest in particular)[1]. Clearance of these areas will result in a significant local impact, as the pipeline is a permanent fixture with a managed servitude, thus the opportunity to reinstate affected vegetation does not realistically exist. Partial revegetation can be undertaken and ground cover may be established. However, it is thus to be accepted that only an early seral state can be accepted as the prevailing management regime. As such, the loss of habitat structure/type can be considered to be permanent.

6.1.2 Mitigation

Ideally, isolated areas of sensitive vegetation within the IOCB should be avoided. Such areas will become evident during detailed surveys. If not possible mitigation options include the following:

- Rehabilitation;
- Revegetation;
- Plant Rescue; and
- Offset.

Rehabilitation may be a misnomer by definition, in that the establishment of particular vegetation forms and particular habitats would be contrary to the management regime that is to be applied to the pipeline (e.g. a forest habitat would affect ongoing management of the pipeline). Within grassland habitats, however rehabilitation or reinstatement may be feasible, provided such management regimen can be implemented. As such, rehabilitation must be undertaken with caution following careful consideration of the objectives that would accompany any rehabilitation procedure and the requirements in respect of pipeline management.

Plant rescue initiatives and the appropriate planting of vegetation are feasible management practices that can be applied across a number of vegetation types within the IOCB, sans the use of larger woody specimens. Plant rescue and relocation initiatives can be undertaken where required during the survey phase, prior to the commencement of construction and "rescued" plants can be either relocated to points outside of the servitude or used in revegetation initiatives during rehabilitation, depending upon the nature of such specimens.

Revegetation can be uniformly applied as a means of ensuring stability along the pipeline route and promoting the re-establishment of biotic activity within the servitude immediately following construction. Such revegetation initiatives can include the use of grass turf or appropriate seed mixes and may be supplemented by the above mentioned repatriation of "rescued" plants.

"Offset:" is often promoted as a means of redressing the apparent disturbance or "loss" of natural habitat or systems. The benefit and success of offsets has yet to be proven (Bull et al., 2013) and is a debatable topic. Offset should be avoided unless absolutely necessary. Calculating, identifying and successfully establishing a suitable offset can be a complex and costly undertaking with no guarantee of success. Other forms of "offset" are also considered by various authorities, including financial contributions and stewardship agreements or partnerships with conservation authorities. Given the strategic importance of

[1] It must be noted that from both environmental and engineering perspective, the gas pipeline routing will avoid forests as far as possible.

the proposed pipeline, the latter option may be the most practical offset strategy, if the offset approach is adopted.

6.2 Alien invasive plants

6.2.1 Impact description

The impact of exotic plants, often described as 'alien invasive plants" is particularly significant within the IOCB as climatic and edaphic conditions are suitable for their establishment, while regular disturbance and high levels of anthropogenic driven disturbance promotes the establishment of such exotic plants. A number of plants are listed in terms of the National Environmental Management Biodiversity Act (NEMBA), while others are not listed but are considered to be problematic (e.g *Vitex agnus castis* – which is a common invader on coastal dunes). Alien plants act to alter the structure of various natural habitats, with such changes being manifested in the ethos or behaviour of fauna. Alien plants may act to reduce the effective habitat of a number of rare or endangered species. Such species are driven by disturbance including not only high level transformation experienced during the construction phases of projects, but during maintenance and other activities. It follows that a linear development such as a pipeline will act as a repository for propagules of exotic plants and will also serve as a conduit along a particular route for the spread of such species.

6.2.2 Mitigation

Mitigation measures may be set in place within the gas pipeline servitude which can include:

- Regular review of the pipeline servitude and consideration of the species emergent and established within the servitude.
- Regular (at least bi-annual) exotic vegetation control using the most appropriate and specific measures to control exotic species that have established, for example the use of applicable herbicides or in some cases fire or manual removal.
- Regular education programmes for staff to assist in the identification of existing species of invasive plants and to identify other possible species that may affect the servitude.

6.3 Disturbance of fauna

6.3.1 Impact description

Faunal distribution across the IOCB is sporadic but expansive and often associated with differing habitats and niche environments. A number of species have adapted to transformed environments and may be considered to be associated with such environments (e.g cane rat *Thryonomys swinderianus*). Other species are only known from specific sites and are intrinsically associated with these areas (e.g. Whitish Amakosa Rocksitter, *Durbania amakosa albescens).*

It follows that disturbance to habitat will see a response from fauna within the affected area that may range from simple relocation to other habitat or in the case of *D amakhosa albescens*, possible localised extinction.

6.3.2 Mitigation

The management of habitats in and adjacent to the servitude is perhaps the most significant mitigation measure that can be applied in respect of faunal populations affected by the gas pipeline. Such mitigation may commence within the planning and construction phase, where avoidance measures may be practiced to ensure the retention of key species and habitats in or proximal to the pipeline. During construction, the

flushing or active capture and removal of species from the working area, may be undertaken. In addition, the management of exotic vegetation within the servitude may act to improve habitat integrity and therefore indirectly promote or preserve the presence of key species.

6.4 Constraining of conservation initiatives

6.4.1 Impact description

The identification of areas outside of the formally protected areas within the IOCB and avoiding other areas of ecological importance in the biome is being identified as an important guideline for the identification of an appropriate route. While such an approach may be a rational one to the identification of such servitude from a contemporaneous perspective, such routing, depending upon where it is located does serve to constrain the expansion and connection of protected areas.

In the declaration of protected areas, it is clear that following the proclamation process, the pipeline and servitude itself will remain the property of a third party with differing management objectives to that of the conservation authority. In practical terms this state would mean that the requirement to maintain the servitude, conduct regular inspections, maintain access and undertake pipeline maintenance will create additional disturbances and constraints that may hinder the management of the protected area. A case in point is the Opathe – Imfolozi corridor, which is a long term initiative to link these two reserves for the benefit of land conservation and migration of larger fauna.

6.4.2 Mitigation

To avoid or reduce the likelihood of constraining protected area expansion, where this may apply, the utilisation or adherence to extensive buffer zones around protected areas may be successful mitigation as would the avoidance of placing the servitude between proximal protected areas, where connection and expansion is likely to form a conservation objective. In addition, it may be useful to align vegetation management programmes and objectives along the servitude with that of the conservation authority, if this is feasible.

7 RISK ASSESSMENT

7.1 Consequence levels

The following Consequence levels have been assigned:

Vegetation Loss	
Extreme	80 to 100 % loss of coverage of an isolated natural habitat, forest or azonal vegetation type
Severe	60 to 80 % loss of coverage of an isolated natural habitat, forest or azonal vegetation type
Substantial	40 to 60 % loss of coverage of an isolated natural habitat, forest or azonal vegetation type
Moderate	20 to 40 % loss of coverage of an isolated natural habitat, forest or azonal vegetation type
Slight	<20 % loss of coverage of an isolated natural habitat, forest or azonal vegetation type or any level of clearance of agricultural land, secondary vegetation and exotic vegetation.

Faunal disturbance	
Extreme	The loss of an isolated natural population where no opportunity exists to save the individuals/trapped individuals cannot be rescued.
Severe	The loss of an isolated natural population where opportunity exists to rescue and relocate up to 50 % of the affected individuals/trapped individuals can be rescued but the potential for survival is <50 %
Substantial	The loss of an isolated natural population where opportunity exists to rescue and relocate more than 50 % of the affected individuals/or the loss of individuals due to the disturbance will be partial/ trapped individuals can be rescued but the potential for survival is 50 %
Moderate	No loss of an isolated population but affected individuals have limited opportunity to move away/trapped individuals can be rescued and survival is >50 %.
Slight	No loss of an isolated population and affected individuals can move away freely/trapped individuals can be rescued and survival is a certainty.

Potential conservation loss	
Extreme	The pipeline passes through a protected area, game farm, nature reserve, and/or stewardship area.
Severe	The pipeline passes along the boundary of a protected area, game farm, nature reserve, stewardship area.
Substantial	The pipeline passes through the buffer zone surrounding a protected area, game farm, nature reserve, stewardship area.
Moderate	The pipeline passes along the edge of the buffer zone surrounding a protected area, game farm, nature reserve, stewardship area.
Slight	The pipeline passes outside the buffer zone of a protected area, game farm, nature reserve, stewardship area.

7.2 Risk assessment results

The risk assessment results are provided below in Table 10. The risks have been maintained for the mitigation/management measures as none of the proposed mitigation or management measures will reduce the risk of the impact, only the severity of the impact. The only way of reducing the risk of the impacts is to practice avoidance. Where the more sensitive areas are avoided, the lower will be the risk of an impact occurring. Should an impact occur (i.e. the risk cannot be reduced through avoidance) mitigation and management will reduce the severity of the impact and ultimately the consequence of the impact. Avoidance can also reduce the likelihood, severity and consequence of an impact. Figure 26 illustrates the importance and effectiveness of using avoidance options as the favoured mitigation option. In this example, a patch of Northern Coastal Forest (near Park Rynie on the KZN South Coast) will be affected by the red alignments. They will also be affected, but to a lesser degree, by the yellow alignment and

completely unaffected by the green route alignment. The forest patch is surrounded by sugar cane and any alignment outside of the forest footprint will significantly reduce the likelihood, consequence and risk of an impact occurring. If such avoidance cannot be provided, other mitigation options may reduce the impacts slightly – such as plant rescue, revegetation (not rehabilitation) and AIP management. Rehabilitation is not an option due to the nature of the pipeline. As such, the forest cannot recover and will be permanently lost. This may not necessarily be a serious concern in other vegetation types however, the likelihood of remaining forests being disturbed (outside of protected areas) within the IOCB is considered to be highly likely. For this reason the reliance on rehabilitation based mitigation measures is cautioned, as in many cases they will not effectively mitigate the impact.

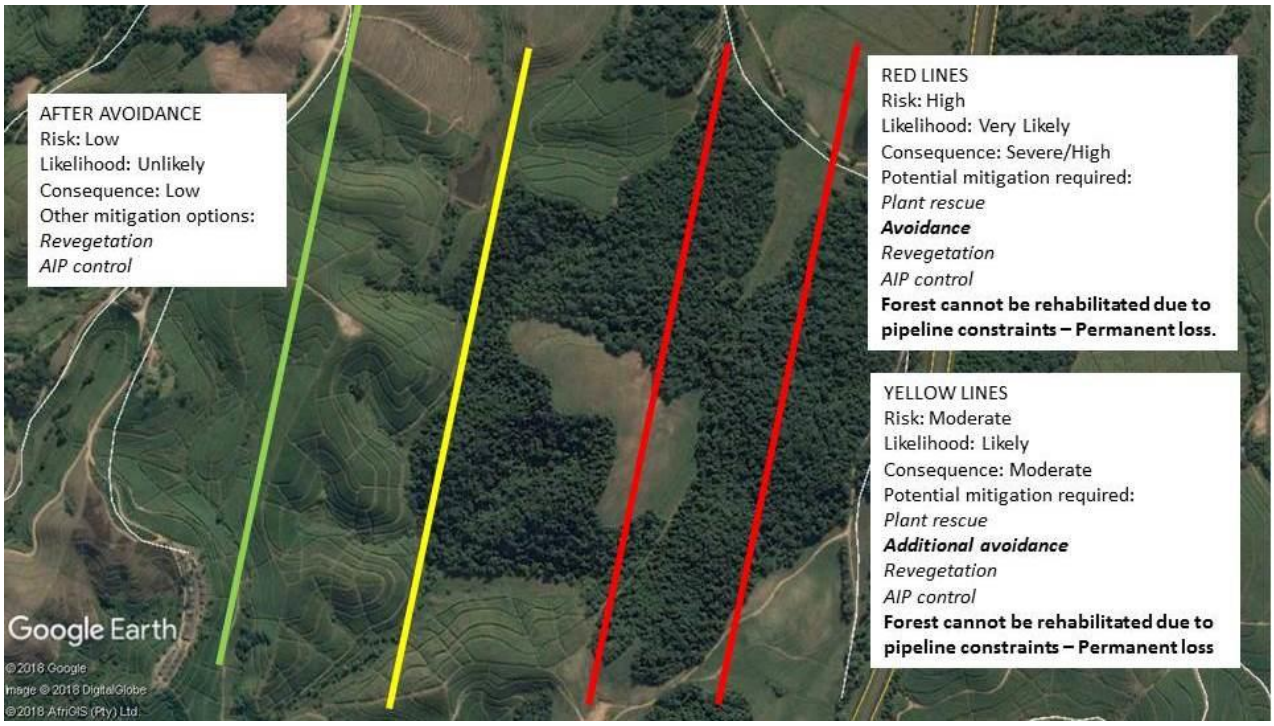


Figure 26: An example of pipeline alignments and associated risk, likelihood and consequence ratings. The image features a very likely scenario, where forest habitat will be impacted within the IOCB.

7.3 Limits of Acceptable Change

Due to the extent of transformation within the IOCB, there is an accepted "no net loss" policy that is applied to remaining natural and intact habitat. Based on this, avoidance should be applied wherever possible with a focus on minimising habitat loss or change wherever it may occur. As such, the limits of acceptable change are very small, with very little leeway. As discussed in the text above, remaining pockets of vegetation that may be considered primary habitat and indeed many areas of secondary habitat, should not be subject to change.

Table 10: Risk assessment of potential impacts associated with gas pipeline development in the IOCB (Gas Pipelines Phases 4 & 7).

Impact	Location /Sensitivity	Without mitigation			With mitigation - Avoidance			With mitigation - Other		
		Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk
Disturbance and transformation of natural vegetation	Very High	Severe	Likely	High	Slight	Unlikely	Very Low	Severe	Likely	High
	High	Substantial	Likely	Moderate	Slight	Unlikely	Very Low	Substantial	Likely	Moderate
	Medium	Slight	Likely	Very Low	Slight	Likely	Very Low	Slight	Likely	Very Low
	Low	Slight	Very Likely	Very Low	Slight	Likely	Very Low	Slight	Likely	Very Low
Alien invasive plant species	Very High	Severe	Likely	High	Slight	Unlikely	Very Low	Substantial	Not likely (mitigation = AIP control)	Moderate
	High	Substantial	Likely	Moderate	Slight	Unlikely	Very Low	Moderate	Not likely (mitigation = AIP control)	Low
	Medium	Moderate	Likely	Low	Moderate	Likely	Low	Slight	Not likely (mitigation = AIP control)	Very Low
	Low	Moderate	Likely	Low	Moderate	Likely	Low	Slight	Not likely (mitigation = AIP control)	Very Low
Disturbance of fauna	Very High	Substantial	Likely	Moderate	Substantial	Unlikely	Moderate	Substantial	Very Likely	High
	High	Moderate	Likely	Low	Moderate	Not Likely	Low	Moderate	Likely	Low

Impact	Location /Sensitivity	Without mitigation			With mitigation - Avoidance			With mitigation - Other		
		Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk
	Medium	Slight	Unlikely	Very Low	Slight	Unlikely	Very Low	Slight	Unlikely	Very Low
	Low	Slight	Unlikely	Very Low	Slight	Unlikely	Very Low	Slight	Unlikely	Very Low
Loss of conservation importance	Very High	Extreme	Very Likely	Very High	Moderate	Likely	Low	Severe	Very Likely	High
	High	Substantial	Likely	Moderate	Moderate	Likely	Low	Substantial	Likely	Moderate
	Medium	Moderate	Likely	Low	Slight	Unlikely	Very Low	Slight	Unlikely	Very Low
	Low	Slight	Likely	Very Low	Slight	Unlikely	Very Low	Slight	Unlikely	Very Low

8 BEST PRACTICE GUIDELINES AND MONITORING REQUIREMENTS

In establishing the gas pipeline within the IOCB some broad "best practice" methods should be implemented at the planning, construction and operational stages of the project. These are discussed below.

8.1 Mitigation

As fauna are directly associated with the occurrence of habitat impact on specific species and fauna in general can best be reduced through:

- The avoidance of key habitats – normally those associated with critically endangered vegetation types;
- An understanding of expected fauna within habitat affected by the pipeline;
- Relocation of fauna from site through search and capture operations;
- The flushing of fauna from areas; and
- Exclusion of fauna by the cordoning of habitats in advance of construction operations.

8.2 Planning phase

Evidently this SEA and its associated evaluations are part of the planning process associated with the gas pipeline. The identification and mapping of these areas is considered to be the first stage in employing "best practice" within the project scope. However, during the more advanced levels of planning it would be important to ensure that:

- Routes proposed within the approved corridors are placed as close to existing transformed areas (which include settlement or peri-urban environments, road and rail infrastructure and existing pipelines) as possible, provided there are no incompatibility with current land uses or constraints from a design perspective; and
- Ecological drivers are identified within the routes including edaphics and lithic factors and that habitats that may be irreparably affected by such disturbance through excavation are avoided (e.g. sand forest).

8.3 Construction phase [location, footprint, procedures]

During the construction phase of the project, particular attention should be paid to the following factors:

- The delimiting of working sites and the cordoning thereof. Such actions will prevent the incremental expansion of areas into habitat and environments that lie outside of the working servitude.

- A prudent approach to the siting of construction phase laydown areas, access roads for construction vehicles and similar temporary works should be taken that ensures minimal disturbance to important habitats.

- Sound "housekeeping" of construction areas should be implemented. Such measures include control of solid and liquid materials used in construction, particularly those that may be deemed "hazardous", as well as control of labour and machinery on site. Waste management forms an important aspect of construction, particularly in rural areas where appropriate disposal methods may be problematic.

- Where plant rescue operations have been performed, management and auditing of plants that have been repatriated or are placed in nursery, should be undertaken on a regular basis.

8.4 Operations phase

Once constructed and operational, it is understood that regular maintenance will be undertaken in the pipeline servitude. Appropriate protocols should include:

- A programme for management should be compiled and adhered to that includes:
    - Vegetation management regime. This programme should indicate how and when vegetation growth within the corridor will be undertaken (i.e. mowing with brush cutter or tractor slasher; what season and response to exotic weed invasion).
    - Redress of excavations within pipeline servitudes – the reinstatement of ground once repairs to the pipeline have been instituted, where required.

- Route management should include aspects such as the identification and logging of fauna and faunal activities within the servitude (e.g. records of species active within the corridor – such as active burrowing by aardvark or porcupine). While academic, such monitoring may assist with the identification of problem animals.

8.5 Rehabilitation and post closure [methods, standards]

Post construction methods of stabilising the pipeline route can include:

- Rehabilitation – the planting of a mix of seral related plant species within affected areas and their management towards a climax habitat form.
- Revegetation – the planting of a management aligned habitat that serves the requirements of the pipeline management.

The rehabilitation option may not apply to the pipeline servitude on account of management options, but may be utilised at points such as laydown areas and other disturbed environments. Such areas may be useful for the placement of "rescued" plant species and should be managed to approximate the species composition associated with the relevant habitat.

Revegetation is likely to comprise of the stabilisation of areas using a basic grass mix and perhaps additional factors such as soil stabilising geofabrics and other stormwater management measures. Exotic weed control is considered to also be an important aspect of such measures.

8.6 Monitoring requirements

Due to the extent of the pipeline area, the use of GIS is recommended as an important tool in the long term management of the route. The following methods are recommended in the long term management of the pipeline:

1. The proposed working servitude should be provided as a .shp file, which can be overlain on periodic aerial photography. From this information changes in vegetation form and structure along the line route can be identified and consideration of the origin of such change may be made.
2. Species occurrence, where observed can also be identified and where significant appropriate conservation management approaches can be made in that particular portion of the pipeline.
3. Exotic weed control measures can be managed on a spatial level with such data including areas that have been addressed through weed control measures, as well as areas requiring increased control measures. Exotic species presence or absence may also be identified and measured along the pipeline.
4. Faunal species, where observed, may also be identified using spatial data, with such information including rare or protected species records, as well as possible nuisance animal aspects.

9 GAPS IN KNOWLEDGE

In reviewing the data and information relating to the IOCB, the following important deficits in information are apparent:

- A difference between the available data for KwaZulu-Natal and the Eastern Cape is evident. More data was available for Kwazulu-Natal including detailed spatial data sets and specific point data. The inclusion of the Draft ECBCP (2017) provided additional data, comparable to the EKZN Wildlife CBA and improved the available data for interpretation for the Eastern Cape. These two data sets where however not directly comparable due to slight differences in assigned categories. This creates a lack of connectivity of data between the two provinces and highlights the interpretational challenges faced when comparing the sensitivity of a single biome than split between two provinces with data inconsistencies. Where possible the closest comparisons (categories) were used to apply sensitivity ratings and maintain a level of consistency.
- Faunal records are limited to primarily, conservation areas and areas where monitoring is safe to undertake e.g. gated residential estates, protected areas. As such the presence of larger fauna can only effectively be correlated with habitat, rather than observation. This situation clearly skews the data, rendering its use at a fine scale level of spatial analysis, dubious. The data is however useful for supporting the importance of certain intact habitat, where there is a correlation.
- Transformation across the IOCB region is both rapid and generally pervasive. Such a state renders the accuracy of such spatial information to be of limited temporal duration. In this regard the importance of site specific evaluations during the impact assessment and detailed planning phases is very high.

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